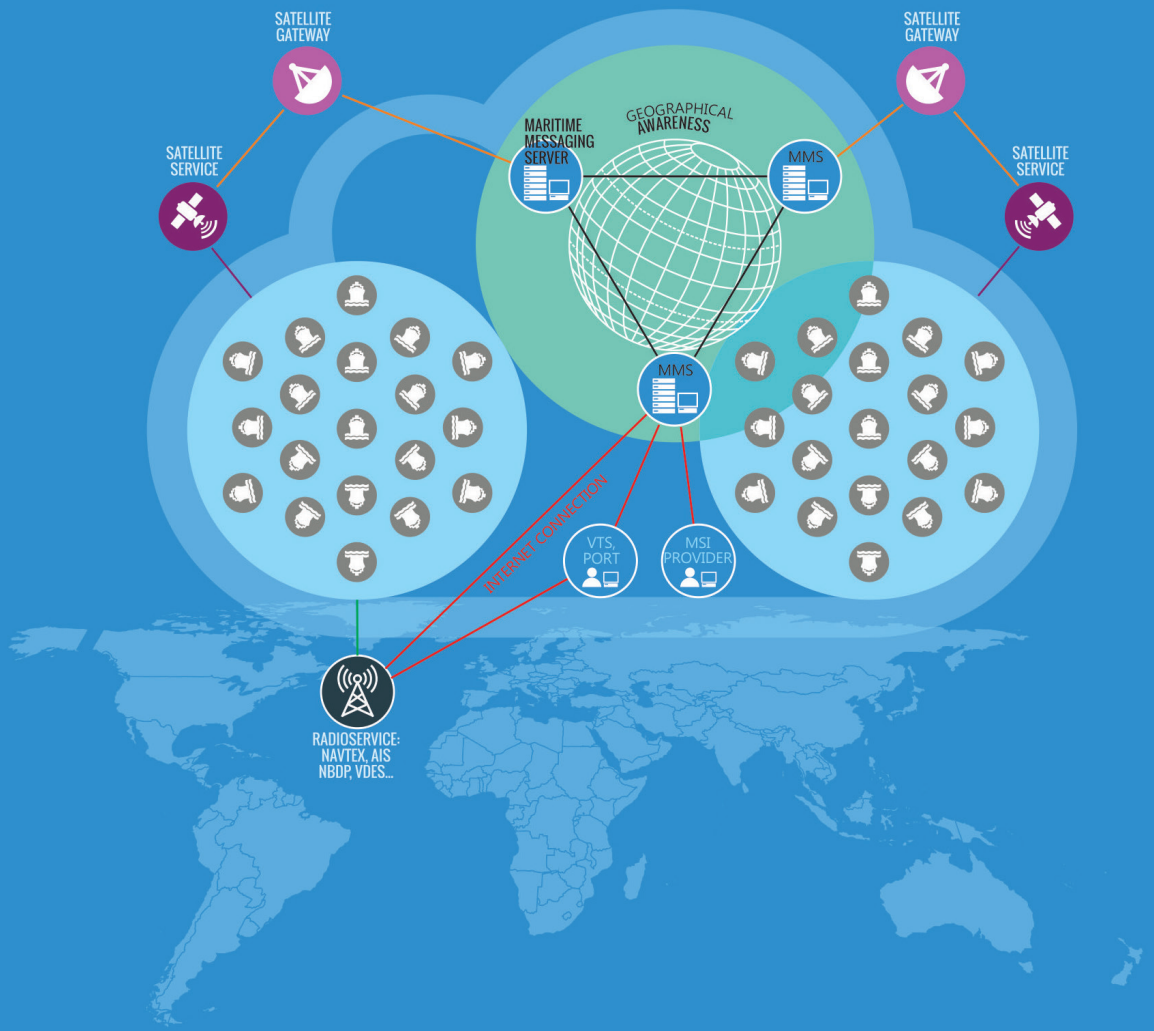

ON DIGITALIZATION IN MARITIME COMMUNITY

(PRILOZI DIGITALIZACIJI U POMORSTVU)

Sanja I. Bauk

EKONOMSKA LABORATORIJA ZA ISTRAŽIVANJE TRANZICIJE

sph SCIENTIFIC PUBLISHING HUB

Digitalization in maritime community

Prilozi digitalizaciji u pomorstvu

Sanja Bauk

SPH – Scientific Publishing Hub

Kotor – Osijek – Czestochowa – Žilina – Celje

2017

Sanja Bauk
IN DIGITALIZATION IN MARITIME COMMUNITY
PRILOZI DIGITALIZACIJI U POMORSTVU
/Elektronsko izd./

URL (e-pub): http://sphub.org/
Prvo elektronsko izd.

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Lektura i korektura:

autorka

Izdavači:

SPH – Scientific Publishing Hub: Kotor, Montenegro; Osijek, Croatia; Czestochowa, Poland; Žilina, Slovakia; Celje, Slovenia
ELIT – Ekonomska laboratorija za istraživanje tranzicije: Podgorica, Crna Gora

CIP - Kataložni zapis o publikaciji
Narodna in univerzitetna knjižnica, Ljubljana

656.61:004.9(0.034.2)

BAUK, Sanja
Digitalization in maritime community = Prilozi digitalizaciji u pomorstvu [Elektronski vir] / Sanja Bauk. - 1. elektronsko izd. - El. knjiga. - Kotor [etc.] : SPH - Scientific Publishing Hub ; Podgorica : ELIT - Ekonomska laboratorija za istraživanje tranzicije, 2016

ISBN 978-961-6948-17-3 (SPH - Scientific Publishing Hub, pdf)

288144896

Sadržaj

Predgovor

Ovaj rukopis je prvenstveno namijenjen studentima dodiplomskih i postdiplomskih studija na Pomorskom fakultetu u Kotoru, Univerziteta Crne Gore. Takođe, namijenjen je istraživačima i svima onima koji su zainteresovani za ovu predmetnu oblast.

Sadržaj je organizovan u dvije cjeline. U prvoj su obrađeni neki segmenti savremenih informaciono-komunikacionih sistema i koncepata u razvoju u domenu pomorstva, kao što su: (S-)AIS, ECDIS, e-Navigacija, pomorski klaud, AMOS i MSW. Ovi sistemi i koncepti su razmatrani sa upravljačkog, prije nego sa tehničkog stanovišta. Razlozi su u njihovoj složenosti i veoma izraženoj dinamici u razvoju, kao i sve manja traktabilnosti njihovog funkcionisanja za većinu istraživača i korisnika.

U drugoj cjelini je data kolekcija istraživačkih radova, od kojih su neki tokom proteklih par godina objavljeni u referentnim međunarodnim časopisima, dok su neki još uvijek u postupku recenzije. Većina ovih radova je na engleskom jeziku, pošto su tako izvorno napisani. Ovo smatram korisnim za studente i istraživače, budući da je engleski jezik *standard*, ili opšteprihvaćena platforma za sporazumijevnje u naučnoj zajednici, a posebno u sferi digitalizacije.

Organizacija prve cjeline rukopisa je relativno jednostavna i ne zahtijeva nužno neka dodatna pojašnjenja. Ona sadrži opise: svrhe, strukture, osnova funkcionisanja, prednosti, nedostataka i pravaca daljeg razvoja ključnih informaciono-komunikacionih sistema u pomorskoj navigaciji i u pomorstvu u širem smislu. Pri tome su (S-)AIS, ECDIS, e-Navigacija i pomorski klaud razmatrani kao sistemi za podršku navigaciji, dok su AMOS i MSW opisani kao *jedinstveni prozori* za upravljanje administrativnim poslovima na brodu, odnosno, na bidirekcionoj relaciji brod – upravni organi u luci.

S druge strane, organizacija kolekcije istraživačkih radova u drugoj cjelini rukopisa, iziskuje dodatno pojašnjenje. Teme radova su inspirisane mojim interesovanjem za pojedine oblasti u domenu digitalizacije u pomorstvu, u određenim vremenskim presjecima, kao i prilikama po pitanju mojeg uspjeha u konkurisanju za neke istraživačke projekte. Tako da su se u ovoj kolekciji našli radovi koji se odnose na pozicioniranje luka, uključujući tu i stepen njihove digitalizacije; radovi koji se odnose na povećanje bezbjednosti radnika u lukama, korišćenjem sofisticiranih senzorskih i pozadinskih info-komunikacionih rješenja; kao i radovi koji se odnose na nove vidove obrazovanja i obuke u pomorstvu, podržane savremenim digitalnim medijima.

Vjerujem da će ovaj rukopis poslužiti nekima od čitalaca kao inspiracija, odnosno, kao podsticaj za dalje bavljenje ovom problematikom.

Autorka

Prof. dr *Sanja Bauk*

Teslina vizija jednog dijela “Svjetskog-Sistema” iz 1900. godine:

“… *The establishment of an universal marine service enabling the navigators of all ships to steer perfectly without compass, to determine the exact location, hour and speed, to prevent collisions and disasters, etc*.”

Nikola Tesla, My Inventions and Other Writings – Introduction by Samantha Hunt, Penguin Group, New York, NY, USA, 2011, p. 64.

DIO I

1. AIS

Tehnologija prvobitno nazvana brod – brod, brod – obala (eng. Ship – Ship, Ship – Shore, 4S), formirala je osnovu sistema poznatog pod nazivom ***univerzalni brodski automatski identifikacioni sistem*** (Universal Shipborne Automatic Identification System, eng.), ili skraćeno - AIS (Automatic Identification System, eng.). Najjednostavnije rečeno, AIS je autonoman i kontinualan sistem emisije podataka, koji radi na VHF (30-300 [MHz]) pomorskom mobilnom opsegu detaljnije opisanom u *Recommendation ITU-R M.1371*. Domet mu je obično 10-25 [nm], ukoliko nema ekstenzije za velike udaljenosti ili komunikaciju sa satelitima [1,2]. Sistem omogućuje razmjenu informacija tipa: identifikacije, pozicije, kursa, brzine broda i sl., sa drugim brodovima i obalnim stanicama. Može da upravlja sa više izvještaja istovremeno, uz veliku brzinu ažuriranja podataka, pri čemu koristi tehnologiju samoorganizujućeg višestrukog pristupa na bazi podjele vremena (SOTDMA - Self Organizing Time Division Multiple Access, eng.), te tako obezbjeđuje veliku brzinu prenosa podataka, visoku operativnost i pouzdanost. AIS je definisan IMO (International Maritime Organization, eng.) standardom performansi i nosi naziv univerzalni AIS, kako bi označio standardizovanu tehnologiju. Međutim, termin univerzalni se često ne koristi kao deskriptor, već se i dalje jednostavno koristi samo – AIS [3,4].

1.1. Osnovni principi AIS-a

AIS omogućuje automatsku razmjenu informacija, odnosno, obrađenih podataka unijetih posredstvom brodskih senzora, te statičkih i dinamičkih podataka vezanih za putovanje - između brodova, kao i između broda i obalne(ih) stanice(a). Osnovne funkcije AIS-a treba da omoguće sljedeće:

- razmjenu informacija između brodova na VHF opsegu, s ciljem dobijanja uvida u saobraćajnu situaciju u okruženju;
- razmjenu informacija između broda i obalne stanice, kakva je VTS (Vessel Traffic Service, eng.), u cilju poboljšanja upravljanja saobraćajem, posebno u vodama sa velikom gustinom saobraćaja;
- automatsko izvještavanje u oblastima u kojima je ono obavezno i
- razmjenu bezbjedonosnih informacija između brodova, kao i između brodova i obalnih stanica (slika 1.1).

1.2. Zahtjevi koje AIS mora da zadovoljava

Brodovi koji su u skladu sa SOLAS (Safety of Life at Sea, eng.) Konvencijom moraju obavezno da ispunjavaju zahtjeve u smislu posjedovanja odgovarajućih navigacionih uređaja, kao što su kompas, radar, dubinomjer, brzinomjer i dr. Nova oprema, koju po SOLAS konvenciji brod mora da ima, treba da zadovoljava sljedeće međunarodne standarde:

- *Standard performansi*, propisan od strane Međunarodne pomorske organizacije (IMO - International Maritime Organization, eng.);

– *Tehničku specifikaciju*, propisanu od strane Međunarodne telekomunikacione unije (ITU - International Telecommunication Union, eng.) i
– *Test standard*, propisan od strane Međunarodne elektrotehničke komisije (IEC - International Electrotechnical Commission, eng.).

IMO standard performansi određuje operativne zahtjeve u skladu sa zahtjevima korisnika opreme, pri čemu AIS oprema treba da ima sljedeće funkcije: mogućnost ostvarivanja komunikacije sa drugim brodovima; mogućnost ostvarivanja komunikacije sa obalnim stanicama uz automatski i kontinualan rad; mogućnost obezbjeđivanja odgovarajućih informacija, kao i mogućnost korišćenja pomorskog VHF kanala.

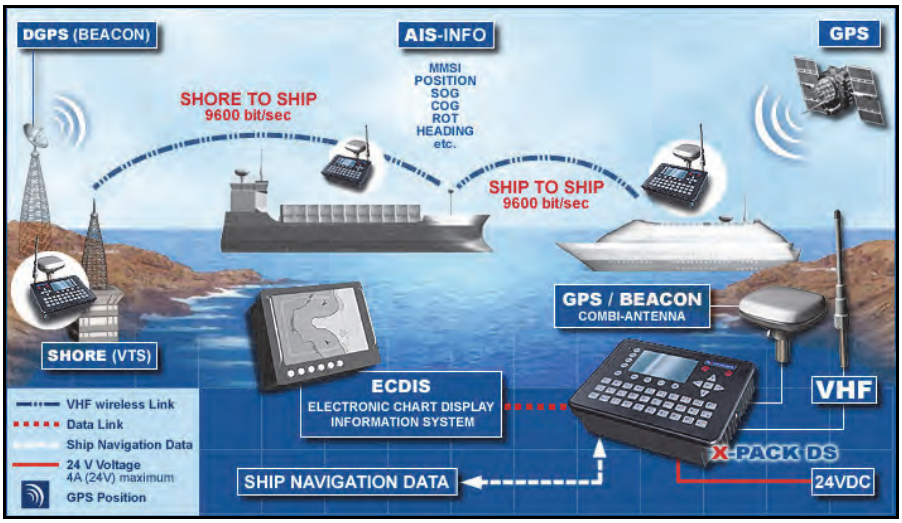
ITU tehnički standard određuje tehničke karakteristike sistema u cilju zadovoljavanja funkcionalnih zahtjeva i definiše tehničke kriterijume tipa: karakteristika transfera; modulacije; formata podataka, poruka i paketa; tehnike višestrukog pristupa na bazi podjele vremena (TDMA - Time Division Multiple Access, eng.) i upravljanje kanalskim resursima.

IEC tehnički standard se odnosi na obaveznu opremu broda po SOLAS konvenciji i u slučaju AIS-a uključuje: test specifikaciju, standard ulazno/izlaznih podataka, standard konektora, test integriteta i dr.

1.3. AIS kao navigacioni uređaj

Pored svoje prvobitne uloge, AIS stanica se može koristiti kao sredstvo za navigaciju. AIS sistem može da [1,2]:
– upotpuni funkcionisanje ili u potpunosti zamijeni neki navigacioni uređaj;
– obezbijedi informacije o identitetu i stanju broda, kao i druge informacije vezane za plimu, plimatske struje, lokalnu vremensku prognozu i sl.;
– obezbijedi informacije o pozicijama navigacionih bova, tj. da obezbijedi procjenu da li su one na pravom mjestu, na bazi korekcionih signala satelitskog diferencijalnog globalnog sistema pozicioniranja (DGPS - Differential Global Positioning System, eng.);
– obezbijedi kontrolisanje rada nekog navigacionog uređaja uz pomoć daljinske kontrole i promjene parametara, te da automatski uključi pomoćne uređaje i opremu, kada je to potrebno;
– obezbijedi detekciju i identifikaciju u svim vremenskim uslovima i potpune informacije o svim brodovima opremljenim AIS-om, pored kojih posmatrani brod prolazi, na VHF opsegu i dr.

Postoje najmanje tri vida implementacije AIS-a kao navigacionog uređaja, koji podrazumijevaju sljedeće:
– Instalirati aktuelnu AIS mobilnu jedinicu na navigacioni uređaj i koristiti AIS mobilni format poruka za slanje informacija vezanih za taj uređaj (AtoN - Aid to Navigation, eng.);
– Kreirati sintetički AIS AtoN, tj. podatke o navigacionom uređaju treba prenijeti do druge lokacije, odakle se oni u AIS formatu šalju dalje;
– Kreirati virtualni AIS, gdje su prividno AIS poruke, u stvari poruke dobijene direktno od navigacionog uređaja, dok AIS objektivno ne postoji. Virtualni AIS se može koristiti samo periodično i kratkotrajno, ali ne može biti trajno rješenje [1-4].



Slika 1.1. Koncept funkcionisanja AIS (X-Pack DS) uređaja (izvor: [5])

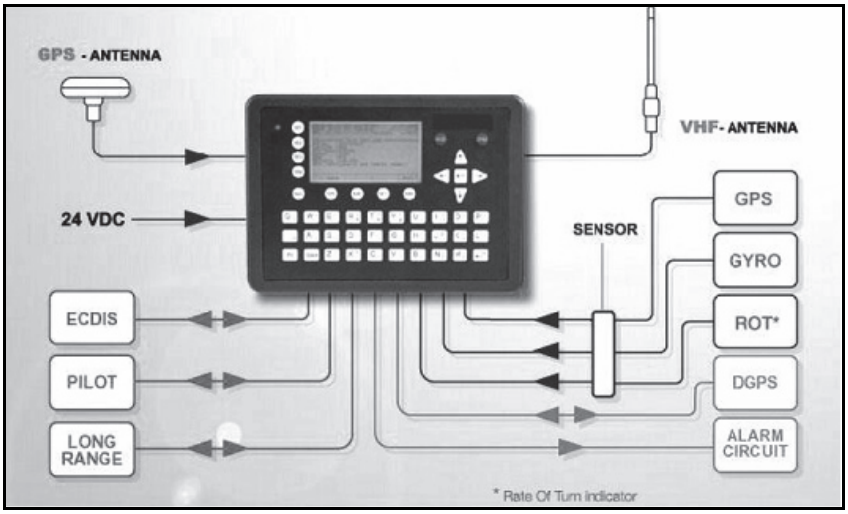
Odredba 19, poglavlja V SOLAS Konvencije, specificira navigacione uređaje i opremu koje brodovi moraju da imaju, u zavisnosti od vrste i gabarita. Prema ovoj odredbi: AIS moraju da imaju svi brodovi gabarita većeg od 300 [gt]; brodovi koji plove međunarodnim vodama; teretni brodovi preko 500 [gt] koji plove na međunarodnim rutama; kao i svi putnički brodovi nezavisno od veličine. Ovaj zahtjev je stupio na snagu 31. decembra 2004. godine. [6]

1.4. Rad AIS-a

AIS je brod-brod i brod-obala sistem emisije informacija. Za brod-brod mod rada, IMO je obezbijedila poseban vodič za korišćenje AIS-a, namijenjen pomorcima (*Resolution A.917(22): Guidelines for the onboard operational use of shipborne automatic identification systems (AIS)*, eng.) [6].

Upozorenje. Nemaju svi brodovi AIS. Oficir na straži mora uvijek biti svjestan da drugi brodovi, posebno jahte, ribarski brodovi i vojni brodovi, kao i neke obalne stanice, uključujući VTS centre, ne moraju biti opremljeni AIS-om. Oficir takođe mora biti svjestan činjenice da AIS ugrađen na drugim brodovima, kao obavezan uređaj, može pod određenim okolnostima biti isključen, na osnovu zapovjednikove profesionalne procjene.

Osnovne radne procedure. Brodski AIS uređaj je povezan sa izvorom napajanja, antenom i brojnim, različitim navigacionim uređajima, uključujući i integrisani navigacioni sistem, u slučajevima kada postoji na brodu (slika 1.2). Prilikom instaliranja, u memoriju AIS uređaja moraju se unijeti svi važni statički podaci vezani za brod: identitet, dužina, širina, vrsta broda i lokacija pozicione antene (fiksirane na određenoj poziciji) [7]. AIS uređaj mora da bude opremljen tastaturom i monitorom, ili dinamičkim displejem, koji služi kao AIS interfejs i izvršava sljedeće funkcije: prikazuje operativni status uređaja (koji treba redovno kontrolisati), kao i informacije o ciljevima (metama, tj. brodovima i drugim objektima u okruženju).



Slika 1.2. Sistem senzora i aktuatora priključenih na AIS (X-Pack DS) uređaj (izvor: [8])

Operacije tokom putovanja. Aktiviran AIS automatski i kontinualno emituje informacije o poziciji broda, kao i sve statičke i dinamičke informacije vezane za brod i putovanje, u skladu sa IMO standardom performansi. Dok se promjena brzine i podaci o manevrisanju automatski ažuriraju, postoji još uvijek potreba da zapovjednik broda ili druga odgovorna osoba, ručno unese, na početku putovanja ili u bilo kom trenutku kada nastupi promjena, sljedeće podatke vezane za putovanje: gaz broda; vrstu opasnog tereta (što je ujedno i najznačajnija stavka ukoliko se prevozi ovakav teret); odredište i očekivano vrijeme dolaska (ETA - Estimated Time of Arrival, eng.); plan rute – međutačke; stvarni, tekući navigacioni status i kratke informacije vezane za bezbijednost.

Aktiviranje. U principu, AIS bi uvijek trebalo da je uključen. Takođe, preporučuje se da AIS ne bude isključen za vrijeme boravka broda u luci, zbog potrebe obezbjeđivanja informacija o brodu lučkim vlastima. S druge strane, bilo u plovidbi ili u luci, tj. kad god zapovjednik procijeni da bi rad AIS-a mogao da ugrozi bezbjednost broda – uređaj se može isključiti. Međutim, mora se reaktivirati neposredno nakon prestanka opasnosti. Ovo može biti slučaj u područjima gdje su prisutni pirati. Isto tako, može biti neophodno da se isključi AIS ili da se smanji snaga transmisije u toku izvršenja operacija rukovanja teretom. Kada je AIS isključen, statički podaci, kao i oni vezani za putovanje, ostaju memorisani. Reaktiviranje se vrši jednostavno, ponovnim uključivanjem.

1.5. Rad AIS-a na obali

Prema IMO-u (*Revised Guidelines for Vessel Traffic Services, including Guidelines on Recruitment, Qualifications and Training of VTS Operators*, 1997, eng.) ustanovljeni su zadaci koje bi ***služba saobraćaja brodova*** (VTS - Vessel Traffic Service, eng.) trebalo da izvršava:

– VTS u svakom trenutku treba da generiše iscrpan pregled saobraćajne situacije u oblasti u kojoj je nadležna, uključujući i faktore koji utiču na to stanje;

– VTS treba da obezbijedi sliku saobraćajne situacije. Ona omogućuje VTS operateru da procijeni stanje i donese odgovarajuće odluke. Za kompilaciju ovakve slike, potrebno je sakupiti podatke o situaciji u kanalu, (uskom) prolazu, ili na otvorenom moru, kao što su: meteorološki i hidrografski uslovi; podaci o operativnom statusu navigacionih uređaja; podaci o situaciji u saobraćaju, koji se odnose na pozicije brodova, pravce plovljenja, manevre, odredišta i rute; kao i podaci o brodovima u vidu propisanih, obaveznih izvještaja, ili ako je to neophodno, dodatnih podataka za efikasniji rad VTS-a.

Instaliranje AIS-a u VTS-u. Prilikom određivanja broja, a shodno tome i troškova ugradnje AIS-a u VTS sistem, neophodno je izvršiti pažljivu studiju, kako bi se utvrdili broj i lokacija baznih AIS stanica i ripitera, u cilju postizanja pune i pouzdane pokrivenosti regiona. Iako VHF prijem u mnogome zavisi od visine i lokacije antene, rad u uslovima gustog elektronskog saobraćaja, može da učini neophodnim instaliranje dodatnih baznih stanica u cilju smanjenja interferencije.

Interoperatibilnost VTS-a. Ukoliko VTS uprave uključuju u svoju nadležnost više VTS centara, onda njihovi sastavni elementi, u koje svakako spada i AIS, moraju biti umreženi u lokalnu mrežu. Kada postoje regionalne mreže ovog tipa, ili ako postoje planovi za njihovu izgradnju, onda one moraju biti kompatibilne sa odgovarajućim nacionalnim i međunarodnim mrežama.

Raspoloživost VHF komunikacionih kanala. ITU je propisala dva pomorska VHF kanala za AIS, prvenstveno za brod-brod komunikaciju. Ono što još uvijek nije izvjesno, jeste, kada je neophodan dodatni kanal za podršku u radu VTS-a [4,5]. Potreba za dodatnim kanalom je posebno izražena kada veliki broj brodova saobraća u oblasti koja je u nadležnosti VTS-a, kao i kada VTS treba da odredi *identitet* broda koji je na većoj udaljenosti. U ovom slučaju AIS signal, dobijen od brodova koji su na većoj udaljenosti od VTS-a, može da bude oslabljen, u poređenju sa AIS signalima dobijenim od brodova u blizini.

Dostupnost nacionalnih/regionalnih i lokalnih DGNSS korekcija. U cilju praćenja brodova sa tačnošću reda 10 [m], ili većom, pouzdani DGNSS (Differential Global Navigation Satellite System, eng.) korekcioni signali moraju da budu dostupni svim brodovima u VTS području. Ovi servisi su obezbijeđeni na nacionalnom ili regionalnom principu. U područjima gdje ovakvi servisi ne postoje, VTS moraju sami da ih obezbijede. U tehničkom smislu je moguće emitovati određenu korekciju, korišćenjem sopstvenog AIS.

1.6. Integracija AIS-a sa postojećim radarskim sistemima

VTS sistemi bazirani na radaru, razlikuju se prema vrsti radarske slike i načinu njenog procesuiranja, prvenstveno prilikom kompilacije saobraćajne slike. Konstrukcija i starost radarskog sistema utiču na način i uspješnost integracije sa AIS-om. Potpuna pouzdanost ovih opcija, moguća je jedino uz konsultacije sa proizvođačima. U mnogim VTS područjima saobraćaj je raznovrstan i uključuje brodove koji jesu, kao i one koji nisu, u skladu sa SOLAS Konvencijom. Pod ovakvim okolnostima - radar ostaje primarno sredstvo za detekciju brodova koji nemaju AIS.

AIS podaci se emituju različitim brzinama u zavisnosti od brzine broda i njegovog manevrisanja. Za razliku od ovoga, radarski podaci se generišu konstantnom brzinom, u

skladu sa brzinom okretanja radarske antene. Integracija AIS-a sa VTS sistemom baziranim na radaru, zahtijeva od VTS-a da bude u stanju postizanja i održavanja korekcija podatka dobijenih na osnovu AIS-a i radara, uprkos nepredvidivosti promjena u generisanju AIS podataka.

1.7. Korišćenje elektronskih karata i AIS-a u VTS-u

VTS sistemi tradicionalno koriste shematske prikaze geografskih i hidrografskih svojstava, za njih relevantnog područja, kao pozadinu slike saobraćajne situacije. Tačnost ovog prikaza, nije podesna za preciznu navigaciju. Sa pojavom elektronskih karata, evidentne su prednosti koje se postižu njihovim korišćenjem kao pozadinske slike. Brodovi se mogu pratiti ili im se može pružiti podrška u skladu sa preciznim svojstvima ovih karti. U VTS sistemima koji nisu opremljeni elektronskim kartama, navigacione informacije se daju na osnovu svojstava koja detektuju radari, kao što su obalna linija i navigacione bove, ili na osnovu onoga što je ucrtano u postojeće VTS dijagrame.

U slučaju korišćenja elektronskih kartei, važno je da su one izdate od strane ovlašćenih hidrografskih službi, što garantuje validnost podataka koje sadrže.

Očekuje se da će svi VTS biti uskoro u stanju da emituju korekcije lokalnih karata brodovima opremljenim ECDIS-om i da šalju navigaciona upozorenja elektronski, tj. putem AIS-a. U restriktivnim vodama, VTS operater pri praćenju manevra broda ima potrebu da smanji skalu displeja. Pod ovakvim okolnostima, važno je da su u pozadini saobraćajne slike elektronske karte, koje mogu da prikažu detaljnije geografska i hidrografska svojstva. Ovo je moguće jedino ako su elektronske karte nastale kao rezultat izvornih mjerenja, a ne precrtavanjem postojećih klasičnih karata. Takođe je važno da tačnost kartografskog prikaza radarske slike bude reda 10 [m] ili manje, kako bi se razlike između radarskog i AIS prikaza lakše uočile i otklonile [1,2].

AIS kao uređaj za izbjegavanje sudara. Potencijal AIS-a kao uređaja za izbjegavanje sudara je prepoznat i on se kao takav preporučuje u određenim situacijama. Kada se koristi u kombinaciji sa odgovarajućim aplikacijama, u skladu sa propisima o izbjegavanju sudara i dobrom praksom osmatranja, AIS može znatno poboljšati pregled situacije. U slučaju izbjegavanja sudara na displeju se pokazuju podaci o kursu, području i imenu selektovanog broda. Ostali podaci o označenom brodu se mogu dobiti horizontalnim skrolovanjem na displeju, dok se vertikalnim skrolovanjem dobijaju podaci o svim drugim brodovima dostupnim AIS-u [1,2]. Više detalja o korišćenju AIS-a u izbjegavanju sudara može se naći u posebnom priručniku (*Use of AIS Information in Collision Avoidance*).

Integracija i prikaz AIS informacija. Kako bi se u potpunosti iskoristile mogućnosti AIS-a, sistem treba da je integrisan sa nekim od postojećih displeja na komandnom mostu, ili sa posebnim grafičkim displejem. Idealno bi bilo da je AIS povezan sa radarom, ECDIS-om, ili integrisanim navigacionionim sistemom.

Problemima harmonizacije prikaza AIS informacija najintenzivnije se bavi IEC i to: prikazom AIS informacija na radarskom displeju; prikazom AIS informacija na ECDIS-u; prikazom AIS informacija na posebnom displeju; prikazom AIS informacija u okviru integralnog navigacionog sistema; prikazom navigacionih upozorenja; prikazom meteoroloških upozorenja; prikazom logističkih informacija i dr.

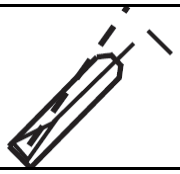
Simboli koji se koriste za prikaz AIS meta. Simboli koji se koriste za prikaz AIS meta su u skladu sa IMO-vim preporukama i za sada su samo privremeni [4,6,9]. Iskustvo će pokazati da li će ovi simboli biti zadržani ili će se zamijeniti drugima. Često se koriste simboli AIS meta shematski predstavljeni i opisani u tabeli 1.1.

Operativni zahtjevi za prikaz AIS informacija. AIS informacije se mogu predstaviti na grafičkom displeju i pri tome, najmanje, treba da bude prikazano sljedeće: pozicija broda, kurs, brzina preko dna, pravac i brzina i/ili pravac zakretanja. U slučajevima kada se AIS informacije predstavljaju grafički, treba koristiti odgovarajuće simbe. U slučaju kombinacije sa radarskim prikazom, radarski signali ne smiju biti zaklonjeni, zamračeni ili na bilo koji način degradirani (slika 1.3). Istovremen prikaz radarske i AIS slike mora da bude stabilizovan na odgovarajući način. Podaci o metama dobijeni posredstvom AIS-a i radara moraju se jasno razlikovati. Kada je grafički prikaz AIS meta onemogućen, tada se koriste drugi standardizovani vektorski prikazi meta, koji su na određeni način ekvivalentni AIS simbolima. Pri tome mora biti označena vrsta aktivnog prikaza meta. Prikaz AIS simbola osim za neaktivne i izgubljene mete, treba da ima prioritet u odnosu na mete EPA (Electronic Plotting Aid, eng.), ATA (Automatic Tracking Aid, eng.) i ARPA (Automatic Radar Plotting Aid, eng.). Operateri mogu na zahtjev da dobiju prikaz dodatnih podataka na displeju, uključujući tu identifikaciju brodske mobilne stanice MMSI (Maritime Mobile Service Identity, eng.). Ako primljena dodatna AIS informacija nije kompletna, to će biti naznačeno. Pored toga, AIS simbol aktivne mete se može zamijeniti uvećanim simbolom broda na displeju velikog razmjera. Takođe treba naglasiti da više meta, uključujući i sopstveni brod, može biti selektovano u isto vrijeme, pri čemu se dobijaju korespodentni podaci, jasno prikazani.

Slika 1.3. AIS: Prikaz azimuta i udaljenosti od drugih brodova u radarskom formatu (izvor: web)

Korišćenje AIS-a u meteorološke i hidrografske svrhe. Još jedna od mogućih primejna AIS-a je prenos meteoroloških i/ili hidrografskih podataka. Kada postoji mogućnost korišćenja ove aplikacije na međunarodnom nivou, format poruke mora da bude ozvaničen od strane Međunarodnog udruženja stručnjaka za navigacione uređaje i svetionike (IALA - International Association of Maritime Aid to Navigation and Lighthouse Authorities, eng.), prije nego što proizvođači opreme učine ovu aplikaciju mogućom u tehničkom smislu. AIS uređaj se tada koristi za emitovanje AtoN i meteorološko-hidrografskih informacija, kao posebnih poruka.

Tabela 1.1. Primjeri simbola AIS meta (izvor: [9, p.4])

AIS meta	Simbol	Opis simbola
AIS neaktivna meta		- Jednakokraki, oštrougli trougao koji svojim centroidom predstavlja referentnu poziciju mete. Najoštriji ugao bi tre-bao da se poklapa sa linijom kursa. - Simbol mete koja miruje, odnosno koja je neaktivna, može da bude manji od simbola mete koja je aktivna.
AIS aktivna (opasna) meta		- Jednakokraki, oštrougli trougao koji svojim centroidom predstavlja referentnu poziciju mete. Na vrhu najoštrijeg ugla trougla nalazi se linija koja se poklapa sa linijom kursa, ili linijom kursa preko dna, ako informacije o kursu nisu dostu-pne.
		- Vektor koji predstavlja kurs ili brzinu preko dna obično se predstavlja isprekidanom linijom, koja počinje u centru mete. - Kurs se predstavlja punom linijom, fiksne dužine, koja po-činje u najoštrijem uglu trougaonog simbola. Oznaka na vrhu linije kursa predstavlja smjer zakretanja broda, s ci-ljem detektovanja manevra mete bez kašnjenja. - Prediktor putanje može takođe biti dostupan.
		- **Opasna meta** je podebljana (u crvenoj boji na ekranu u bo-ji) i treperi dok nautičar ne potvrdi da je uočio. - Prediktor putanje može takođe biti dostupan i obično je predstavljen isprekidanom zakrivljenom linijom.
AIS meta sa srazmjernim obrisom		- Stvarni obris mete može biti prikazan uz uobičajeni trouga-oni simbol. Ovaj obris je pozicioniran u skladu sa stvarnom pozicijom broda. Dužina i širina broda su takođe proporcionalno prikazane, kao i orjedntacija pramčanice.
AIS označena meta		- Kvadrat označen sopstvenim uglovima, treba da bude iscrtan oko simbola mete.
Izgubljena AIS meta		- Dvije pune ukrštene linije iscrtane preko poslednje zabilje-žene pozicije (uključujući i orjentaciju) mete. Simbol treba da svjetluca. Meta treba da bude predstavljena bez vektora, odnosno identifikatora kursa i smjera zakretanja.
Trag AIS mete		- Pređeni put mete je označen tačkama, postavljenim na međusobno istom rastojanju.
AIS-SART (Search and Rescue Transponder, eng.)		- Krug sa ucrtanim krstom pod uglom (punim linijama).

Poruke ovog tipa obično sadrže sljedeće informacije: brzinu i snagu (naleta) vjetra, pravac vjetra, nivo talasa, temperaturu vode, temperaturu vazduha, brzinu struja i njihove pravce na različitim dubinama, informacije o plimi i sl. Ovi podaci omogućuju dobijanje odgovarajućih informacija u realnom vremenu, u prijemnim stanicama, na svim brodovima u VHF domenu predajne stanice.

AIS velikog dometa. Prema IMO-voj definiciji standarda performansi, zahtijeva se da AIS oprema funkcioniše kao sredstvo posredstvom koga obalna država može da dobije informacije o brodu i teretu, kada brod plovi u njenim teritorijalnim vodama. Za razliku od njegove osnovne funkcije, AIS velikog dometa se koristi za širokooblasno ili *off-shore* snimanje pomorskog saobraćaja. Razlozi uvođenja AIS-a velikog dometa (LR – long range, eng.) su sljedeći: bezbjednija navigacija, aktivno učešće broda u akcijama traganja i spasavanja (SAR - Search and Rescue, eng.), istraživanje i eksploatacija mora i zaštita životne sredine. Da bi mogao da funkcioniše na velikom dometu, AIS-u je potreban kompatibilan telekomunikacioni sistem, tipa Inmarsat-C ili MF/HF radio, kao podsistem GMDSS-a. Ova veza mora da bude u skladu sa zahtjevom IEC 61 162-2 [7,10].

Naravno, ovdje treba imati u vidu da je AIS razvijen 90-tih godina prošlog vijeka, a da se od 2008. godine radi intenzivno na satelitskom AIS-u (tzv. S-AIS), čija će osnovna svojstva biti opisana u poglavlju 1.11.

1.8. Prednosti AIS-a

Kontinualan rad AIS-a obezbjeđuje brojne prednosti, posebno pomorcima. Glavna je, automatska identifikacija broda putem MMSI-a i izbjegavanje sudara. Pomoću AIS-a je takođe moguća brza radio komunikacija.

Prednosti su slične i sa stanovišta VTS-a. Većina VTS centara zahtijeva obavještenja od strane brodova o približavanju ili ulasku u VTS oblast. Identifikacioni proces zahtijeva vrijeme i potpunu kooperativnost brodova koji su uključeni u ovaj proces. Poboljšanja koja se postižu u praćenju broda primjenom AIS-a su sljedeća: veće geografsko pokrivanje; veća tačnost u određivanju pozicije; odsustvo radarske sjenke; preciznost prikaza saobraćajne situacije; dostupnost podataka o manevrisanju u realnom vremenu; smanjen uticaj vremenskih uslova na proces praćenja i mogućnost obezbjeđenja preciznih navigacionih informacija.

Veće geografsko pokrivanje. AIS podatke primaju druge AIS stanice ili baza repeticionih stanica (ripitera). Tako da će VTS putem AIS opreme biti u mogućnosti da prima podatke o identitetu i lokaciji broda na maksimalnoj udaljenosti. Kao rezultat ovoga, često je moguća detekcija meta koje su izvan konvencionalnog radarskog opsega. Čak i kada ovo nije moguće, proširenje VTS opsega detekcije može se postići instaliranjem dodatnih, umreženih ripiter stanica. Takođe, ovdje treba imati u vidu intenzivan razvoj S-AIS-a i globalnog AIS pokrivanja (pogledati poglavlje 1.11).

Veća tačnost u određivanju pozicije. Cilj je da se sa AIS-om odredi pozicija sa tačnošću većom od 10 [m] uz pomoć DGNSS korekcionih signala. Ovo je znatno veća tačnost od one koju ostvaruje radar u funkciji sopstvene frekvencije, brzine ponavljanja impulsa i širine snopa, a koja obično iznosi od 30 - 50 [m].

Odsustvo radarske sjenke. U obalnim i lučkim vodama radarsko praćenje brodova može biti onemogućeno blizinom kopna i/ili kopnenih objekata. Ovaj efekat radarske sje-

nke, može u VTS baziranim na radaru, da prouzrokuje gubitak mete i tako onemogući VTS da precizno prati brodove i njihove manevre u kritičnim trenucima. Gubitak traga rezultira potrebom za ponovnim pronalaženjem i reidentifikacijom izgubljene mete, što povećava gustinu elektronskog saobraćaja u VTS centru. Dok su AIS praćenjem u velikoj mjeri izbjegnute ove pojave, neposredna blizina zgrada i mostova, poznata kao *urbani kanjon*, ponekad može da prouzrokuje poteškoće za AIS transponder u područjima koja su jako izgrađena. Ovo ima za posljedicu, ili onemogućavanje prijema diferencijalnog GNSS signala od strane AIS transpondera, ili onemogućavanje uzastopnog slanja više AIS poruka.

Preciznost prikaza saobraćajne situacije. Radarsko praćenje brodova može biti poremećeno ili prekinuto kada dva broda prolaze blizu jedan drugog, na način da će radarsko praćenje jednog broda biti konfuzno zbog blizine drugog. Ovo rezultira zamjenom radarskih slika i može da dovede do opasnosti ukoliko VTS operater to ne uoči i brzo ne reaguje. Posljedice ovog fenomena mogu se odraziti i na dalji rad VTS-a. Mnogo preciznije i pouzdanije praćenje posredstvom AIS-a, sprečava incidentne situacije izazvane efektom zamjene radarskih slika.

Dostupnost podataka o manevrisanju u realnom vremenu. VTS sistemi bazirani na radaru obezbjeđuju detalje o kursu i brzini preko dna. Ove informacije su *istorijske* i određuju se na osnovu traga koji brod ostavi. Za razliku od radara, AIS šalje podatke o manevru (pravac i promjenu brzine) u realnom vremenu. Ovi podaci se preuzimaju direktno od brodskog navigacionog sistema i automatski šalju AIS-om kao dinamičke poruke.

Smanjen uticaj vremenskih uslova na proces praćenja. Na performanse navigacionog radara negativno utiču padavine. Kada je vrijeme kišno ili sniježno, efikasno radarsko praćenje je ponekad onemogućeno, čak i kada se koriste savremene tehnike suzbijanja ovih negativnih efekata. S druge strane, pri ovakvim vremenskim uslovima, VHF radio transmisija nije tako oslabljena. Ovo rezultira time da VTS centri obično održavaju tačnu sliku saobraćajne situacije i u lošim vremenskim uslovima, zahvaljujući AIS-u. Međutim, na kvalitet VHF radio transmisije mogu da utiču atmosferska pražnjenja. U ovim uslovima, VHF prijemni opseg se jako proširuje, te dovodi do znatnog povećanja formata AIS poruke. Pri ovome VTS treba automatski da odbije prijem ovakve poruke i tako spriječi zagušenje, te da pokuša ponovo da primi poruku u odgovarajućem formatu.

Mogućnost obezbjeđenja preciznih navigacionih informacija/savjeta. Kada VTS centri mogu da prime AIS informacije od brodova u svom djelokrugu, kvalitet, tačnost i pouzdanost praćenja brodova su znatno povećani. Shodno ovome, neki VTS centri su u mogućnosti da pruže navigacionu pomoć i pomoć u organizaciji saobraćaja, te su osposobljeni za davanje preciznih savjeta u određenim situacijama.

1.9. Nedostaci AIS-a

Iako AIS ima potencijal da znatno poboljša kvalitet rada VTS-a, sistem ima određena ograničenja, tipa:

- VTS operateri mogu postati previše *zavisni* od AIS-a i stoga ga mogu tretirati kao jedino i primarno sredstvo za identifikaciju brodova. Kao rezultat, mogu da ne ostvare neke kontakte, jer svi brodovi ne moraju biti opremljeni AIS transponderom;
- AIS mogu da budu predmet istih smetnji i oštećenja kao i ostali VHF-MF sistemi;
- Kada AIS stanica dostigne tačku zasićenja (maksimalan broj transmisija), TDMA sprečava preopterećenje izborom transmisija, to jeste prihvata signale koji potiču od

bližih, a odbija one od daljih AIS stanica. Ovo svojstvo je od izuzetne koristi za sam AIS, ali ne i za VTS, kome su nekada od iste ili čak veće važnosti informacije o brodovima na većoj udaljenosti;
- Ne postoji intencija da AIS postane opšte komunikaciono sredstvo, stoga pomorci i operatori VTS-a treba i dalje da koriste odgovarajuće komunikacione tehnologije opšte namjene;
- Iako su AIS prikazi obično *imuni* na efekat zasjenčenja, koji se javlja kod radarskog prikaza, velika blizina zgrada i mostova, ponekad može da izazove pojavu efekta *urbanog kanjona*. Ovaj efekat obično prouzrokuje smetnje u radu AIS transpondera na način što onemogućuje prijem GNSS signala i/ili sukcesivnu transmisiju poruka [1,2].

1.10. AIS klase A i B

Postoje dvije klase AIS poruka: A i B, zavisno od vrste transpondera koji ih emituje. Transponderi se razlikuju u pogledu opsega, kompleksnosti i cijene. AIS informacije koje emituje transponder klase A, uvijek će imati prioritet i biće dostupne svim brodovima u određenom području. S druge strane, AIS informacije koje emituju transponderi klase B, biće dostupne samo ukoliko postoji dovoljno prostora za njihovo emitovanje na AIS opsegu [11].

AIS klase A. U cilju izbjegavanja istovremene emisije, brodovi velikih gabarita, koriste AIS klase A, koji ima SOTDMA (Self-Organized TDMA, eng.) sistem korišćenja kanala. Ovaj algoritam omogućuje AIS transponderu da *uoči* kako drugi brodovi emituju poruke i da prilagodi svoj model emitovanja. U slučaju da u određenom području ima više brodova sa transponderima klase A, nego što to dopušta predviđena širina frekventnog opsega, sistem će automatski ograničiti područje prijema AIS informacija, tako da će brodovi koji su na većoj udaljenosti biti automatski isključeni iz komunikacije.

AIS klase B. Manji brodovi opremljeni AIS-om, npr., jahte, koriste jeftinije AIS transpondere klase B, koji rjeđe emituju. Ovi transponderi koriste CSTDMA (Carrier Sense TDMA, eng.) sistem. Oni uvijek *slušaju* par sekundi prije emisije, da *čuju* da li u tom trenutku emituje neki veći brod; tek nakon toga, tj. pošto utvrde da je kanal slobodan, počeće i sami da emituju.

Neke starije stanice tipa A, mogu samo da *vide* poziciju, ali ne i da identifikaciju stanice klase B. Takođe, veći brodovi mogu da isključe prikaz AIS informacija klase B, kako bi izbjegli konfuznu sliku na displeju u slučajevima kada u određenoj zoni ima puno manjih brodova. Dakle, AIS informacije klase B će biti prikazane jedino u slučajevima kada za to ima dovoljno prostora na AIS kanalu.

1.11. S-AIS

Nova satelitska AIS arhitektura, koja će imati 58 satelita uz osnovnu *Iridium Next* konstelaciju od osam satelita, biće osnova naprednog praćenja brodova putem S-AIS-a (exactView RT & Harris, [12]). Sateliti u ovom sistemu su međusobno povezani i u stalnoj su komunikaciji sa zemaljskim stanicama, što omogućuje korisnicima prijem AIS podataka, u realnom vremenu, na globalnom nivou (slika 1.4).

Kompanije exactEarth, ORBCOMM, Spacequest, Spire i druge su uz pomoć velikih vladinih projekata, aktivno i uspješno uključene u razvijanje i obezbjeđivaje funkcionalnosti ovog satelitskog sistema [13].

Slika 1.4. S-AIS kosmička *Iridium Next* konstelacija (izvor: web)

***Ključna svojstva S-AIS-a**:*
- Globalno pokrivanje;
- Ažuriranje podataka svakog minuta;
- Kašnjenje u prijemu ažuriranih informacija na strani korisnika je najviše jedan minut;
- Pouzdana detekcia AIS transpondera klase A i B, uključujući male brodove opremljene ABSEA™ AIS transponderima i dr. [12].

***Prednosti S-AIS-a**:*
- Obezbjeđivanje korisnicima, putem samo jednog izvora, veoma pouzdanih AIS informacija;
- Automatsko izvještavanje o akcidentima u pomorstvu;
- Maksimalno korišćenje resursa, zahvaljujući kompletnoj i ažurnoj slici situacije u zoni plovidbe i dr. [12].

1.12. O exactEarth S-AIS-u

Vodeća organizacija na polju globalnog AIS praćenja, je exactEarth[1], koja sakuplja najopsežnije podatke o nadgledanju brodova i obezbjeđuje najkvalitetnije informacije korisnicima širom svijeta. Organizacija je osnovana 2009. godine, s ciljem kreiranja i obezbjeđivanja AIS satelitskog servisa, na globalnom pomorskom tržištu. Sa sjedištem u Kembridžu (Ontario, Kanada), exactEarth koristi potencijale napredne mikrosatelitske

[1] Interesantno je pomenuti da je slogan exactEarth organizacije - *svijet bez horizonta* ("world without horizonts", eng.).

tehnologije, kako bi obezbijedila rješenja za praćenje brodova visokog kvaliteta i pouzdanosti, koja su u isto vrijeme relativno jednostavna u pogledu korišćenja.

Zahvaljujući istraživačkim i razvojnim aktivnostima exactEarth organizacije, AIS signali se danas mogu detektovati niskoorbitnim satelitima (LEO – Low Earth Orbit, eng.; postavljenim 200-2000 [km] iznad površine Zemlje [14]) i posljedično obezbijediti globalno praćenje brodova opremljenih AIS transponderima uz pomoć mreže brojnih zemaljskih stanica.

1.12.1. Tehnološka platforma

Tehnološka platforma exactEarth-a se bazira na nekoliko podsistema:

AIS transponderi. Izvor podataka za exactAIS servis su AIS transponderi koji su već instalirani na oko 165 000 brodova širom svijeta. Korišćenje exactAIS servisa ne zahtijeva nikakve izmejne na postojećoj opremi na brodovima.

Ovdje treba napomenuti, da je korišćenjem exactAIS servisa moguće sljedeće:

- Dakle, konzistentno praćenje oko 165 000 brodova;
- Praćenje brodova/plovila bilo gdje u svijetu, uključujući i veoma udaljene oblasti;
- Kompletiranje slike saobraćajne situacije na moru u određenom području, brže nego uz pomoć bilo kog drugog AIS sistema [12];
- Kompilacija više od 7 000 000 AIS poruka dnevno, čime exactAIS obezbjeđuje razmjenu informacija o situaciji na svim svjetskim plovnim puteva.

Uz exactAIS servis, exactEarth nudi exactEarth Viewer i exactAISPremium™ servise, koji uključuju AIS terestričke podatke, s ciljem obezbjeđivanja što potpunijeg uvida u saobraćajnu situaciju na moru.

Prijemnici na satelitima. Ovi prijemnici ili risiveri su konstruisani za prijem AIS podataka putem exactView svemirskog segmenta i rezultat su višegodišnjeg istraživačkog i razvojnog rada, odnosno, tehnologije poznate kao „de-collining“, eng., koja omigućuje simultan prijem signala od velikog broja brodskih AIS transpondera. Ova tehnologija je komercijalizovana i omogućuje veoma visoku rezoluciju pri detekciji brodova.

Zemaljske stanice. Ove stanice su locirane na strategijskim lokacijama širom planete i primaju podatke sa satelita. Podaci su kodirani i prosljeđuju se od zemaljskih stanica ka centru za obradu podataka.

Centar za obradu podataka. Ovaj centar obezbjeđuje računarske kapacitete za čuvanje i obradu podataka dobijenih od zemaljskih stanica. Obezbjeđuje izuzetno visok nivo pouzdanosti, uključujući rezervne izvore napajanja, hlađenje, zaštitu od zapaljenja i druge bezbjedonosne mjere. Centar se nalazi u Kembridžu (Ontario, Kanada).

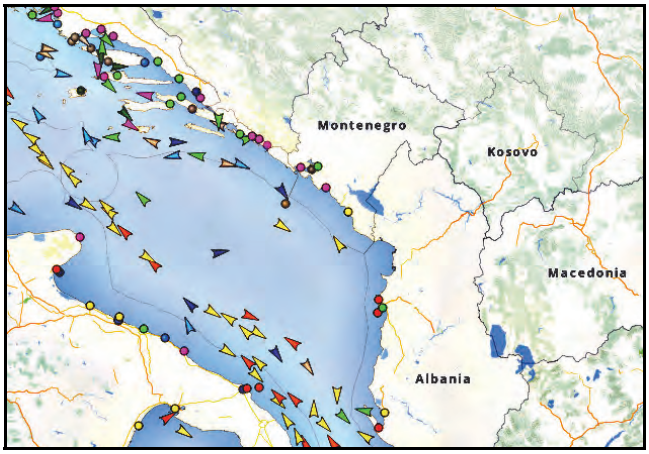
Operativni centri. Oni upravljaju prethodno obrađenim satelitskim podacima, dobijenim od centra za obradu podataka, konfigurišu baze podataka i obezbjeđuju podatke različitim korisnicima širom svijeta.

Isporučivanje podataka korisnicima. Podaci se isporučuju nadležnim pomorskim upravama putem raznih zaštićenih mehanizama. Pri tome korisnici mogu da izeberu način prikaza podataka, bilo putem namjenskih ili web baziranih displeja.

a. ExactAIS. ExactAIS obezbjeđuje globalno praćenje svih brodova opremljenih AIS transponderima, koristeći exactEarth satelitsku konstelaciju i globalnu mrežu zemaljskih

stanica širom svijeta. Pošto se procesuiraju u Centru za obradu podataka u Kanadi, poruke se odmah putem zaštićenih linija prenose korisnicima. Poruke su zaštićene industrijskim standardom koji je kompatibilan sa postojećom AIS tehnologijom. ExactAIS emituje podatke bezbjedno, brzo i konstantno, omogućujući korisnicima da nadgledaju pomorski saobraćaj u bilo kom plovnom području širom svijeta. ExactAIS procesuira i distribuira sve primljene AIS poruke svojim korisnicima za zone koje su za njih od posebne važnosti (AOI - Aera of Interest, eng.). Ove poruke sadrže: ime broda, MMSI, IMO broj, poziciju, kurs i brzinu [15].

b. ExactAIS Viewer. ExactEarth obezbjeđuje web baziran sistem prikaza AIS informacija, poznat kao exactAIS Viewer. Radi se o web baziranoj aplikaciji koja omogućuje korisnicima da vide trenutnu poziciju brodova koju daje exactAIS sistem na GIS (Geographic Information System, eng.) mapi, u cilju postizanja vjernije vizualizacije (slika 1.5). Korisnici mogu da koriste filter, kako bi vidjeli samo one brodove koji su za njih od značaja u datim okolnostima, širom svijeta, a takođe mogu da prilagode svojim potrebama pojedine navigacione kontrole [15].



Slika 1.5. ExactAIS Viewer prikaz AIS meta (izvor: [16])

Korisnici ExatAIS Viewer-a, mogu da vide najnovije podatke o brodovima za protekla 24 časa, kao i istorijske podatke za period od najmanje pet proteklih dana. Pri ovome, na raspolaganju im stoje funkcije tipa:

- Globalna navigacija;
- Zoom in/Zoom out;
- Predled informacija o meti;
- Praćenje određene mete;
- Filtriranje prikaza, kako bi se na displeju vidjeli samo brodovi koji su u fokusu korisnika;
- Podešavanje filtara;
- Markiranje područja (zona) sa frekventnim saobraćajem;
- Pregled generalnih izvještaja poslatih sa svih brodova, koji su u području od interesa za korisnika;
- Statistika broja brodova u vidljivom području i dr.

c. ExactAIS Premium™. ExactAIS Premium™ sistem uključuje i AIS informacije sa kopna, u cilju obezbjeđivanja što potpunijeg AIS globalnog pokrivanja. U komunikaciji sa exactEarth satelitskom konstelacijom, korisnici ovog servisa mogu da dobiju potpune i tačne podatke o kretanjima brodova bez obzira na njihovu trenutnu poziciju. Servisi koje pruža exactAIS Premium™ su:

- Trenutno raspoloživi exactAIS satelitski servisi;
- Integracija terestričkih AIS informacija;
- Ažuriranje podataka svakog sata;
- Isporučivanje više informacija istovremeno i dr.

ExactAIS Premium™ omogućuje korišćenje prikupljenih satelitskih i terestričkih podataka za analize i planiranje navigacije „od veza do veza“. Dodatno, ovaj servis omogućuje potpuniji nadzor zona od posebnog interesa, ribarskih zona, kao i ključnih ekonomskih zona.

1.12.2. O exactView-u

ExactView nije samo skup koordiniranih satelita, već kompletno poslovno okruženje, koje obuhvata detekciju i emisiju AIS informacija u pomorstvu, prostorno distribuiranim korisnicima širom svijeta.

Prva generacija exactView satelita će biti znatno proširena putem dva nova lansiranja, planirana za 2016. godinu. Trenutno, exactView konstelaciju čini osam satelita, kao i nedavno lansirani EV-9, prvi ekvatorijalni satelit koji je znatno poboljšao ukupno vrijeme prolazaka satelita na globalnom nivou. Godine 2016, otpočelo je takođe lansiranje novih 58 exatView RT & Harris satelita [12].

Zahvaljujući exactView-u, filtrirani AIS podaci se brzo distribuiraju i kompletna slika saobraćajne situacije na plovnim putevima širom svijeta, dobija se za veoma kratko vrijeme i dostupna je korisnicima putem velikog broja bezbjednih mreža.

U sadejstvu za mrežom zemaljskih stanica, bezbjedno emitovani satelitski AIS signali, omogućuju korisnicima da nadgledaju i prate područja koja su za njih od posebnog značaja (AOI – Area of Interest, eng.) - kao svojevrsnu podršku u donošenju poslovnih odluka, zaštiti životne sredine, u situacijama traganja i spasavanja na moru i sl.

1.12.3. Primjene exactEarth S-AIS-a

U domen primjene exactEarth S-AIS-a spadaju: globalno praćenje brodova, odbrana i bezbjednost, zaštita životne sredine, sprječavanje ilegalnog ribarstva, traganje i spasavanje na moru i dr. U nastavku će biti ukratko opisana neka od područja primjene.

Globalno praćenje brodova. Upravama pomorske plovidbe su potrebna troškovno efikasna rješenja koja će im omogućiti bolji uvid u modele pomorskog saobraćaja i otkrivanje/identifikaciju atipičnih ili na bilo koji način *sumnjivih* ponašanja.

Servis exactAIS obezbjeđuje znatno poboljšanje vidljivosti pomorskog saobraćaja na svjetskim plovnim putevima, na udaljenostima većim od 50 [nm] od bazne AIS stanice. Uz globalno pokrivanje, exactAIS može da detektuje na hiljade brodova samo u jednom prolazu.

Dodatne prednosti ovog servisa su:

- Povećana efikasnost sa visokim stepenom logističke optimizacije i praćenja brodova, po principu "od veza do veza";
- Obezbjeđivanje obimnih, složenih dinamičkih informacija o brodovima, uključujući njihove pravce plovljenja, kurseve i brzine;
- Povećanje preglednosti saobraćajne situacije u određenom plovnom području, zahvaljujući preciznijim informacijama o svim aspektima planiranja i analize izvršenja pomorskih operacija;
- Proširenje opsega sistema upravljanja pomorskim saobraćajem na područje Arktika i dr.

Servis exactAIS omogućuje upravama pomorske plovidbe da prate plovila u zoni svoje jurisdikcije i u uslovima najgušćeg saobraćaja.

Odbrana i bezbjednost. Servis exactAIS se razvija u pravcu aktivnog obavještavanja (ABI – Activity Based Intelligence, eng.), kao važno sredstvo u efektivnom odlučivanju i proaktivnom djelovanju u očuvanju nacionalne bezbjednosti. Ovaj servis podržava nacionalne bezbjedonosne inicijative kroz planiranje akcija, integralno nadgledanje obale i otkrivanje *sumnjivih* brodova. Zahvaljujući njemu, bezbjedonosno-obavještajne organizacije mogu da:

- Filtriraju *prijateljske* brodove i fokusiraju se na praćenje *sumnjivih* brodova;
- Da uštede vrijeme i novac, na način što će složene i skupe aktivnosti nadzora svesti na rutinske patrolne zadatke i dr.

Zaštita životne sredine. ExactAIS podaci igraju veoma važnu ulogu u zaštiti životne sredine, na način što otkrivaju ekološke prekršaje u zaštićenim i posebno osjetljivim zonama.

Više od 90% svjetske trgovine se obavlja morem. Iako je brodarstvo ključno za globalnu ekonomiju, intenzivan pomorski saobraćaj štetno utiče na morski ekosistem.

Servis exactAIS pruža, dakle, podršku organizacijama za zaštitnu životne sredine širom svijeta, posebno u osjetljivim područjima. Podaci koje on obezbjeđuje, koriste se za izradu interaktivnih mapa kojima se vizualizuje kretanje brodova tokom čitave godine, kao i emisije štetnih gasova (www.shipmap.org).

Zahvaljujući exactAIS servisu organizacije za zaštitu životne sredine, mogu da:

- Identifikuju ekološki zaštićena marinska područja (MPA – Marine Protected Areas, eng.), analiziraju istorijske podatke i kreiraju modele saobraćaja, koji im pomažu u identifikovanju pojava narušavanja eko-sistema i sankcionisanja vinovnika;
- Automatski dobiju upozorenja kada brodovi uđu u neku MPA, kao i informacije o potencijalnim opasnostima, s ciljem sprječavanja ekoloških incidenata i dr.

Sprječavanje ilegalnog ribarstva. ExactAIS obezbjeđuje podatke neophodne u zaštiti od prekomjernog i/ili ilegalnog ribolova. Ilegalan, neprijaljen i neregularan (IUU – Illegal, unreported and unregulated, eng.) ribolov, danas se smatra glavnom opasnošću u obezbjeđivanju održivog ribarstva. ExactAIS podaci igraju značajnu ulogu u sankcionisanju vinovnika od strane pomorskih uprava. U borbi protiv ilegalnog ribolova širom svijeta, exactAIS omogućuje:

- Automatsko identifikovanje nekooperativnih IUU plovila (brodova) u blizini legalnih ribarskih brodova, koji imaju mogućnost adekvadnog odziva;
- Dinamičko upoređivanje stvarnih i onih poslatih od strane broda podataka o poziciji;
- Proširenje zone nadgledanja i izvan uobičajenih ribolovnih područja i sl.

"... ExactEarth je vodeća kompanija na polju globalnog praćenja AIS stanica. Sistem kojim kompanija raspolaže, obezbjeđuje širok dijapazon informacija o nadgledanim brodovima i najbolji kvalitet podataka, korisnicima širom svijeta. Informacije koje pruža exactEarth olakšavaju posao upravama sigurnosti plovidbe i trgovačkim organizacijama u pomorstvu, bilo da se radi o praćenju samo jednog broda, ili nadgledanju velikih, veoma udaljenih, satelitski slabo pokrivenih geografskih područja."

"... ExactEarth je stvorila jedinstven sistem koji prikuplja, obrađuje, distribuira i arhivira AIS poruke dobijene od brodova širom svijeta, korišćenjem globalne satelitske tehnologije i posebno patentiranog satelitskog AIS sistema detekcije."

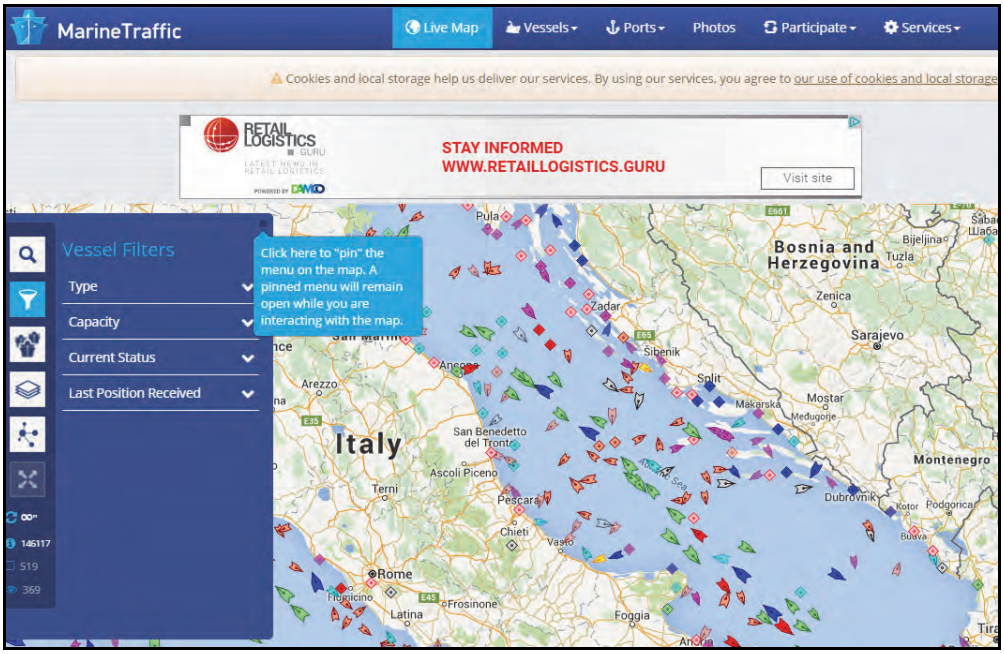
"... ExactEarth koristi konstelaciju relativno malih satelita, koji obilaze Zemlju krećući se u pravcu sjevero-zapada, konstanto prolazeći iznad različitih regiona u skladu sa rotacijom planete. Sateliti naprave jedan prolaz u periodu od 90 do 100 [min]. Sa svoje prosječne visine od 650 [km] iznad površine Zemlje, imaju „polje vidljivosti" od oko 5000 [km] u prečniku. Sateliti imaju zadatak da prikupe sve AIS emisije sa svih brodova koji su im u polju vidljivosti." [15]

1.13. Web bazirani AIS servisi

U ovom poglavlju će biti opisani web bazirani AIS servisi. Neki od ovih servisa su besplatni, tj. dostupni su svim on-line korisnicima, dok su neki komercijalnog tipa i imaju restriktivan pristup.

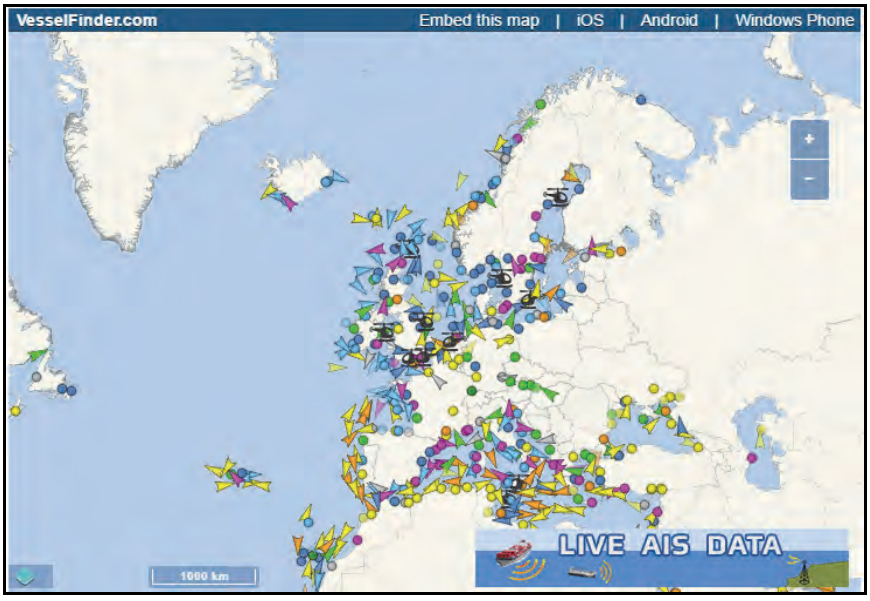
Marine Traffic. Marine Traffic uz pomoć Google Map-a prikazuje u realnom vremenu informacije o AIS pozicijama brodova/drugih plovila i o njihovom kretanju svjetskim morima. Sistem je razvijen je kao akademski projekat grčkog Univerziteta Aegean. Podaci se prikuplaju na osnovu AIS emisija. AIS transponderi emituju poziciju broda, brzinu preko dna (SOG - Speed Over Ground, eng.), kurs preko dna (COG – Course Over Ground, eng.), ime broda, veličinu broda i sljedeću luku pristajanja. Izgled web portala koji omogućuje razne AIS servise prikazan je na Slici 1.6.

Ovaj on-line sistem nudi mogućnosti prikaza *žive* mape (Live Map, eng.) na kojoj se može odabrati određeno plovno područje i tako dobiti uvid u trenutno stanje saobraćaja brodova/drugih plovila, odnosno, aktivnih AIS meta. Brodovi su prikazani na elektronskoj mapi u formi obrisa stvarnih brodova. Označivači brodova (tagovi, mete) su obojeni različitim bojama u zavisnosti od toga da li se radi o tankeru, putničkom brodu, teretnom brodu, jahti, itd. Jednostavnim klikom na metu, dobijaju se informacije o brodu i njegovoj trenutnoj poziciji. Takođe, mogu se dobiti razne filtrirane informacije: o svim brodovima, brodovima u dometu, brodovima u blizini, informacije o lukama, fotografije brodova i dr. Dodatno, korisnicima stoje na raspolaganju brojne mogućnosti aktivnog učestvovanja u nadgradnji sajta kao i brojni servisi [17].



Slika 1.6. Marine Traffic web portal (izvor: [17])

Vessel Finder. Vessel Finder je sistem praćenja brodova u realnom vremenu. Postoji takođe nova verzija Vessel Finder web portala koja koristi Open Street Map interfejs, čime je dodatno pojednostavljeno praćenje AIS meta. Na ovom web portalu korisnici mogu naći sopstveni brod, brod svojih konkurenata, sve svjetske luke, najnovije vijesti iz pomorske industrije i biznisa. Sistem ima brz i intuitivan interfejs i jednostavnu navigaciju. Na slici 1.7 je dat prikaz prozora u Vessel Finder-u.



Slika 1.7. Vessel Finder interfejs (izvor: [17])

Glavna svojstva Vessel Finder on-line servisa su [17]:

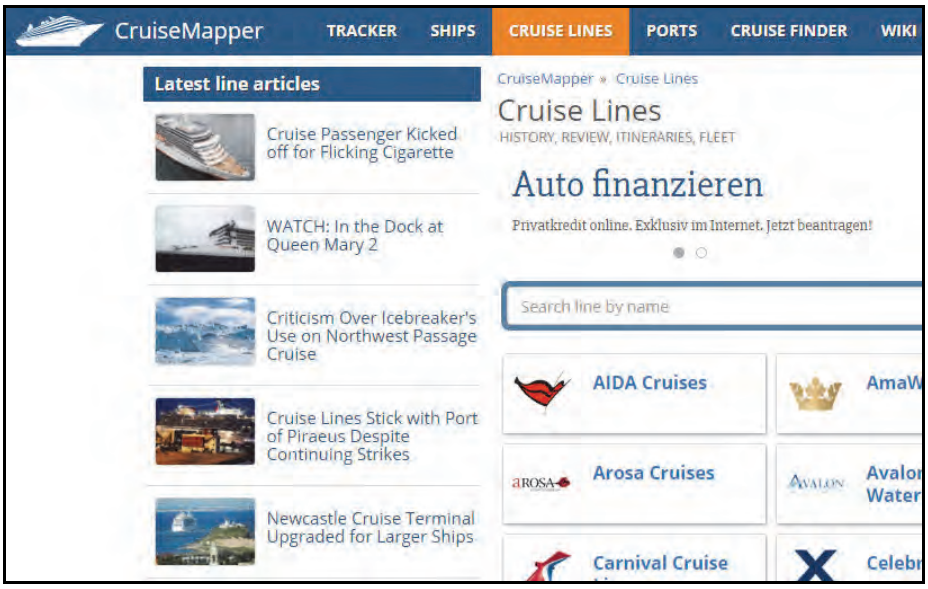
- Globalno pokrivanje;
- Android i iOS aplikacije;
- Korisnici mogu da traže brod po imenu, IMO broju i/ili MMSI. Korisnik jednostavno treba da unese neki od ovih podataka i da automatski dobije relevantne informacije o brodu;
- Sistem ima detaljnu bazu podataka o preko 150 000 brodova, koja sadrži podatke tipa: imena broda, IMO broja, MMSI-a, vrste broda, luke odredišta, sljedeću luku pristajanja i sl.;
- Za svaki brod, korisnik može jednostavno naći poziciju, putanju (pređeni i planirani put);
- Takođe, posredstvom ovog sistema, korisnici mogu dobiti najnovije informacije o incidentima, piratima, novim brodovima, lukama, itd.;
- Zahvaljujući Vessel Finder bazi luka moguće je za svaku od većih luka dobiti informacije o dolascima i odlascima brodova;
- Postoji, takođe, galerija fotografija brodova;
- Vessel Finder ima dizajan koji je veoma jednostavan za korišćenje;
- Baza luka i brodova se stalno proširuje i dr.

Vessel Finder podržava mobilne aplikacije, tako da ga je moguće koristiti posredstvom tableta ili pametnog telefona (slika 1.8).

Slika 1.8. Vesel Finder na *pametnom* telefonu (izvor: [17])

Cruise Mapper. Cruise Mapper je web sajt (www.cruisemapper.com) na kome se mogu naći sve relevantne informacije koje mogu da olakšaju izbor kruzera za neko putovanje. Glavne informacije koje se mogu dobiti posredstvom ovog sajta su:

- Spisak kruzing linija, uključujući spisak kruzing kompanija;
- Lista kruzera;
- Detalji o kruzerima, tipa: trenutna pozicija/lokacija, IMO broj, godina izgradnje, brzina, graditelj, vlasnik i dr.;
- Destinacije;
- Detalji o planiranim putovanjima, uključujući kruzing itinirere;
- Raspored posade i dr.



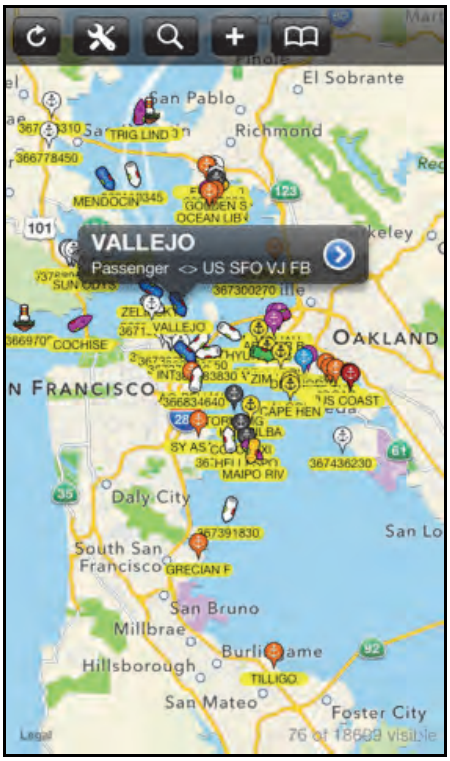
Slika 1.9. Cruise Mapper na računarskom displeju (izvor: [18])

Cruise Mapper ima interfejs koji je intuitivan i jednostavan za navigaciju (slika 1.9). Korisniku je potrebno obično svega nekoliko sekundi da pronađe traženu informaciju. Na stranici namijenjenoj pretraživanju, dostupni su filtri za kruzere, linije, kalendar kruzing putovanja i luke polazaka. Takođe, mogu se naći najvažnije informacije o odredišnim lukama, uključujući informacije o aktivnostima i mogućnostima zabave na kruzerima [18].

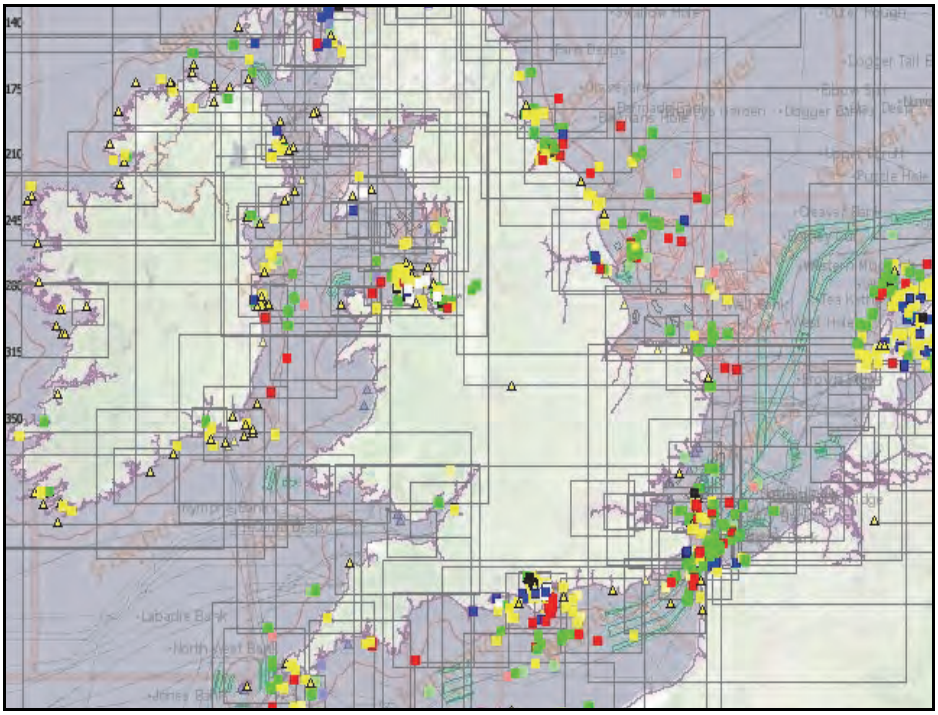
Ship Finder. Ship Finder je visoko rangirana aplikacija za iPhone, iPad, Android i Windows telefone, koja odnedavno ima novu besplatnu web aplikaciju za desktop korisnike (slika 1.10). U okviru ove aplikacije, posebno je interesantna mogućnost praćenja kretanja brodova putem „Sail Me“ servisa i Google Earth-a. Na ovaj način su on-line dostupni *živi* podaci o pomorskom saobraćaju širom svijeta. Sistem je brži od radarske tehnologije i koristi se direktno na brodovima u navigacione svrhe, a posebno za izbjegavanje sudara [19].

ShipAIS. ShipAIS sajt za praćenje brodova (www.shipais.com) je razvila grupa entuzijasta (slika 1.11). Ovaj web sajt prikazuje brodove koji plove vodama oko Velike Britanije. Na sajtu postoje statistike o brodovima, njihove fotografije, trenutne pozicije i dr. Ovim sistemom su pokrivena plovna područja: Cromarty-Forth, Tyne-Humber, Thames-Dover, Portland-Wight, Plymouth-Lundy-Fastnet, Malin-Hebrides, Fair Isle i dr. [20]. Iako neki korisnici smatraju da vizualizacija ovog on-line sistema za detekciju AIS meta i njihovo praćenje nije najbolja, sistem je funkcionalan i pruža određeni vid podrške nadgledanju saobraćajne situacije u prethodno specificiranim područjima sa gustim saobraćajem.

Ovdje ukratko opisani, kao i neki drugi web bazirani sistemi identifikacije i praćenja AIS meta, mogu se smatrati pomoćnim alatima na putu ka potpunoj implementaciji koncepta *zvanične* (standardizovane) e-Navigacije i pomorskog klauda, kojim će ona u velikoj mjeri biti podržana. O ovim sistemima u razvoju, biće više riječi u poglavljima koja slijede.



Slika 1.10. Ship Finder interfejs (izvor: [19])



Slika 1.11. ShipAis UK interfejs (izvor: [20])

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2. ECDIS osnove

Kao što je hronometrom John Harrison-a (1764), prije više od 250 godina, otpočela revolucija u navigaciji, tako će ECDIS revolucionarno izmijeniti navigaciju u decenijama koje predstoje. Naime, novu digitalnu tehnologiju, poznatu kao – prikaz elektronske karte i informacioni sistem (ECDIS - Electronic Chart Display and Information System, eng.) nautičari koriste na isti način kao i tradicionalne papirne karte, za vođenje broda iz tačke A u tačku B. ECDIS podržava iste metode rada na karti kao papirne karte, samo mnogo fleksibilnije, tj. na digitalizovan način.

Na papirnoj karti navigator planira rutu olovkom, šestarom i lenjirom, nakon što izbriše ranije planirane i korišćene rute. Elektronski navigacioni uređaji podržavaju ovaj koncept i memorišu podatke o prethodnim rutama, ali dozvoljavaju unos i korišćenje samo jedne - aktuelne rute. Ako brod plovi regularno istim rutama, na papirnoj karti se brišu samo pojedini dijelovi starih ruta. Aktuelna ruta mora biti nedvosmislena za nautičara, ali je poželjno da se i druge potencijalne rute mogu jednostavno rekonstruisati.

Elementi planiranja rute u ECDIS-u su međutačke i segmenti rute (kraci) između međutačaka. Pri tome su međutačke i kraci nosioci mnogo više informacija u odnosu na svoje ekvivalente na papirnim kartama. Kraci mogu biti konstruisani za predefinisane brzine, dok međutačke mogu da sadrže informacije o promjeni brzine, kursa i radijusu zakretanja broda pri promjeni kursa [1,2].

"*Elektronska revolucija je u velikoj mjeri uticala na način vođenja broda. Kako je elektronska navigacija sve više zastupljena, klasična astronomska se više ne koristi na većini brodova. Sekstant, hronometar i nautičke tablice, ostali su interesantni jedino sa stanovišta istorije navigacije.*

Prelazak na korišćenje savremene elektronske navigacije je veoma brz. Iako veliki broj pomoraca ima razvijene sposobnosti osmatranja, smijeranja, određivanja pozicije, sa ECDIS-om i satelitskom navigacijom, sve je manje neophodno razvijati ove vještine. Stoga su početnici u navigaciji danas familijarniji sa savremenom elektronskom, nego sa tradicionalnim metodama navigacije.

Tehnologije i metodologije se mijenjaju, ali osnovi principi navigacije ostaju isti. Osnovna potreba da se realizuju uobičajeni zadaci nautičara, u smislu držanja straže, tj. vizuelnog i zvučnog osmatranja uz pomoć raspoloživih uređaja u postojećim okolnostima, kao i poznavanje pozicije broda u svakom trenutku i podataka o njegovom kretanju – nijesu se promijenili. Nepromijenje su ostale i neophodnosti poznavanja uticaja struja na kretanje broda, vjetra i drugih meteoroloških uslova, kao i opšteg stanja u okruženju broda, odnosno, u zoni plovidbe.

Lako se oduševiti sofisticiranom tehnologijom, pod pretpostavkama da ona djeluje u skladu sa onim zašto je projektovana i da je pouzdana. Međutim, preveliko povjerenje u savremene navigacione uređaje lako može da smanji oprez. Sve dok je tehnologija moćna u svojoj funkcionalnosti i dok se alarmi ne uključuju - tek tada je sve u redu.

Kako bi se skrenula pažnja na opasnosti od akcidenata u navigaciji, poznavanje načina funkcionisanja opreme, posebno njenih ograničenja, kao i vještine neophodne pri njenom korišćenju, od suštinske su važnosti. ECDIS u ovom smislu ne predstavlja izuzetak." (Rod Shot, Global Maritime Education and Training Association, izvršni sekretar, [3])

2.1. Planiranje rute

Postavlja se pitanje - kako će navigator naći svoj put kroz mrežu kraka i međutačaka? - ECDIS, naime, obezbjeđuje dvije različite vrste kraka i međutačaka: jedne za planiranu (preferentnu) rutu, a druge za alternativne rute. Kraci i međutačke se kreiraju u modu planiranja (planning mode, eng.). Alternativne rute povezuju međutačke i formiraju mrežu kraka, koja predstavlja rute koje nautičar može koristiti pod određenim oko-lnostima, tj. za određeno putovanje. *SevenCs* ECDIS, npr., obezbjeđuje sljedeće funkcije namijenjene jednostavnom konstruisanju rute [3]:

- kreiranje kraka;
- kreiranje međutačke;
- umetanje međutačke;
- pomijeranje međutačke;
- uređivanje kraka, ili međutačke;
- brisanje (uklanjanje) kraka, ili međutačke;
- umetanje rute(a) i dr.

Nakon planiranja alternativnih ruta, mora biti odabrana aktuelna, odnosno, ona kojom će brod ploviti. ECDIS podržava ove operacije posredstvom funkcije auto selekcije (auto selection function, eng.). Ukoliko je put duž rute, sastavljen iz kraka i međutačaka – nedvosmislen, preferentna ruta će biti odabrana automatski. Međutim, ako se iz jedne međutačke granaju dva kraka, ECDIS funkcija selekcije zahtijeva od nautičara da donese konačnu odluku. Kada se aktivna ruta odredi, prikaz alternativnih ruta može da unese zabunu. Kako bi se ovo izbjeglo *SevenCs* ECDIS omogućuje isključenje opcije prikaza alte-rnativnih ruta [4].

2.2. Provjera planirane rute

Nakon planiranja rute, neophodno je potvrditi da ona zadovoljava određene kriterijume, najmanje iz dva razloga:

- nautičar mora da slijedi spoljašnje kriterijume, koje su postavili brodar, vlasnik i zapovjednik broda;
- ECDIS displej je obično podešen na veliki razmjer i pošto je prikaz objekata prorijeđen, nautičar može da previdi potencijalne opasnosti. Stoga se obavezno zahtijeva provjera valjanosti rute.

Iako nije jednostavno definisati kriterijume za optimizaciju rute, skup minimalnih zahtjeva koje ona mora da zadovolji je sljedeći:

- ruta ne smije da prouzrokuje nasukanje broda;
- takođe, ne smije da dovede do sudara sa plovnim ili fiksnim objektima, odnosno, preprekama;
- ona mora da podliježe u manjoj ili većoj mjeri devijaciji, zavisno od okolnosti i navigacionih uređaja i dr.

U skladu sa prethodno navedenim, tri osnovna parametra, koja su direktno vezana za bezbjedonosne zahtjeve, moraju da budu prilagođena za svaki brod:

- bezbjedan gaz;

– bezbjedne visine iznad nivoa mora;
– bezbjedne udaljenosti.

Ukoliko je program za provjeru rute pronašao grešku, parameter i/ili objekat koji je uzročnik greške je posvijetljen, što znači da ruta nije dobro planirana i da je treba ispraviti. Nakon ispravljanja rute, ponovo se vrši kontrola. Ako je planirana ruta ispravna, memoriše se u poseban fajl, ili u vidu liste međutačaka i tada može da otpočne plovidba.

ECDIS standard performansi zahtijeva ne samo provjeru rute prije početka putovanja, već i provjeru pozicije broda u odnosu na planiranu rutu tokom čitavog putovanja. U cilju zaštite od nasukanja, sistem za stalno snimanje pozicije omogućuje detekciju odstupanja stvarne od planirane rute i ukoliko je potrebno automatski uključuje alarm, kako bi oficir na palubi mogao da preduzme odgovarajuće akcije.

ECDIS je više nego alat koji sprječava nasukanje broda. Njegova sposobnost predikcije, omogućuje nautičaru da vidi poziciju broda kroz nekoliko narednih minuta. Treba naglasiti da ova predikcija nije simulacija, već rezultat ekstrapolacije aktuelnih parametara i stoga je primjenljiva za sve vrste brodova od najmanjih pilotskih čamaca do najvećih super tankera [1,2,5-9].

> "*ECDIS u kombinaciji sa sistemom za uštedu u potrošnji goriva, uz detaljne prognoze vremenskih prilika i struja, omogućuje plovidbu broda duž planirane rute najekonomičnijom brzinom. Snimanja i anlize podataka sa niza putovanja, obezbjeđuju bolje prognoziranje i optimizaciju brzine na pojedinim segmentima rute uz smanjenje potrošnje goriva.*" (Wiggo Lander, kap., Stena Germanica, [10])

2.3. Određenje pojma

ECDIS (Electronic Chart Display and Information System, eng.) u doslovnom prevodu znači prikaz elektronske karte i informacioni sistem. Radi se o računarski podržanom navigacionom sistemu, koji je u skladu s IMO (International Maritime Organization, eng.) propisima i koji se koristiti kao zamjena za klasične, papirne navigacione karte. ECDIS je sistem za automatsku poršku navigaciji, koji objedinjuje informacije sa primarnih navigacionih senzora u realnom vremenu. Time ovaj sistem omogućuje kontinuirano određivanje pozicije broda u odnosu na kopno, razne objekte na kopnu i na moru (vidljive na kartama), kao i dobijanje upozorenja od potencijalnih opasnosti. Na Slici 2.1 je dat prikaz displeja i tastature/track-ball-a *Martek Marine iECDIS*-a.

ECDIS uključuje elektronske navigacione karte (ENC-Electronic Navigational Charts, eng.), informacije o poziciji broda sa GPS-a (Global Positioning System, eng.) i sa drugih navigacionih uređaja, kao što su radar, eho sonder (mjerač dubine), anemometar (mjerač brzine vjetra), automatski identifikacioni sistem (AIS – Automatic Identification System, eng.), itd. ECDIS može da obezbijedi i dodatne navigacione informacije, kao što su pravci plovljenja (seiling directions/enroute, eng.). Pri tome, pravci plovljenja uključuju detaljne informacije o priobalnim područjima i prilazima lukama, tj. informacije o vremenskim uslovima, strujama, lednicima, raznim drugim potencijalnim opasnostima, svojstvima/opremljenosti luka i dr. Takođe, oni podržavaju najveće razmjere karata za određeno plovno područje, odnosno, geografsku regiju ili sektor.

ECDIS je definisan u *IMO ECDIS Performance Standards (Resolution A.817 (19))* na sljedeći način: *"ECDIS je informacioni sistem za podršku navigaciji, koji se uz odgovarajuća rezervna rješenja, može smatrati usklađenim sa savremenim zahtjevima koje moraju da ispunjavaju navigacione karte - V/19 i V/27, iz SOLAS (Safety of Life at Sea, eng.) Konvencije iz 1974. godine, u smislu da prikazuje informacije pohranjene u sistemskim elektronskim navigacionim kartama (SENC), uključujući informacije o poziciji broda i tako daje podršku nautičarima pri planiranju i praćenju rute, kao i dodatne navigacione informacije, ukoliko je to potrebno."* [11,12]

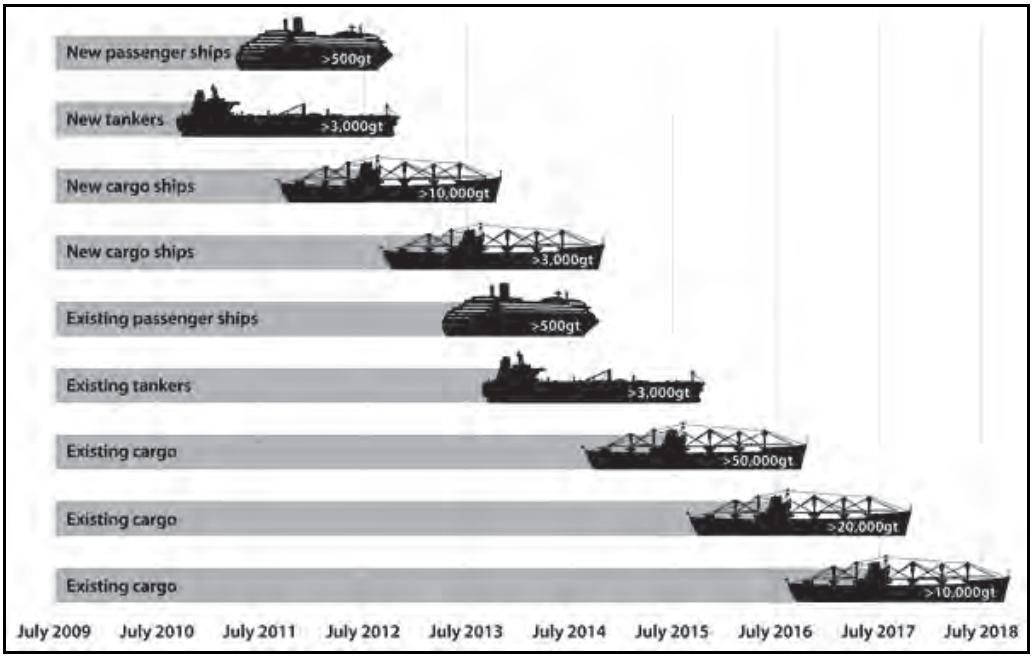
Slika 2.1. Martek Marine iECDIS displej (izvor: [13])

ECDIS kombinuje informacije iz različitih izvora na jedinstvenom displeju. Optimalan prikaz navigacione karte daje odličnu pozadinu za prikaz ključnih informacija. To mogu biti informacije o vremenu, on-line metama, zabranjenim/restriktivnim (tzv. „no go", eng.) zonama, npr., piratske ili MARPOL (International Convention for the Prevention of Pollution from Ships, eng.) zone, kao i drugi navigacioni podaci. Sa predefinisanim pozadinskim slikama, odnosno, lejerima, koji omogućuju jednostavan prelazak sa jednog na drugi ekran, danas ne postoji bolji alat od ECDIS-a za efikasno predstavljanje važnih navigacionih informacija, tako da je zahvaljujući ovom sistemu, navigacija danas postala relativno jednostavna i bezbjedna [14].

2.4. IMO zahtjevi

Na 86. sjednici IMO-vog komiteta za pomorsku bezbijednost, održanoj 2009. godine, usvojena su nova pravila po kojima je ECDIS obavezan na brodu [15]. U cilju ispunjavanja ovog IMO zahtjeva, kompanije će morati da uvedu ECDIS, atestiran od strane prepoznate organizacije ili pomorskog klasifikacionog drušva, u skladu sa propisima zemlje čiju zastavu brod vije i vremenskim rokovima prikazanim na Slici 2.2. Primarno sredstvo navigacije će biti ECDIS, ali će se takođe zahtijevati i rezervni sistem u slučaju otkaza. Rezervni sistem će biti drugi ECDIS (tzv. *dualni* ECDIS sistem) povezan sa posebnim izvorom napajanja i GPS-om, ili tradicionalne papirne karte.

Pošto proizvođači ECDIS opreme neće biti u prilici da odmah zadovolje sve zahtjeve za isporuku i implementaciju ovog sistema, kompanije bi trebalo na vrijeme da naruče ECDIS i da sprovedu blagovremeno odgovarajuću obuku posade [16].



Slika 2.2. Obaveza uvođenja ECDIS-a (izvor: [17])

Legenda: New passenger/tankers/cargo ships, eng. – Novi putnički/tankeri/teretni brodovi; Existing passenger/tankers/cargo ships, eng. – Postojeći putnički/tankeri/teretni brodovi

2.5. Razvojni put

Mogućnosti korišćenja elektronskih karata su postale realnost, tek kada su postignute odgovarajuće performanse računara u smislu memorisanja i procesuiranja podataka. Elektronske karte zahtijevaju veliki memorijski prostor, dok su *moćni* procesori neophodni za procesuiranje velikih količina podataka koje one sadrže. Sa poboljšanjem procesora i povećanjem kapaciteta memorije računara, 1990-tih godina, postalo je realno izvodljivo

zamjenjivanje papirnih karata - elektronskim. U početku su elektronske karte uglavnom bile rasterske, koje je najbolje opisati kao digitalizovane slike papirnih karata.

ECDIS je ustvari računar koji se koristi na brodu za pohranjivanje i procesuiranje digitalnih karata i drugih podataka relevantnih za bezbjednu navigaciju. U osnovi, ECDIS podrazumijeva:

- uskladištenje digitalizovanih/elektronskih karata;
- procesor, hard disk, poluprovodničku memoriju, optičke čitače i dr.;
- softver za rad sa elektronskim kartama;
- intuitivan korisnički interfejs, koji omogućuje korisniku da izvršava zadatke i dobija navigacione informacije;
- elektronske veze sa primarnim senzorima, koji obezbjeđu informacije o poziciji, brzini, kursu broda i dr.

Kako bi elektronska navigacija bila izvodljiva, neophodna je standardizacija elektronskih karata, pri čemu i ECDIS mora takođe da zadovoljava odgovarajuće zahtjeve u tom smislu. Standardizaciju elektronskih karata obezbjeđuju službe Međunarodne hidrografske organizacije (IHO – International Hydrographic Organization, eng.), dok je ECDIS standarde razvila Međunarodna pomorska organizacija (IMO – International Maritime Organization, eng.).

Danas je sa ECDIS-om, koji zadovoljava sve propisane standarde, navigacija bez papirnih karata, dakle, postala ne samo moguća, već relativno jednostavna i prije svega bezbjedna [3].

2.6. Regulativa

Pravni zahtjevi vezani za ECDIS su sadržani u V poglavlju SOLAS (Safety of Life at Sea, eng.) Konvencije. Određeni zahtjevi su definasani i od strane države čiju zastavu brod vije, kao i od strane države(a) u kojoj(ima) se nalazi(e) luka(e) pristajanja. Kako bi se obezbijedila potvrda da brodovi zaista zadovoljavaju propisane zahtjeve u pogledu ECDIS opreme, izdaju se odgovarajući sertifikati, putem regularnih kontrola, odnosno, inspekcijskih pregleda brodova.

ECDIS je instrument podrške navigaciji uz pomoć elektronskih navigacionih karata, akvizicije i prikazivanja navigacionih i drugih informacija. Ove informacije uključuju kurs, poziciju broda, brzinu, smjer i brzinu struja, vjetra i dr., u realnom vremenu. Kako bi ovo omogućio ECDIS mora da bude opremljen oficijelnim, ažurnim vektorskim elektronskim kartama i mora biti povezan sa brodskim žirokompasom, brzinomjerom, dubinomjerom, anemometrom i dr., kao i obavezno sa nekim od elektronskih sistema određivanja pozicije. Takođe, mora da ima odgovarajući administrativni, odnosno, pravni okvir koji obezbjeđuje država čiju zastavu brod vije [18].

> "*Zahvaljujući novim IMO pravilima, uvođenje dualnog ECDIS-a, bez korišćenja papirnih karata, kao rezervnog rješenja, donijeće znatne uštede. To je jednostavno zaključiti. Ne samo da su elektronske navigacione karte jeftinije od papirnih, nego za posjedovanje jednih i drugih treba gotovo dvostruko više sredstava. Sa implementacijom ECDIS-a na Nordic tankerima, takođe je smanjeno vrijeme koje je bilo potrebno*

za korekcije papirnih karata i planiranje rute, za nekih 5-10 časova na sedmičnom nivou." (Soren Anders, inspektor, SQE, Nordic Tankers Marine A/S, [18])

2.7. Standardi performansi

U cilju postizanja potpune funkcionalnosti, IMO je formulisala standarde performansi za ECDIS. Dakle, ECDIS treba da zadovoljava standarde propisane MSC (Maritime Safety Circular, eng.) 232(82) rezolucijom, usvojenom 05. maja 2006. godine [3]. Ovi standari se odnose na sljedeće:

- Funkcija ECDIS-a je prije svega - bezbjedna navigacija. U tom smislu, ovaj sistem treba da prikazuje sve neophodne informacije, koje treba da su verifikovane od strane državnih institucija, odnosno, ovlašćenih hidrografskih instituta. Ovo podrazumijeva da prikaz informacija mora da odgovara ECDIS standardima, kao i standardima IHO-a propisanim dokumentom S-57[2];
- ECDIS mora da omogućuje ažuriranje elektronskih karata na jednostavan i pouzdan način;
- Navigacione karte u ECDIS-u treba da su tako kreirane da smanje što je moguće više aktivnosti nautičara;
- ECDIS treba da obezbjeđuje istu pouzdanost i da ima isti (ili veći) kapacitet u smislu prikaza svih relevantnih navigacionih informacija kao i klasične papirne karte;
- ECDIS mora da alarmira eventualni nastanak kvara ili neadekvatno prikazivanje informacija;
- ECDIS treba da se razlikuje od elektronskih karata u smislu da ima kapacitet za davanje određenih *objašnjenja*;
- Korisnik ECDIS mora da bude osposobljen da odabere odgovarajući od tri moguća prikaza informacija na ECDIS displeju: osnovni, standardni i onaj koji sadrži dodatne informacije, itd.

Ono što obavezno mora biti dostupno posredstvom ECDIS-a, jeste sljedeće:

- Informacije o elektronskim navigacionim kartama, načinu njihovog obezbjeđivanja i ažuriranja;
- Podešavanje razmjera karte;
- Prikaz radarskih informacija *preklopljenih* preko osnovnog ECDIS prikaza;
- U *Transas* ECDIS-u, npr., iz "Configuration" menija moraju biti dostupna četiri različita prikaza ekrana: "daylight", eng. (pod dnevnom svjetlošću); "dusk", eng. (u sumraku); "night", eng. (noću); i "night inverted", eng. (prikaz noću invertovan);
- Korišćenje standardnih simbola i boja je decidno definisamo IHO preporukama S-52. Međutim, treba napomenuti da simboli na karti variraju u zavisnosti od razmjera;
- Mogućnosti (re)planiranja rute;
- Mogućnosti snimanja putovanja;
- Tačne kalkulacije, npr., azimuta i udaljenosti u odnosu na određene objekte;

[2] IMO-ov novi S-100 model hidrografskih podataka je povezan sa IHO S-101 specifikacijom proizvoda za vektorske navigacione karte i oba standarda bi trebalo da stupe na snagu krajem 2016. godine. (Izvor: 3i – Integrating Intelligent Information, ECDIS: Next generation. [Internet]. (preuzeto: 05.05.2016). URL: http://i3digital.e-navigation.com/ecdis-next-generation.html

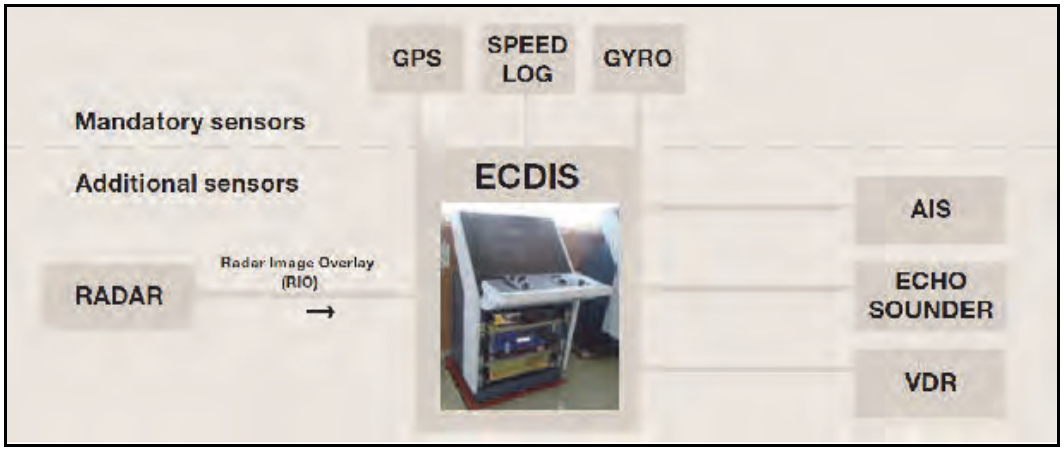
- Prikaz senzorskih inputa (npr., sa brzinomjera, sa sistema za elektronsko pozicioniranje i dr.) i alarmiranje (crveno svjetlo na displeju ili zvučni alarm) u slučaju da se desi kvar na nekom od senzora;
- Testiranje i alarmiranje u slučaju neke disfunkcije i sl.;
- Vršenje pozadinskih radnji;
- Glavno i rezervno napajanje uvijek moraju biti obezbijeđeni, pri čemu glavni ECDIS uređaj mora da bude spojen na glavno i rezervno napajanje, dok rezervni ECDIS mora da ima posebno napajanje i dr.

"*… Naš zaključak danas je, da je to bio dugačak put, ali vrijedan truda, pošto naši oficiri palube i ostala posada kažu da im ECDIS pruža osjećaj veće bezbjednosti, kao i da je samo upravljanje brodom postalo bezbjednije.*" (Tor-Arne Tonnesen, inspektor, Solvang, [18])

2.8. Veze sa drugim uređajima

Uređaji koji mogu biti integrisani sa ECDIS-om spadaju u dvije, da tako kažemo, nejasno podijeljene kategorije: počev od onih koje su od suštinske važnosti za funkcionisanje ECDIS-a, do onih koje su dopunski i neobavezni, ali mogu doprinijeti kreiranju dodatne vrijednosti prilikom korišćenja ECDIS-a. Proizvođači ECDIS opreme stalno traže načine kako da budu konkurentni, tako da dodaju nove funkcije osnovnim proizvodima i omogućuju dobavljačima, u određenoj mjeri, da uključe u svoju ponudu uređaje koji su kompatibilni sa ECDIS-om.

Neki od uređaja koji su obično povezani sa ECDIS-om su: GPS (za određivanje pozicije), žiro ili magnetni kompas (za određivanje kursa), brzinometar (za mjerenje brzine preko dna), eho sonder (za mjerenje dubine), anemometar (za mjerenje brzine i pravca vjetra) i dr. ECDIS takođe prima digitalne i video signale od radara i AIS-a (slika 2.3). ECDIS je povezan i sa uređajem za automatsko vođenje broda, tj. autopilotom.



Slika 2.3. Uređaji na brodu sa kojih ECDIS integriše podatke/informacije (izvor: [20])
Legenda: Mandatory/Additional sensors, eng. - obavezni/dopunski senzori; Speed log, eng. - brzinomjer; Echo sounder, eng. - dubinomjer, VDR (voyage data recorder, eng.) – uređaj koji snima podatke vezane za putovanje

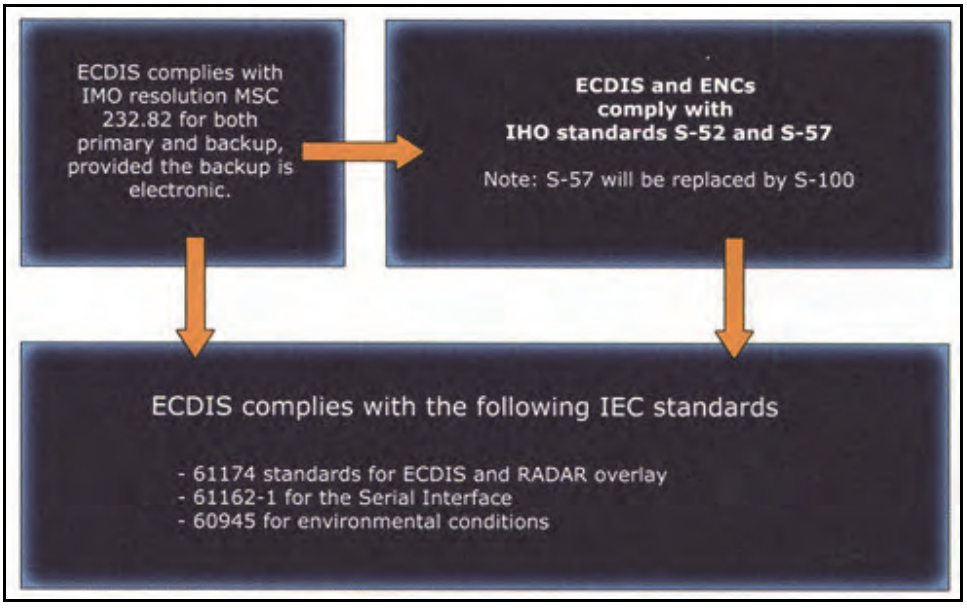
Integrisanje ECDIS-a i radara daje nautičarima bolji pregled situacije u okruženju. Posebne prednosti preklapanja ECDIS i radarske slike su: bolje izbjegavanje sudara i praćenje pozicije, bolje otkrivanje meta, smanjenje radarskih smetnji, višestruka provjera, smanjenje grešaka, smanjenje obima posla i dr. Integracija ECDIS-a i AIS-a ima sljedeće prednosti: moguće je otkriti, pratiti i upravljati kretanjem plovila, koje je izvan domašaja osmatrača ili izvan domašaja radara. Tako da se mjere izbjegavanja sudara na ovaj način mogu preduzeti i sa udaljene lokacije.

ECDIS je takođe obično integrisan sa navigacionim teleksom (NAVTEX-om) i potencijalno sa drugim elementima GMDSS-a (Global Maritime Distress and Safety System, eng.), kao i sa uređajem za snimanje podataka o putovanju (VDR – Voyage Data Recorder, eng.).

Uvođenje ECDIS-a na komercijalne brodove, postaje sinonim za integrisani navigacioni sistem (IBS - Integrated Bridge System, eng.) u kome je ECDIS u fokusu kada su u pitanju navigacija i prateće aktivnosti.

2.9. Atestiranje

ECDIS mora da ima potrebna odobrenja, kako bi bio instaliran na brod. U tom smislu, ECDIS oprema mora biti u skladu sa IEC (International Electrotechnical Commission, eng.) standardom 61174 [3]. Ovaj standard se odnosi na operativne i izvršne zahtjeve ECDIS-a, metode testiranja i odgovarajuće rezultate nakon testiranja. ECDIS će dobiti potrebna odobrenja, jedino pod uslovima da softver, procesor, monitor i konzola zadovoljavaju IMO i IEC zahtjeve. Potrebna odobrenja izdaje država čiju zastavu brod vije i klasifikaciona društva u ime države pod čijom zastavom brod plovi. Shematski prikaz standarda koje ECDIS treba da zadovolji, dat je na slici 2.4.



Slika 2.4. Shematski prizaz ECDIS standarda (izvor: [3, p.7])

2.10. Nautičke karte

Nautičke karte su karte posebne namjene, prilagođene pomorskoj navigaciji i prikazuju: dubine, prirodu dna, ispupčenja, konfiguraciju i obilježja obale, opasnosti i dr. [21]. Prema IMO zahtjevima, svi brodovi koji plove međunarodnim vodama, moraju imati nautičke karte. Ove karte mogu biti u analognoj (papirne) ili u digitalnoj formi (elektronske). Jedino karte izdate od strane vlada i zvaničnih hidrografskih instituta, mogu se smatrati oficijelnim kartama, koje ispunjavaju zahtjeve korišćenja u navigaciji. Svaki drugi vid karte (npr., privatne karte) nije dozvoljen kao navigaciono sredstvo prema SOLAS Konvenciji.

Postoje dvije vrste zvaničnih digitalizovanih karata: (i) rasterske navigacione karte (RNC - Raster Navigational Charts, eng.) i (ii) elektronske navigacione karte (ENC – Electronic Navigational Charts, eng.) koje su još poznate i kao vektorske karte [15].

Rasterske karte su samo skenirane, pasivne slike papirnih karata. Njih čine elementi slike koji se nazivaju pikseli. Piksel je tačka koja identifikuje boju. Svakom pikselu se može odrediti tačna pozicija u odnosu na latitudu i longitudu, što omogućuje da ove karte budu *preklopljene* i da na njima budu prikazana trenutna pozicija broda i druge informacije vezane za njeno određivanje. Ovo podrazumijeva istovremeno preklapanje digitalizovanih karata radarskim prikazom i prikazom AIS meta [3, 5-7].

Vektorske karte su aktivne u smislu da korisnik može da dobije određene informacije o pojedinim objektima i/ili područjima plovidbe, da postavi alarme za upozorenja u restriktivnim zonama, u cilju izbjegavanja nasukanja i sl. One sadrže opisna svojstva objekata, koja se prikazuju na karti u vidu duge liste podataka, povezane za određenu fiksnu koordinatu na karti, tzv. *datum*. *Datum* je nivo vode u odnosu na koji se mjere sve dubine prikazane na karti. Generalno posmatrano to je plimatski *datum*, postavljen u određenoj plimatskoj fazi. Objekti i njihova svojstva se prikazuju na zahtjev [3, 5-7].

Regularne elektronske karte moraju da zadovolje sljedeće uslove:

- moraju da budu u skladu sa IHO standardom S-57;
- moraju da budu izdate od strane ovlašćene državne institucije, odnosno, ovlašćene hidrografske organizacije/instituta;
- sadržaj elektronskih karata mora biti baziran na izvornim podacima, sadržanim u klasičnim, oficijelnim kartama nadležnih državnih/hidrografskih institucija;
- podaci na kartama moraju da budu kodirani i prikazani u skladu sa međunarodnim standardima;
- elektronske karte moraju da se oslanjaju na referentni svjetski geodetski sistem WGS 84;
- karte moraju regularno da se ažuriraju, na bazi službenih informacija, koje se distribuiraju u digitalnom formatu;
- elektronske karte moraju biti učitane u sertifikovane ECDIS uređaje, koji zadovoljavaju sve neophodne IMO i IEC standarde;
- prikaz podataka na elektronskim kartama mora da zadovoljava IHO S-52 standard i dr.

Primjera radi, prikaz ekrana *Transas*-ovog ECDIS-a, koji ilustruje da je trenutno u upotrebi oficijelna karta *au316137* tipa ENC, dat je na slici 2.5.

Slika 2.5. Oznaka i vrsta karte na *Transas*-ovom ECDIS displeju (izvor: [3, p.9])

Ilustracije radi, horizontalni *datum* karte, ili referentni geodetski sistem WGS 84, na *Transas*-ovom ECDIS displeju, prikazan je na slici 2.6.

Slika 2.6. Oznaka referentnog geodetskog sistema na *Transas*-ovom ECDIS displeju (izvor: [3, p.10])

2.10.1. Što je ENC?

ENC je akronim od engleskog naziva *Electronic Navigation Chart* i znači elektronska navigaciona karta. Radi se, ustvari, o kolekciji zvaničnih navigacionih karata koje koristi ECDIS. IMO je dala sljedeću definiciju ENC-a: *"ENC je baza podataka, standardizovana po sadržaju, strukturi i formatu, izdata u cilju korišćenja u ECDIS-u od strane vladinog autorizovanog hidrografskog insituta. ENC sadrže sve informacije neophodne za bezbjednu navigaciju, a mogu da sadrže i dodatne informacije u odnosu na one prisutne na papirnim kartama, ukoliko se procijeni da su one neophodne za bezbjednu navigaciju."* [15]

ENC podržavaju različite razmjere. U tabeli 2.1 je dat prikaz razmjera koje okvirno imaju ENC, zavisno od svrhe.

Tabela 2.1. Razmjeri koje podržavaju ENC (izvor: [12, p.35])

Svrha	Razmjer
Pregled situacije	< 1:1 499 999
Opšte potrebe	1:350 000 – 1:1 499 999
Obalno područje	1:90 000 – 1:1 349 999
Prilaz luci	1:22 000 – 1:89 999
Lučko područje	1:4 000 – 1:21 999
Vez	1:4 000

Svaka ENC ima *ime* koje se sastoji od osam simbola. Prva dva predstavljaju zemlju proizvođača (npr., FR-Francuska, GB-Velika Britanija, itd). Kompletna lista kodova proizvođača je data u okviru IHO standarda S-62. Treći simbol, broj od 1-6, vezan je za određeni vid navigacije. Preostalih pet simbola predstavlja jedinstvenu alfa-numeričku oznaku elektronske karte.

2.10.2. Što je SENC?

SENC je akronim od engleskog naziva *System Electronic Navigational Chart*, koji se može prevesti kao sistemska elektronska navigaciona karta. ECDIS konvertuje ENC podatke u sopstveni, interni SENC format u svrhu dobijanja optimalnog prikaza karte. SENC podaci mogu da variraju u zavisnosti od proizvođača. SENC omogućuje regularno ažuriranje elektronskih karata i daje mogućnost nautičarima da sami dodaju određene podatke. Dakle, radi se o bazi podataka dostupnoj ECDIS-u za kreiranje prikaza elektronskih karata i aktiviranje raznih navigacionih funkcija [15].

> "… *Sa implementacijom ECDIS-a na Tarntank Ship Management brodovima, tj. u uslovima kada je na našim brodovima napravljen prelazak sa papirnih karti i knjiga na SENC i ADP (Admirality Digital Products, eng.), možemo reći da su naši troškovi za nautičke karte i publikacije značajno smanjeni, kao i da je proces njihovog naručivanja postao daleko efikasniji.*" (Claes Moller, menadžer kompanije, Tarntank Ship Management AB, [22])

2.10.3. Što je RSDC?

RSDC je akronim od engleskog naziva *Raster Chart Display System*, što znači sistem za prikaz rasterske karte. Plovidba u RSDC modu je dozvoljena u slučaju da u određenom području nisu dostupne vektorske elektronske navigacione karte. Korišćenje RSDC moda u područjima za koje postoje vektorske karte, nije dozvoljeno. Ukoliko se za plovidbu koristi RSDC, onda su papirne karte primarne za navigaciju, a RSDC je samo pomoćno sredstvo [15].

2.10.4. Ažuriranje nautičkih karata

Ažuriranje nautičkih karata obavlja se na samom brodu i to putem DVD-a, e-maila, ili direktno on-line. Radi se o složenom procesu koji je uslovljen promjenama ruta brodova i ENC područja pokrivanja, stoga treba da postoji više načina putem kojih posada može obezbijediti ažurne karte [3,15]. Prije nego što se stave u upotrebu, elektronske karte treba da su licencirane, nabavljene od ovlašćenih distributera i učitane u ECDIS. Elektronske karte i njihovi apdejte izdaju nacionalne hidrografske organizacije/instituti.

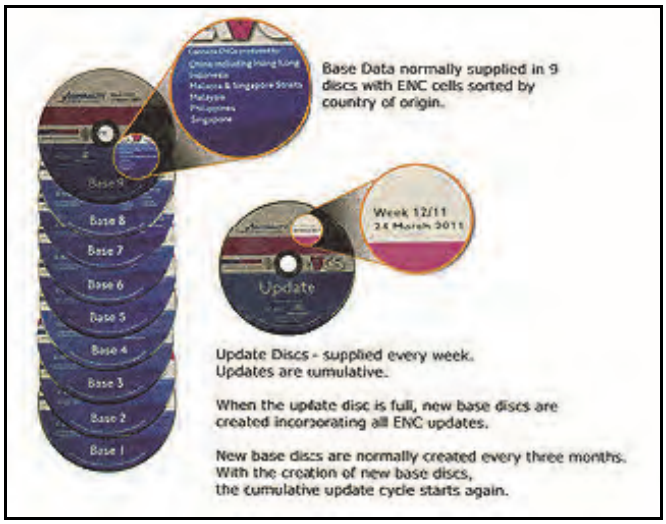
Brod normalno nabavlja elektronske karte od Regionalnog koordinacionog centra za elektronske navigacione karte (RENC – Regional Electronic Navigational Chart Coordinating Centre, eng.). Ovi centri obezbjeđuju globalni servis, kroz upoređivanje podataka koje objavljuju različiti hidrografski instituti, vrše njihovu kompilaciju i potom ih distribuiraju na tržište, pri čemu garantuju ispunjenost svih standarda kada su u pitanju njihov kvalitet i uniformnost. RENC distribuiraju svoje proizvode preko mreže pod-distributera, ili agenata, privatnih dobavljača, proizvođača ECDIS-a i dr.

Prije nego što se pojavi na tržištu, ENC se šifruje, prema IHO S-63 standardu. Razlozi za šifrovanje ENC su sljedeći:

- jednostavan mehanizam neophodan pri licenciranju i plaćanju;
- omogućavanje isporuke prema stvarnim potrebama, a ne u kompletu, kada to nije neophodno;
- obezbjeđivanje integriteta podataka;
- omogućavanje korišćenja i kada je u pitanju posebna ECDIS oprema, dakle, mogućnost prilagođavanja zahtjevima specifične grupe ECDIS uređaja;
- omogućavanje korisnicima da koriste *ključ* za dešifrovanje, tj. za prikazivanje ENC na displeju ECDIS uređaja i dr.

Podaci koje isporučuju distributeri, dijele se na bazične (ili osnovne) i apdejt ENC podatke [3]. Bazični podaci se regularno obezbjeđuju na devet diskova sa ENC ćelijama (zonama), sortiranim prema zemljama porijekla, svaka tri mjeseca i moraju se učitati u ECDIS prije ažuriranja tzv. apdejt diskova. Apdejt diskovi se distribuiraju svake sedmice i kumulativni su, što znači da aktuelni disk sadrži sve prethodne apdejte (slika 2.7).

Brod ili kompanija moraju da obezbijede regularan apdejt ENC ili RNC, putem potpisivanja sporazuma, ili nekog sličnog dokumenta, koji moraju da postoje na brodu pri inspekcijskom pregledu.



Slika 2.7. Princip ažuriranja ENC-a (izvor: [3, p.12])

Brod može da koristi oficijalne RNC u zonama gdje nisu dostupne ENC. Ove karte omogućuju bezbjednu navigaciju, pod uslovom da su verifikovane od strane države pod čijom zastavom brod plovi i da na brodu postoji njihov odgovarajući *backup* u vidu papirnih karti. Displej se u ovom slučaju naziva: sistem za prikaz rasterskih karti (Raster Chart Display System – RCDS, eng.). Ovdje treba napomenuti, da neke države ne odobravaju korišćenje ovog sistema. Treba napomenuti i to, da ukoliko brod nema ENC za svaku od oblasti u kojoj plovi, onda za oblasti (zone) za koje ih nema, mora da ima kompletan folio klasičnih papirnih navigacionih karti.

2.11. Zahtjevi za osposobljenošću posade

Nautičari, odnosno, oficiri palube (OOW – Officers On Watch, eng.) moraju da imaju sertifikate o završenoj ECDIS obuci u skladu sa IMO modelom kursa 1.27 (40 sati), kako bi bili zadovoljeni standardi kada je u pitanju sertifikovana obuka za držanje straže, u skladu sa preporukama STCW (Standards of Training, Certification and Watchkeeping for Seafarers, eng.) Konvencije [3,15].

U ovom modelu kursa su sadržane sve one oblasti u kojima korisnik ECDIS-a mora da demonstrira kompetencije, nakon završenog kursa, pri korišćenju ovog sofisticiranog sistema za podršku navigaciji. Prema najnovijim preporukama iz Manile (2010), od oficira palube se zahtijeva da prođu opštu i posebnu/specijalizovanu obuku za korišćenje ECDIS-a.

Odnosni IMO model kursa za ECDIS, sadrži sljedeća područja/oblasti obuke:

- pravne aspekte i zahtjeve;
- osnovne vrste elektronskih karata;
- ECDIS podatke;
- prikazivanje ECDIS podataka;
- senzore;
- osnovne navigacione funkcije i postavke;

- posebne funkcije za planiranje i nadgledanje rute;
- ažuriranje karata;
- prikaz i funkcije drugih navigacionih informacija;
- prikaz greški;
- status indikacija (pokazatelja), indikatore i alarme;
- dokumentaciju;
- nadzor integriteta;
- rezervni sistem;
- rizik od pretjeranog oslanjanja na ECDIS i dr.

Sve kompanije moraju da obezbijede da su korisnici ECDIS-a na brodovima prošli odgovarajuću obuku i pokazali na kraju kompetencije u operativnom korišćenju ECDIS-a za potrebe bezbjedne navigacije. Ovo je sastavni dio bezbjedonosne politike ISM (International Ship Management, eng.) koda [3,19].

> "… *Mi smo se veoma rano odlučili za prelazak na dualni ECDIS na našim tankerima. Naš glavi cilj je bio da povećamo bezbjednost navigacije, ali uz to i da smanjimo posao posade na korekcijama karata. Oba cilja su postignuta. ECDIS daje odličan pregled nautičarima, putem prikazivanja svih važnih navigacionih informacija na jednom ekranu.*" (Rolf Andersen, rukovodilac Nautičkog i IT sektora, Lauritzen Kosan A/S [23])

2.12. Značaj ECDIS-a

Uz pravilno instaliranje i korišćenje na brodu, u skladu sa standardizovanim preporukama, uključujući obučenu i motivisanu posadu, ECDIS je vid investicije sa velikim potencijalom za postizanje ušteda. Istovremeno se povećavaju efikasnost i bezbjednost.

Uštede sa najvećim potencijalom su u područjima navigacionih karata i nautičkih publikacija, potrošnje goriva, kao i vremena i rada utrošenog na korekciji karata, planiranju i praćenju rute i pripremi izvještaja.

U Det Norske Veritas (DNV) izvještaju: „Uticaj pokrivenosti ENC-a na smanjenje rizika kod ECDIS-a", iz 2007. godine, ocijenjeno je da je ECDIS efikasno rješenje za smanjenje rizika kod velikih putničkih brodova, kao i kod drugih vrsta brodova na međunarodnim trgovačkim rutama, sa značajnim potencijalom u smislu smanjenja gubitaka ljudskih života i učestanosti sudara i nasukanja. Prema DNV ocjenama, ECDIS predstavlja *neto ekonomsku korist sam po sebi* [24].

2.13. Korišćenje ECDIS-a u punom kapacitetu

Korišćenje ECDIS-a u punom kapacitetu, podrazumijeva sljedeće [12, p.81-2]:

- *Automatsku korekciju nautičkih karata*: ECDIS, dakle, omogućuje nautičarima da ažuriraju karte automatski. Posebne ECDIS funkcije omogućuju da se ovaj zadatak realizuje brzo i bez greške.
- *Kombinovanje navigacionih operacija*: Prije pojave ECDIS-a, nautičar je morao da konsultuje i kombinuje podatke/informacije iz više izvora, tako da se jedino *u glavi*

nautičara nalazila relativno kompletna slika saobraćajne situacije. ECDIS je dosta toga promijenio nabolje u pogledu vizualizacije.

- *Prikaz pozicije broda u realnom vremenu*: Automatski, kontinuiran prikaz pozicije broda, pramčanice, kursa i brzine - mogu se uključiti u ECDIS prikaz.
- *Centralno mjesto na komandnom mostu*: ECDIS spaja puno tehnologija i izvora informacija u jednu centralnu tačku, tako da oficiri palube ne moraju da izlaze na most i šetaju njime kako bi opazili ono što im treba u datom trenutku.
- *Prikaz prilagođen situaciji*: Informacioni filtri prikazuju upravo ono što je nautičarima potrebno u datom trenutku i pošteđuju ih tako od nepotrebnih detalja. Monitori i prikaz informacija su prilagođeni uslovima osvjetljenja, uslovima na moru i potrebama određene situacije.
- *Prikaz radarske slike*: Kombinovanjem elektronskih navigacionih karata i radarskog prikaza, ECDIS, ustvari, objedinjuje u jednom uređaju informacije relevantne za izbjegavanje sudara i nasukanja.
- *Automatsko praćenje broda duž rute*: Planirana ruta se zahvaljujući ECDIS funkcijama može automatski kontrolisati u smislu kontinuiranog praćenja u realnom vremenu: dubina, devijacije, prikaza objekata u okruženju i dr.
- *Automatska kontrola rute broda*: Brod može automatski da prati planiranu rutu, prateći promjene kursa i radijuse zakretanja, koje je unaprijed proračunao ECDIS.
- *Smanjenje ljudske greške*: Alarmi upozoravaju oficire palube, ukoliko je brod na putu da prekrši zadate parametre ili ako neki od senzora daju dvosmislene signale.
- *Pružanje pomoći pri manevru*: osoba u moru, sidrenje, vezivanje i druge operacije, takođe mogu biti podržane ECDIS-om, kada zapovjednik tako odluči.
- *Optimizacija rute*: ECDIS može automatski da generiše optimalnu vremensku (meteorološku) rutu, na bazi pouzdanih vremenskih prognoza, baziranih na analizi velikih količina meteoroloških podataka prikupljenih sa prethodnih putovanja.
- *Ušteda u potrošnji goriva*: ECDIS se može koristiti u kombinaciji sa sistemom za uštedu potrošnje goriva i tako projektovati rutu optimalne brzine i dr.

2.14. Od ECDIS-a ka e-Navigaciji

Pod e-Navigacijom se u opštem slučaju podrazumijeva prikupljanje, integrisanje i prikaz navigacionih informacija na brodu i na obali, u cilju podrške navigaciji "od veza do veza", uključujući pomoćne servise, bezbjedno i uz očuvanje pomorskog ekosistema [13].

Pojam e-Navigacije uključuje korišćenje satelitskih sistema za pozicioniranje, podržanih sistemima za pozicioniranje s kopna (Loran C), i/ili onima sa broda (računari za inercijalnu navigaciju), sa kojih su prikupljene informacije prikazane na intuitivan, razumljiv način u ECDIS formatu na samom brodu (slika 2.8), kao i na obali (u vidu replike), sa mogućnostima kontrole i intervenisanja s obale.

Slika 2.8. Komandni most sa ECDIS opremom nove generacije (izvor: [25])

Ključne strukturne komponente sistema e-Navigacije su:

- Tačne, pregledne i ažurirane elektronske navigacione karte (ENC) odgovarajućeg formata, koje pokrivaju čitavo geografsko područje u kome brod plovi;
- Tačni i pouzdani signali o poziciji broda, dobijeni od GPS-a, DGPS-a, Galileo, Loran C i/ili sistema inercijalne navigacije;
- Informacije o ruti broda, kursu, manevarskim parametrima i drugim podacima (hidrografskim, identifikacionim podacima broda, vrsti tereta, bezbjedonosnom statusu) u odgovarajućem elektronskom formatu;
- Prenos informacija o poziciji i navigacionih informacija na relacijama brod-obala, obala-brod i brod-brod;
- Jasan i integrisan prikaz prethodno navedenih informacija na brodu i na obali;
- Određivanje prioreta informacija uključujući mogućnosti alarmiranja u rizičnim situacijama (npr., sudar, nasukanje i dr.) na brodu i na obali [12, p.79].

"Sa razvojem e-Navigacije, postaje jasno da se investicije u ECDIS vraćaju kroz povećanje efikasnosti navigacije i uštede u potrošnji goriva. Međutim, skepticizam kada su u pitanju nove generacije ECDIS-a i ENC-a raste, a neki se plaše da će danas aktuelni hardver, softver i elektronske karte uskoro zastarjeti.

ECDIS nove gereracije će moći da integriše sve vrste karata i informacije sa druge navigacione opreme u realnom vremenu i da ih prikaže putem weba ili mobilnih aplikacija. Sa stanovišta tehnologije, bezbjedno će biti premošćen raskorak između različitih generacija odnosnih uređaja.

... IMO novi S-100 hidrografski model podataka, povezan sa IHO S-101 specifikacijom proizvoda za ENC, stupiće na snagu tokom predstojećih godina (postoje indicije - krajem 2016. godine). Još prošle godine, Jeppesen je trebalo da podrži razvoj novih ECDIS uređaja, sa više-platformskim kernelom, koji bi bili u skladu sa novim standardima i obezbjeđivali napredne funkcije, potrebne nekim korisnicima.

... Veći kapacitet podataka je glavna prednost ovih novih standarda, što će omogućiti uvođenje dodatnih svojstava koja ne postoje u sadašnjim formatima podataka. IHO intenzivno radi na batimetriji visoke rezolucije i novim nautičkim publikacijama. Takođe, S-100 uključuje plimatske informacije i informacije o lučkim operacijama u realnom vremenu."(Kevin Reeder, Patrick Oechlin, [25])

"*Veće količine podataka, informacije u relnom vremenu o plimi, lučkim operacijama, eliminisanje raznih poremećaja i dr., su samo početak u evoluciji ECDIS-a. Nova generacija ECDIS-a će biti dio koncepta e-Navigacije, koja će omogućiti digitalnu integraciju na nivou industrija.*

Prvenstveno, ECDIS će postati kompatibilan sa više uređaja, prije nego što postane dio integrisanih navigacionih sistema (INS-Integrated Navigation Systems, eng.), u kojima će svi uređaji na brodu biti umreženi, pri čemu će različite platforme komunicirati na zajedničkom „jeziku". Ovo će biti praćeno potpunijom implementacijom e-Navigacije uključujući razmjenu podataka na industrijskom nivou i između ključnih stejkholdera u pomorstvu.

Koncept e-Navigacije koja će, dakle, omogućiti integraciju na nivou industrija, podržan je S-100 standardom, koji je u potpunosti usaglašen sa međunarodnim geoprostornim standardima, prvenstveno sa ISO 19000. Proizvođači opreme će koristi zajedničke protokole, čime će se pojednostaviti povezivost ECDIS sistema sa drugom opremom, npr., sa pogonskim strojem, mjeračima protoka goriva, uređajima za manevrisanje i dr.

... Industrije, kao što su komercijalna avijacija i energetika, prešle su na korišćenje otvorenih standarda obrade i prenosa podataka. Uz razvoj standarda, e-Navigaciji je potrebna infrastruktura koja će omogućiti nesmetan, autorizovan transfer informacija na samom brodu, između brodova, između broda i obale, kao i autorizovanih službi na obali i drugih učesnika u razmjeni informacija. Ovo će omogućiti nautičarima da proslijede informacije o brodu i putovanju lučkim vlastima, jednostavnim pritiskom na dugme, što će umnogome pojednostaviti postupak slanja izvještaja sa broda.

... Omogućavanje Interneta stvari na moru za potrebe pomorskih operacija će zahtijevati unificiran pristup arhitekturi softverskih sistema. Dodatno, „pametni" senzori se moraju umrežiti kako bi formirali interoperabilni pomorski ekosistem.

... Danska pomorska uprava podržava concept e-Navigacije i zagovara pomorski klaud (Maritime Cloud, eng.). Klaud servis bi obezbijedio pristup informacijama na serverima širom svijeta. Ovakva rješenja bazirana na otvorenoj IT arhitekturi, povećala bi inovativnost i kompetitivnost, omogućila višestruko korišćenje komponenti, brzo uvođenje nove tehnologije i smanjila potrebe za održavanjem. IMO radi na politici implementacije pomorskog klauda, kao vida postepene tranzicije i zamjene postojeće infrastructure, sistema i procedura.

Ključni korak ka „pametnim" brodovima i povezanim industrijama, tj. razvoj i implementacija S-100 standarda, će biti lakmus test za pomorsku industriju u pravcu intenziviranja i inoviranja kolaboracije sa stejkholderima.

- Dobrodošli u konektovanu budućnost!" (Kevin Reeder, Patrick Oechlin, [26])

U poglavlju koje slijedi, dato je više informacija o samom konceptu e-Navigacije, njenim ciljevima, prednostima, potrebama korisnika, daljem razvoju i implemantaciji, kao i o nekim barijerama na tom putu.

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3. Koncept e-Navigacije

e-Navigacija je IMO koncept baziran na harmonizaciji pomorskih navigacionih sistema i pomoćnih obalnih servisa orjentisanih prema potrebama korisnika. Najopštije se može odrediti kao:

(i) "e-Navigacija je harmonizovano prikupljanje, povezivanje, razmjena, prikazivanje i analiza informacija u pomorstvu, na brodu i na obali, uz pomoć elektronskih uređaja u cilju podržavanja navigacije po principu "od veza do veza" i podržavajućih servisa, za bezbjednu navigaciju i zaštitu pomorskog ekosistema." [1]

(ii) "e-Navigacija je strategija koju je razvila IMO, u cilju povećanja sigurnosti plovidbe u komercijalnom brodarsvu, putem bolje organizacije podataka na brodovima i na kopnu, kao i putem bolje razmjene podataka i komunikacija između brodova i broda i obale. Plan sprovođenja strategije za e-Navigaciju, usvojen je od strane IMO-a, novembra 2014. godine." [2]

Pojam e-Navigacija, često koriste proizvođači opreme i oni koji pružaju servis, ali više kao *težnju*, nego kao pokazatelj postojeće usklađenosti.

Razvojem koncepta e-Navigacije:

- biće razvijeni navigacioni sistemi na brodu za povezivanje brodskih senzora, pomoćnih uređaja, standarnih korisničkih interfejsa i sveobuhvatnih sistema za nadzor i davanje upozorenja. Suštinski elementi ovog sistema će biti: visoko integrisano elektronsko pozicioniranje, elektronske navigacine karte (ENC) i analitičke mogućnosti za smanjenje ljudske greške i što aktivnije uključivanje nautičara u proces navigacije, uz smanjenje radnog opterećenja;
- biće poboljšano upravljanje pomorskim saobraćajem s kopna, posredstvom boljeg obezbjeđivanja, koordiniranja i razmjene sveobuhvatnih i blagovremenih podataka, u formatu koji će biti razumljiviji za operatere na kopnu, u cilju pružanja podrške brodovima, prvenstveno u smislu obezbjeđivanja veće bezbjednosti plovidbe;
- infrastruktura će biti dizajnirana tako da omogući autorizovan i nesmetan prenos informacija na samom brodu, između brodova, na relacijama brod-obala/obala-brod i između obalnih službi i učesnika, sa brojnim pratećim prednostima.

"E" u sintagmi e-Navigacija, može da znači "enhanced", eng. (podržana) ili "electronic", eng. (elektronska), ali ne mora da bude ograničeno na ova dva značenja. U suštini, neki vidovi pomorske elektronske navigacije već odavno postoje, tako da treba istaći da se radi o novom, širem konceptu, prvi put uvedenom od strane IMO-a 2006. godine, kao posebna inicijativa.

Postoji jasna i neophodna potreba da zapovjednik broda i odgovorni na kopnu budu opremljeni savremenim, ispitanim uređajima za bezbjednu navigaciju i komunikaciju, na pouzdaniji i intuitivniji način, uz smanjenje potencijalnih grešaka. Međutim, ukoliko se savremeni tehnološki trendovi nastave bez odgovarajuće koordinacije, postoji opasnost da će dalji razvoj pomorskih navigacionih sistema biti otežan usljed nedostatka odgovarajućih standarda, nekompatibilnosti opreme na brodovima, kao i da će se nepotrebno povećati složenost postojećih problema.

3.1. Ciljevi

Prema IMO-u, osnovni ciljevi e-Navigacije su sljedeći [1]:

- Omogućavanje bezbjedne navigacije brodima, uzimajući u obzir hidrografske, meteorološke i druge navigacione informacije, kao i potencijalne rizike;
- Omogućavanje nadzora saobraćaja brodova i njihovog vođenja s kopna, gdje je to moguće;
- Omogućavanje komunikacija, uključujući razmjenu podataka, između brodova, na relacijama brod-obala i obala-brod, kao i između obale i drugih korisnika;
- Obezbjeđivanje uslova za poboljšanje efikasnosti transporta i logistike;
- Podržavanje efikasnih operacija u kriznim situacijama i u akcijama traganja i spasavanja;
- Obezbijeđivanje odgovarajućeg nivoa tačnosti, integriteta i kontinuiteta u radu sistema koji su ključni za bezbjednost;
- Objedinjavanje i prikazivanje relevantnih informacija na brodu i na obali putem intuitivnog interfejsa, koji će maksimizirati bezbjednost, odnosno, minimizarati rizik od unošenja pometnje i pogrešnog razumijevanja informacija;
- Objedinjavanje i prikazivanje informacija na način da se smanji preopterećenje ljudi na brodu i na obali, uz njihovo istovremeno motivisanje da aktivno učestvuju u procesu donošenja navigacionih odluka;
- Uključivanje obuke i familijarizacija ljudi sa novom opremom, još tokom procesa njene implementacije;
- Obezbjeđivanje globalnog pokrivanja, konzistentnih standarda, kompatibilnosti i interoperatibilnosti opreme, sistema, simbologije i operativnih procedura, u cilju izbjegavanja potencijalnih konflikata;
- Obezbjeđivanje fleksibilnosti i skalabilnost, kako bi se omogućilo korišćenje e-Navigacije svim potencijalnim korisnicima, itd.

3.2. Prednosti

U skladu sa IMO strategijom, od e-Navigacije se očekuje [1]:

(i) **povećanje bezbjednosti**, kroz unapređenje standarda bezbjedne navigacije, putem:

- poboljšanja procesa donošenja odluka, omogućavanjem nautičarima i kompetentnim tijelima/osobama na kopnu, pristup relevantnim, nedvosmislenim informacijama, neophodnim u datim okolnostima;
- smanjenja ljudske greške zahvaljujući automatskim pokazivačima, upozorenjima i posebnim bezbjednim modovima rada;
- proširenja područja pokrivanja obezbjeđivanjem postojanog kvaliteta elektronskih navigacionih karata (ENC);
- uvođenja standardizovane opreme sa opcijom standardnog moda (S-Mode, eng.), ali bez ograničavanja proizvođača da uvodi nova rješenja;
- povećanja otpornosti navigacionih sistema, putem povećanja njihove pouzdanosti i integriteta;

– boljeg povezivanja brodskih i obalnih sistema, što će rezultirati efikasnijim korišćenjem ljudskih potencijala i dr.;

(ii) **bolja zaštita životne sredine**, posredstvom:

– povećanja navigacione bezbjednosti, tj. smanjenja rizika od sudara i nasukanja, kao i od posljedičnih neželjenih izlivanja i zagađenja;
– smanjenja emisije štetnih gasova, optimizacijom rute i brzine broda;
– povećanja sposobnosti i kapaciteta za upravljanje rizičnim situacijama vezanim za uklanjanje naftnih mrlja i dr.

(iii) **obezbjeđivanje "tihog"/"nečujnog"** (silence, eng.) **načina rada** stejkholdera na obali u domenu nadzora i praćenja;

(iv) **povećanje efikasnosti i smanjenje troškova**, putem:

– uvođenja globalnih standarda za atestiranje opreme;
– standardizovanih i automatizovanih procedura slanja izvještaja, u cilju izbjegavanja preopterećenja nautičara administrativnim poslovima;
– povećanja efikasnosti na komandnom mostu, uz maksimalno povećanje mjera opreza, npr., korišćenjem više metoda paralelno za određivanje pozicije broda;
– efikasnog povezivanja sistema koji su već u upotrebi sa novom opremom, koja će u najvećoj mogućoj mjeri odgovarati potrebama korisnika;
– poboljšanja upravljanja ljudskim resursima, povećanjem obima znanja i profesionalnog statusa članova posade na mostu i dr.

3.3. Potrebe korisnika

Inicijativa za e-Navigacijom je potekla od potreba korisnika, tj. nautičara na brodovima svih vrsta i gabarita, kao i od velikog broja korisnika na kopnu.

e-Navigacija je na strani broda, potrebna zbog [1]:

– poboljšanja uslova rada posade;
– veće standardizacije interfejsa;
– bolje familijarizacije s novom opremom;
– efektivnijeg displeja sa NAVTEX porukama i drugim pomorskim bezbjedonosnim informacijama (MSI - Maritime Safety Information, eng.);
– efikasnijeg upravljanja upozorenjima/alarmima;
– poboljšanja pouzdanosti;
– veće standardizacije i automatizacije prilikom pripreme izvještaja;
– boljeg (preciznijeg) otkrivanja (lociranja) ciljeva/meta;
– obezbjeđivanja efektivnijih zona pod nadzorom;
– smanjenja administartivnih zahtjeva;
– veće automatizacije u ažuriranju ključnih informacija i dr.

Potrebe na straini obale su definisane uz pomoć IALA-e (IALA - International Association of Marine Aids to Navigation and Lighthouse Authorities, eng.) i uključuju sljedeće:

– efikasnije prikupljanje podataka i bolji uvid u saobraćajnu situaciju;
– efikasnije upravljanje informacijama;

- efikasnije pružanje informacija brodovima;
- efikasnije dijeljenje informacija među autorizovanim institucijama na kopnu i smanjenje opterećena pomoraca poboljšanjem logistike;
- poboljšanje pristupa relevantnim informacijama kod akcija traganja i spasavanja na moru;
- poboljšanje komunikacija i dr.

Sva ova poboljšanja ne može donijeti samo unapređenje tehnologije, već je potrebno staviti akcenat i na adekvatnu obuku, kao i na radne procedure.

U ovom kontekstu, logično se postavlja pitanje: Koje su to postojeće potrebe, odnosno, trendovi u pomorstvu uslovili razvoj koncepta e-Navigacije? – U nastavku su taksativno navedeni samo neki od njih [1]:

- obalne države zahtijevaju sve više informacija od brodova koji plove vodama pod njihovom jurizdikcijom, kako bi upravljale potencijalnim rizicima i ostvarile bolju komunikaciju sa tim brodovima;
- prisutna je rastuća tendencija luka i obalnih država da primjenjuju sve više pravila za brodove koji dolaze i/ili su u tranzitu u vodama pod njihovim nadzorom;
- postoji rastuća tendencija između obalnih država za regionalnom kooperacijom;
- obim informacija koje se razmjenjuju između brodova i obalnih službi je u stalnom porastu;
- potreba za zaštitom životne sredine i buduća regulativa u tom domenu imaju takođe rastuću tendenciju;
- bezbijedonosni faktori igraju veoma značajnu ulogu u pomorskom, kao uostalom i u svim drugim vidovima transporta;
- povećava se broj usluga koje luke nude (pilotaža, vez i privez, arbitraža i dr.), tako da će se javiti potreba za povećanom koordinacijom između ovih servisa, tj. službi koje ih pružaju;
- kompetencije pomorske posade će varirati i dalje, tako da se to mora na neki način ublažiti;
- korišćenje novih tehnologija može usloviti promjene u zahtjevima za obučenošću posade/zaposlenih u obalnim službama, kao i promjene u operativnim procedurama;
- korišćenje standardizovanih i veoma preciznih sistema za upravljanje pomorskim saobraćajem na otvorenom moru i u lukama će biti u porastu;
- iako će dodatni globalni satelitski navigacioni sistem (GNSS - Global Navigational Satellite System, eng.) - Galileo biti dostupan i njegova operativna efikasnost će se razvijati, ovakav svemirski baziran sistem pozicioniranja, ipak, nije neosjetljiv na smetnje i zahtijeva adekvatnu podršku;
- konstrukciona svojstva brodova i nove tehnologije će biti u usponu;
- rasti će potražnja za brzim i prediktabilnim transportom i rukovanjem teretom;
- *privlačnost* unutrašnjih plovnih puteva, kao vida transporta će najvjerovatnije rasti;
- gustina saobraćaja na svim plovnim putevima (otvorenom moru, obalnim vodama i unutrašnjim plovnim putevima) će rasti, bilo da se radi o plovilima velike brzine, sve većim i bržim komercijalnim brodovima, plovilima za rekreaciju i razonodu, *off-shore* platformama i/ili obnovljivim izvorima energije, itd.

Zbog svega predhodno navedenog, nameće se realna potreba za daljim razvojem i pripremom za implementaciju koncepta e-Navigacije.

e-Navigacija je sveobuhvatan i dugoročan koncept, koji uključuje brojne stejkholdere i ima potencijal da izvrši uticaj na čitavu pomorsku zajednicu. Među onima na koje će e-Navigacija izvršiti uticaj su: pomorci, piloti, proizvođači navigacione opreme, službe za kontrolu saobraćaja na moru (VTS - Vessel Traffic Services, eng.), centri za koordinaciju spasavanja na kopnu (RCC - Rescue Coordination Centers, eng.), obalne države, luke, države čije zastave brodovi viju, hidrografske službe, brodovlasnici, operateri, čarter službe i dr. Razvoj e-Navigacije će takođe izvršiti uticaj na sve vidove obrazovanja u pomorstvu i uslovićе modifikacije operativnih procedura.

3.4. Dalji razvoj i implementacija

e-Navigacija je evolutivan i dinamičan koncept koji će nastaviti da se razvija uporedo sa novim potrebama korisnika i novim tehnološkim rješenjima. Decembra 2008. godine, IMO komitet za bezbjednost je usvojio dokument „Strategija e-Navigacije“. Ova strategija je dalje razvijena u „Plan za implementaciju strategije“ (2014. godine), uzimajući u obzir korisničke potrebe, arhitekturu, razne kost-benefit analize, analize rizika i otkaza, itd. Ovaj implementacioni plan sadrži smjernice i okvirne rokove za inicijalnu implementaciju e-Navigacije. Očekuje se da će ova strategija i plan njene realizacije poslužiti kao osnova za što bolje zadovoljenje potreba korisnika, u skladu sa sve intenzivnijim razvojem tehnologija i pokazateljima dobijenim raznim studijama.

Intervju sa Svein D. Medhaug-om, savjetnikom *Norwegian Maritime Authority*, nakon IMO-ve MSC95 sjednice, [3]:

“- Da li smatrate da IMO poklanja e-Navigaciji dovoljno pažnje i što mislite kakav će to imati ishod?

- To pitanje je prilično kompleksno. Kao što znate, IMO je organizacija UN-a, čine je države članice, nevladine organizacije, kao i jedno posebno administrativno tijelo. IMO pokušava da postigne najbolje moguće rezultate uz ograničenja sa kojima se susreće i sa raspoloživim budžetom. Jedan od ključnih izazova sa kojima se IMO suočava je pronalaženje balansa između rokova i prioriteta. E-navigacija je već neko vrijeme na agendi, jer su predstavnici vlada i industrije uočili njenu potrebu, kao i potencijale. Strategija e-Navigacije je davno postavljenja, ali je za donošenje plana za njenu implementaciju trebalo prilično vremena. Međutim, ovaj nedostatak je uticao na definisanje novih tačaka u akcionom planu, koje su usvojene na MSC95. Pet od šest predloženih tačaka akcionog plana je ušlo u IMO Akcioni plan visokog prioriteta[3].

[3] Predložene tačke za izmjenu/dopunu Akcionog plana vezanog za razvoj i implemantaciju e-Navigacije:
1. Smjernice za *Standardizovane modove operacija* (tzv. S-modovi);
2. Amandmani na *Revidirane standarde performansi za integisani navigacioni sistem*, u cilju harmonizacije dizajna komandnog mosta i prikaza informacija;
3. Revizija *Smjernica i kriterijuma za sistem izvještavanja sa broda*;
4. Revizija *Opštih zahtjeva za radio opremu na brodu*, koja je dio GMDSS-a, kao i za elektronske navigacione uređaje koji se odnose na „ugrađeno testiranje integriteta“ (BIIT – Built-in Integrity Testing, eng.) navigacione opreme i
5. *Smjernice za harmonizovani prikaz navigacionih informacija dobijenih od strane telekomunikacionih uređaja*.

- Kako će ovo uticati na industriju, a kako na istraživanje i razvoj e-Navigacije u predstojećem periodu?

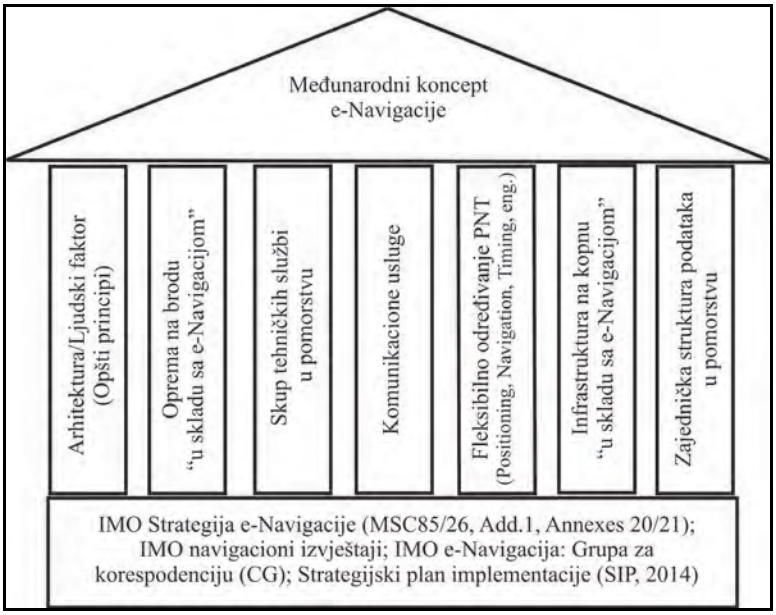
- U dužem vremenskom periodu, treba očekivati da će e-Navigacija biti široko zastupljena u praksi. U kraćem periodu, smatram da će industrija prihvatiti ovaj koncept, u najvećoj mogućoj mjeri. Mišljenja sam da e-Navigacija može da donese prednosti državama i industriji. U praksi, industrija dobija prostor za inovacije, dok vlade koordinišu proces i ispituju koje su ideje tipa: „to je poželjno", a koje tipa: „to je neophodno". Teško je odrediti preciznije uticaj koji će izvršiti ove planirane mjere, ali svakako one obećavaju nove mogućnosti brojnim stejkholderima."

Zadatak e-Navigacije je da poboljša tradicionalnu navigaciju, putem poboljšanja komunikacije na relaciji ljudi-mašine, u cilju efikasnijeg korišćenja jedinstvenih sposobnosti, odnosno, svojstava koje oni imaju. Elektronski uređaji su (potvrđeno) odlični za kontinuirano nadgledanje i provjeru svakodnevnih rutinskih operacija, kao što je provjeravanje nautičkih informacija dobijenih iz različitih izvora, npr. Ovaj isti zadatak, nautičari ne mogu da obave tako brzo i smatraju ga zamornim. Ljudi su, s druge strane, odlični kada su u pitanju intuitivne vještine, povezane, npr., sa apstraktim izazovima upravljanja brodom i resursima na njemu. Značaj e-Navigacije je upravo u optimizaciji podrške koju tehnički sistemi pružaju ljudima u procesu donošenja odluka i bezbjednog upravljanja brodom. Sa napretkom elektronske navigacije (koju ne treba miješati sa konceptom e-Navigacije), tj. elektronskih karata i sistema za određivanje pozicije, uloga pomoraca se znatno promijenila, ali ipak nije došlo do cjelovitih promjena u čitavoj pomorskoj zajednici. Ovo je slučaj i na obalnoj strani. e-Navigacija je proces koji nastoji da preispita uloge nautičara i operatera na kopnu, u smislu da oni (p)ostanu aktivni učesnici u procesu navigacije, a ne samo oni koji vrše njeno praćenje. Ovo bi trebalo da im omogući bolje donošenje odluka, uz pomoć robustnih, moćnih elektronskih tehnologija i upravljačkih informacionih sistema.

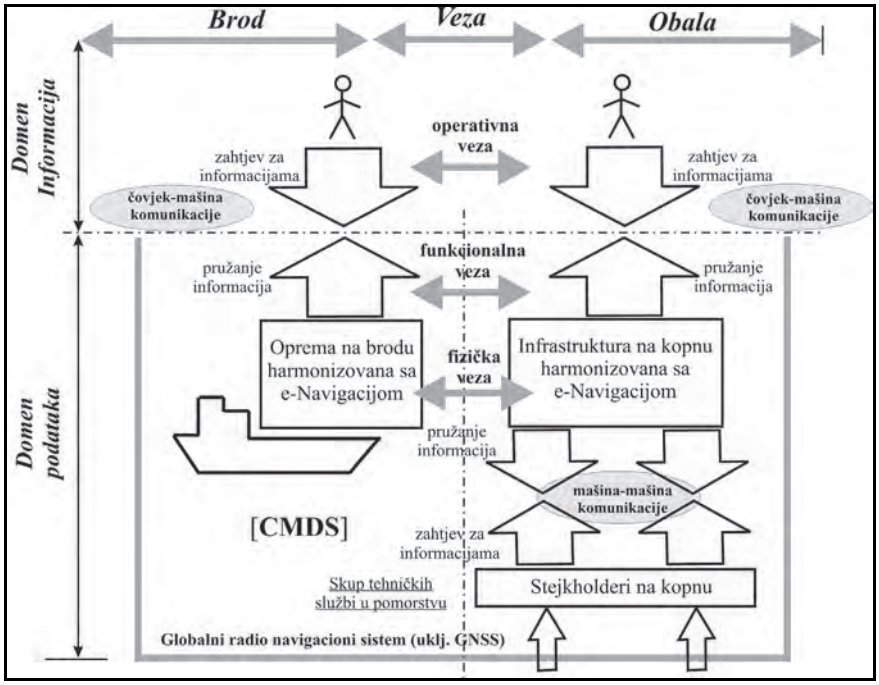
3.5. Arhitektura sistema

e-Navigacija je harmonizovani koncept, koji uzima u obzir tradicionalna i savremena sredstva za navigaciju, s ciljem poboljšanja bezbjednosti. Bitno je istaći da e-Navigacija neće promijeniti uloge i odgovornosti članova posade [1]. U cilju njenog boljeg razumijevanja, na Slici 3.1 je dat pojednostavljen prikaz arhitekture koncepta e-Navigacije, koja počiva na sedam *stubova*:

1 – Arhitektura/Ljudski faktor (Opšti principi);
2 – Oprema na brodu „u skladu sa e-Navigacijom";
3 – Skup tehničkih službi u pomorstvu;
4 – Komunikacione usluge;
5 – Fleksibilno određivanje pozicije i vremena u navigaciji (PNT - Positioning, Navigation, Timing, eng.);
6 – Infrastruktura na kopnu „u skladu sa e-Navigacijom";
7 – Zajednička struktura podataka u pomorstvu (CMDS – Common Maritime Data Structure, eng.).



Slika 3.1. Osnovna arhitektura koncepta e-Navigacije (izvor: [1], adaptirano)



Slika 3.2. Informacioni tokovi u okviru koncepta e-Navigacije
(izvori: [1,4,5], adaptirano)

Nešto složenija arhitektura koncepta e-Navigacije, data je na Slici 3.2. Na ovoj slici je prikazana razmjena podataka između broda i obale, kao i na relaciji obala - stejkholderi

na kopnu. Uključena je takođe i komunikacija sa skupom, tj. portfoliom tehničkih službi u pomorstvu. Veze su simbolički predstavljene na nivou fizičke, funkcionalne i operativne. Predstavljeni su i smjerovi postavljana zahtjeva/upita, kao i dobijanja povratnih informacija. Jasno je da navigaciona i komunikaciona oprema na brodu, kao i na obali, moraju biti harmonizovane sa standardnim postavkama e-Navigacije. Prisutni su čovjek-mašina i mašina-mašina interfejsi, pri čemu se kao osnova za razmjenu podataka koristi CMDS (Common Maritime Data Structure, eng.), tj. zajednička struktura (format) podataka koji se razmjenjuju u pomorstvu. Svi učesnici u razmjeni navigacionih i pratećih podataka/informacija su umreženi putem globalnog telekomunikacionog sistema i koriste se globalnim sistemom pozicioniranja, uključujući GNSS (Global Navigation Satellite System, eng.).

3.6. Barijere u implementaciji

Primjena e-Navigacije podrazumijeva prilagođavanje postojećih navigacionih i komunikacionih sistema ovom novom konceptu. Kako je korišćenje ECDIS-a postalo obavezno za većinu brodova, i ne samo obavezno, već je ECDIS postao na nekim brodovima primarni navigacioni sistem, nesumnjivo se radi o sistemu koji će biti centar podrške odlučivanju u kontekstu e-Navigacije. Međutim, postoje određene barijere u implementaciji i korišćenju ECDIS-a, što opet utiče na usporavanje procesa daljeg razvoja i intenzivnije primjene e-Navigacije u praksi.

U nastavku su ukratko opisani samo neki od ovih problema [6,7]:

(a) Veliki broj brodova koji plove na međunarodnim linijama još uvijek nemaju ECDIS, iako bi prema SOLAS rezoluciji V/19.2, do kraja 2018. godine, trebalo da bude završen proces implemantacije. Operativni teretni brodovi <10 000 [gt] i operativni tankeri <3 000 [gt], kao i putnički brodovi <500 [gt], ne potpadaju pod V/19.2 obavezu posjedovanja i korišćenja ECDIS-a. Ovo će imati negativne implikacije na e-Navigaciju, odnosno, na upravljanje smanjenjem rizika u pomorstvu. Radi se o problemu koji neće biti lako ispraviti na nivou regulative, budući da je ovdje riječ o dosta *osjetljivom* pitanju.

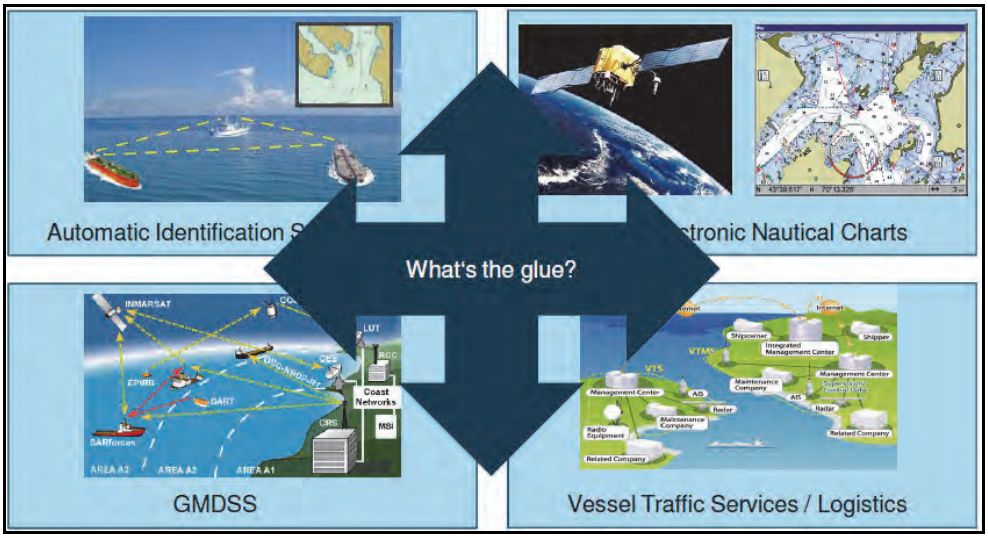
(b) Postoji prilično neizbalansiran nivo obučenosti nautičara na međunarodnom nivou. Kvalitetnija obuka, uključujući i familijarizaciju sa korišćenjem računara, takođe je jedan od preduslova za efikasniji razvoj e-Navigacije.

(c) Oprema na brodu i na kopnu bi trebalo da bude *human-centric* (eng.), tj. da potrebe korisnika stavlja u prvi plan i da omogućuje promjene podešavanja u skladu sa preferencijama korisnika. Tu su, međutim, još uvijek jasno uočljivi brojni nedostaci [7, p.34].

(d) Diskutabilan je standarni mod ECDIS-a (S-Mode, eng.), u smislu da nije jednostavno odrediti minimalne funcionalne zahtjeve, posebno ako se ima u vidu potreba za *human-centric* dizajnom savremenih navigacionih sistema. Takođe, s aspekta bezbjednosti, nije poželjno da se nautičari naviknu na krajnje pojednostavljen prikaz navigacionih informacija. Stoga bi planiranju i razvoju standardnog moda, trebalo pristupiti s posebnom pažnjom.

(e) ENC ne obezbjeđuju 100% pokrivenost i aktuelni standard S-57 ne podržava razmjenu i prikaz svih relevantnih informacija u pomorstvu, s toga se intenzivno radi na univerzalnom S-100 modelu hidrografskih podataka, koji će omogućavati ne samo ko-

rišćenje karata, već i prikaz morskog dna, batimetriju visoke rezolucije, 3D podatke, dinamički ECDIS, on-line apdejt i dr.
(f) Odgovarajuća komunikaciona infrastruktura na relaciji obala-brod, treba takođe da bude obezbijeđena.
(g) Rad na razvoju Interneta stvari na moru (Maritime Internet of Things, eng.) i pomorskog klauda (Maritime Cloud, eng.) treba intenzivirati (slika 3.3) [8,9]. U ovom kontekstu je važno istaći sljedeće: *„Zadatak pomorskog klauda (ili klauda u pomorstvu) je da omogući uspješnu razmjenu informacija, jednostavno i bezbjedno, putem različitih komunikacionih kanala: interneta, satelita, digitalnih radio veza i sl. On će podržavati heterogene softverske sisteme na različitim vrstama brodova, na obali/kopnu i/ili off-shore (uglavnom naftne platforme), uključujući atestirane uređaje posebne namjene, pametne telefone, tablete, personalne računare i dr., s ciljem postizanja uspješne interakcije, u skladu sa standardizovanim interfejsom, odgovarajućim protokolima i kontrolom prava pistupa. Pomorski klaud nije namijenjen, u smislu neposrednog korišćenja, pomorcima i brodovlasnicima. On je okvir za pružanje standardizovanih protokola i funkcionalnu podršku kod autentifikacije, enkripcije, otkrivanja servisa i efikasan prenos širokog spektra informacija u geografskom kontekstu, efikasnije nego što to čini internet danas putem e-meila, VoIP (Voice over IP, eng. – prenos govora putem interneta i/ili telefonske usluge putem interneta), web sajtova, blogova, društvenih mreža, online trgovine i dr.“* [7]



Slika 3.3. Uloga klauda u pomorstvu (izvor: [9])

Legenda: Automatic Identification System, eng. – automatski identifikacioni sistem; Electronic Nautical Charts, eng. – elektronske nautičke karte; GMDSS – globalni sistem opasnosti i bezbjednosti na moru; Vessel Traffic Service/Logistics, eng. – VTS/logistika; What's glue?, eng. – Što je *ljepilo*?

Nešto detaljniji opis pomorskog klauda će biti dat u poglavlju 4.
(h) Interkonekcija u okviru e-Navigacije, razvijena prvenstveno s ciljem povećanja bezbijednosti navigacije, povećava s druge strane mogućnost terorističkih upada u sistem, tj. mogućnosti kiber kriminala [7, p.34].
(i) Nema međunarodno usvojenog standarda za održavanje softvera na brodu [7, p.34], mada bi tu značajnu ulogu mogao da odigra, npr., Bimco [10].

(j) Još uvijek nema standarda za upravljanje e-Navigacijom. Radi se o osjetljivom političkom i pravnom pitanju, posebno u domenu upravljanja rizikom i preuzimanja odgovornosti.
(k) Razvoj *pametnih* aplikacija za mobilne telefone (tablete) za podršku navigaciji na globalnom nivou je jako dinamičan, ali još uvijek *otvoren* proces, da tako kažemo. Na "e-Navigation Underway 2015" međunarodnoj konferenciji (27-29 januar, 2015), Olsen G.L. iz Jeppesen-a je, npr., predstavio *pomorski Android* i objasnio: "da je to jednostavan način za postizanje operativnosti lokalnog pomorskog klauda u brodskom digitalnom okruženju, u uslovima ograničene konekcije." [7, p.34].

Naravno, barijere u domenu implementacije e-Navigacije ne mogu se ograničiti na prethodno navedene. Stoga se intenzivno vrše testiranja opreme i procedura u praksi, kako bi se otkrile slabe tačke u sistemu i intenzivirao rad na njihovom smanjivanju, odnosno, potpunom eliminisanju. Neki od ovih projekata testiranja su: MARNIS, ACCSEAS, MONALISA i dr. [11]

3.7. App-ovi kao podrška konceptu e-Navigacije

Riječ "app" (čit. ap) je skarćenica od engleske riječi „application", koja se odnosi na aplikativni računarski program, u ovom slučaju namijenjen podršci navigaciji. Obično se apovi vezuju za mobilne uređaje, kao što su *pametni* telefoni ili tablet računari, koji su ustvari *pametni* telefoni sa većim monitorom i prilagođenim interfejsom. Danas postoji više od 500 000 apova za Apple iPhone uređaje. Takođe, postoji ogroman broj apova za Android, Windows, Blackberry i Nokia telefone. Tableti koriste uglavnom iste apove kao i mobilni telefoni, mada za njih postoje i posebni. Apovi se mogu učitati sa on-line repozitorijuma softvera proizvođača operativnih sistema za *pametne* telefone, odnosno, tablete. U slučaju iPhone-a i iPad-a, radi se o "App Store"-u. Kada su u pitanju Android uređaji apovi se mogu naći na "Android Market"-u; Windows – "Windows Marketplace"; Nokia – "Ovi Stor", itd. Cijena apova obično varira u rasponu od 1-50 funti [12], s tim što su na on-line softverskom tržištu dostupni i neki besplatni apovi.

Ovaj kratak uvod o apovima, je ujedno uvod u softverska rješenja ovog tipa koji se koriste kao svojevrsna, još uvijek fragmentarna, podrška široj standardizovanoj primjeni koncepta e-Navigacije u perspektivi.

3.7.1. WinGPS™ Marine

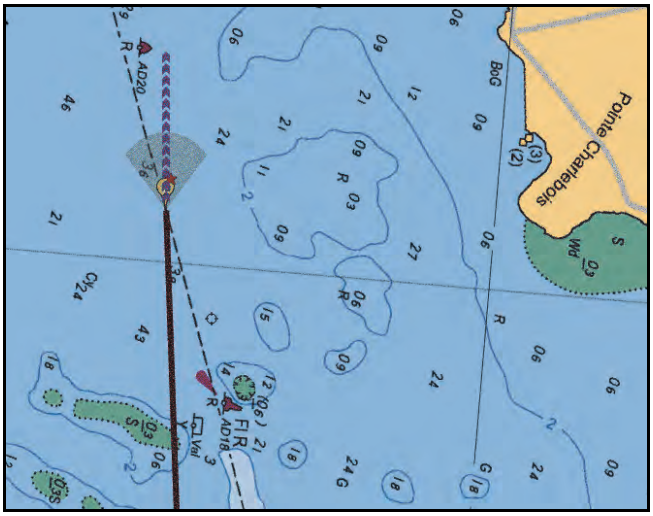
WinGPS™ Marine je dio *Stentec* WinGPS skupa apova koji omogućuju korišćenje PC-a na brodu, laptopa, tableta i/ili *pametnog* telefona, kao navigacionog uređaja [13,14]. Ovaj ap omogućuje jednostavno korišćenja elektronskih karata u planiranju rute i navigaciji. Obezbjeđuje vremenske i plimatske prognoze i AIS informacije. Napredne verzije, omogućuju bežično povezivanje sa drugim navigacionim uređajima na brodu. Takođe, WinGPS™ Marine podržava i Android PC-e na brodu, laptopove, tablete i pametne telefone (slika 3.4).

Slika 3.4. Pametni telefoni/tableti sa WinGPS™ Marine apovima (izvor: [13])

3.7.2. Navigacija pomoću Blackberry pametnog telefona

Blackberry ap za pametne telefone pruža veoma jednostavnu formu asistencije pri navigaciji, putem opcije „auto praćenje“ („Auto Follow“, eng.) [15]. Pošto se aktivira ova opcija, omogućeno je sljedeće:

- Kontinuirano praćenje pozicije broda na standardnoj pokretnoj karti (žuto-narandžasti krug u osjenčenom sfernom trouglu predstavlja vlastiti brod);
- Praćenje u realnom vremenu kursa u kojem brod plovi:
  (a) Dio puta koji je pređen obojen je tamno crveno-braon bojom. Ovo daje navigatoru vizuelnu prestavu o tome koliko mu još predstoji do odredišta;
  (b) Strelice pokazuju pozicije u kojima će se brod naći u predstojećem periodu, ukoliko slijedi zadati kurs – ovo je veoma važno u izbjegavanju opasnosti (slika 3.5).



Slika 3.5. Praćenje unaprijed zadate rute putem Blackbarry ap-a (izvor: [15])

Blackberry ap za pomorsku navigaciju omogućuje učitavanje pre-planirane rute iz menija ili kreiranje sopstvene rute. Duž rute se mogu unijeti markeri koji navigatora upozoravaju zvučnim alarmom u momentu kada dođe do odstupanja stvarne u odnosu na pre-planiranu rutu i sl.

Realno je očekivati da će ubuduće biti sve više ovakvih apova koji će podržavati navigaciju i dalji razvoj i implementaciju sveobuhvatnog koncepta e-Navigacije, na plovilima različitih vrsta i gabarita, uz korišćenje standardizovanih, atestiranih i ažurnih elektronskih navigacionih karata, sa potpunim globalnim pokrivanjem, kao i uz pouzdanu, fleksibilnu komunikaciju sa drugim navigacionim uređajima na plovilima i na obali.

I.3. Izvori

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4. Pomorski klad

Danas su *svi* i *sve* povezani širom planete u svakom trenutku. Riječ je o tzv. *umreženom društvu* (Networked Society, eng.). Ovakvo društvo će iz osnova izmijeniti sadržaj pojmova tipa: inovativnost, saradnja, proizvodnja, upravljanje, održivost, itd. Stručnjaci predviđaju da će saobraćajno-transportni sektor, uključujući pomorstvo, imati dobrobiti od ove evolucije, prije svega u smislu povećanja bezbjednosti, efikasnosti i smanjenja štetnog uticaja na životnu sredinu.

Sastavni dio ovog procesa su i inteligentni transportni sistemi (ITS - Intelligent Transport Systems, eng.) koji povećavaju efikasnost, bezbijednost i zaštitu ekosistema u sektoru transporta. Ovi sistemi su veoma kompleksni i zahtijevaju integraciju informaciono-komunikacionih sistema (ICT – Information and Communication Technology, eng.) sa postojećom transportnom infrastrukturom, flotom, korisnicima i svim ostalim učesnicima u ovom procesu.

Mobilne komunikacije igraju ključnu ulogu u postavljanju osnova za efektivno korišćenje ITS servisa u drumskom i željezničkom saobraćaju, proizvodnji automobila, vazduhoplovstvu, kao i u brodarstvu, odnosno, u pomorstvu u širem smislu.

ITS omogućuju, dakle, različitim vidovima saobraćaja i transporta povezanost u okviru jednog, jedinstvenog, kooperativnog mega-sistema. Inteligentni saobraćaj i transport je, dakle, dio umreženog društva i obezbjeđuje vodeća rješenja po pitanju bezbjednosti, efikasnosti i održivosti.

Iako se preko 90% svjetskog transporta obavlja morem, pomorstvo zaostaje u pogledu implementacije inteligentnih transportnih rješenja, u poređenju sa ostalim vidovima saobraćaja i transporta.

Mobilne komunikacije će nesumnjivo odigrati ključnu ulogu u omogućavaju brodarskoj industriji da intenzivnije koristi metode upravljanja flotom, bazirane na inteligentnoj info-komunikacionoj infrastrukturi. One će pomoći brodarskim kompanijama u upravljanju isporukama, poboljšanju komunikacija između brodova, proaktivnom rješavanju operativnih problema, dijeljenju informacija sa korisnicima, smanjenju potrošnje energije i sl. Dodatno, brodarske kompanije sve više ulažu u tzv. mašina-mašina (M2M – Machine-to-Machine, eng.) ili sistem-sistem komunikacije. Ovo stvara potrebu za potpunom pokrivenošću broda mobilnim mrežama, uključujući tu i efikasne, širokopojasne satelitske komunikacije.

Kako bi postigle najveći mogući stepen povezanosti, brodarske kompanije će morati da modernizuju svoje ICT okruženje. Koncept *konektovanog plovila* (connected vessel, eng.) zasnivaće se na otvorenom, horizontalnom ICT modelu sa rješenjima za povezivanje i upravljanje uređajima, servisima i informacijama. Ovo će omogućiti brodarskim kompanijama da uvedu nove aplikacije i servise na troškovno-efikasnim, fleksibilnim i skalabilnim osnovama. Tako će se stvoriti jedno otvoreno ICT okruženje sa efikasnim klaud servisima u realnom vremenu, uključujući i veoma složene analize podataka bazirane na vještačkoj inteligenciji. Ovakav vid komunikacija će omogućiti povezanost brodova/plovila, nesmetanu komunikaciju posadi s kopnom i pristup inte-rnetu, povećanje bezbjednosti i sigurnosti brodova/plovila, upravljanje servisima i info-rmacijama na nivou flote i dr.

„*Vizija e-Navigacije je infrastruktura koja omogućuje autorizovan i nesmetan protok informacija na samom brodu, između brodova, između broda i obale, tj. službi pomorske uprave/sigurnosti i stejkoldera na kopnu, uz brojne koristi za sve učesnike. Pomorski klaud će ovu viziju učiniti mogućom. Pomorski klaud nije nešto što je „lijepo imati". On je neophodan za realizaciju e-Navigacije.*" (Thomas Christensen, Danish Maritime Authority, [1])

Zbog zaostajanja pomorske industrije za ostalim transportnim industrijama u smislu primjene savremenih ICT rješenja, Ericsson, npr., nastoji da ovo promijeni uvođenjem pomorskog ICT klauda (Maritime ICT Cloud, eng.), kao jednog cjelovitog (end-to-end, eng.) rješenja, koje kombinuje različite klaud modalitete sa industrijskim aplikacijama, obezbjeđivanjem servisa, upravljačkim strukturama, konsaltingom i sl.

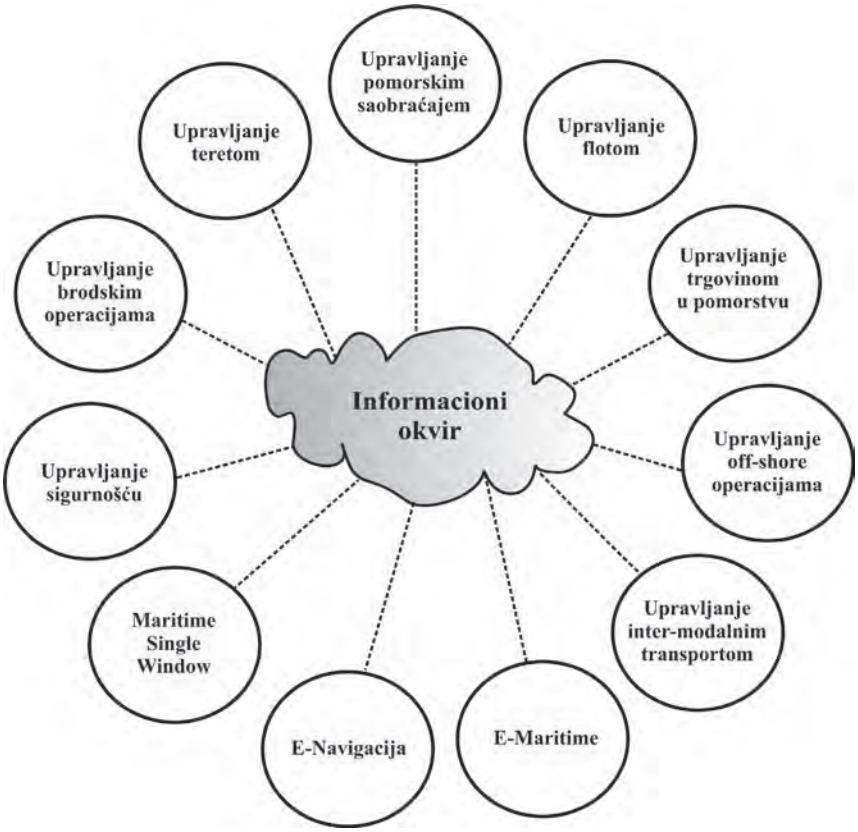
Danas se brodovi uglavnom oslanjaju na manuelno ažuriranje podataka. Informacije o teretu, lukama, vremenu i bezbjednosti, prosljeđuju se po principu „od tačke do tačke" (point-to-point, eng.), umjesto da su dostupne svim učesnicima u pomorskom transportu u realnom vremenu posredstvom mrežne infrastrukture. Ovo je neefikasno, vremenski zahtjevno i povećava mogućnost greške. Stoga Ericsson-ov pomorski ICT klaud ima za cilj da poveže brodove sa obalnim operaterima, službama za održavanje, centrima za podršku korisnicima, transportnim partnerima, lučkim operaterima/upravama i dr. U isto vrijeme, pomorski klaud će omogućavati pružanje podrške u upravljanju flotom, nadgledanju pogonskih strojeva i optimizaciji brzine i potrošnje goriva pri navigaciji i praćenju/predikciji rute, a takođe, doprinijeće bezbjednosti posade i poboljšanju uslova rada.

Ericsson, npr., radi na tome da ponudi kompletan paket pomenutih servisa putem satelitskih veza i pomorskog ICT klauda, u korist svih učesnika u pomorskom saobraćaju i transportu. Ova kompanija će takođe obezbijediti *povezani saobraćajni/transportni klaud* (Connected Traffic Cloud, eng.) koji kombinuje industrijske aplikacije, servise, upravljanje vezama, konsalting i integracione servise. Svaki od ovih segmenata će biti baziran na posebnim klaud platformama za pojedine vidove transporta, npr., klaud konektovanih vozila (Connected Vehicle Cloud, eng.) ili pomorski klaud [2,3].

Koncept pomorskog klauda, shematski je prikazan na slici 4.1.Jasno je da informaciono jezgro ove izuzetno složene ICT infrastrukture čine informacije vezane za: upravljanje brodskim operacijama; upravljanje teretom; upravljanje pomorskim saobraćajem; upravljanje flotom; upravljanje trgovinskim poslovima u brodarstvu; upravljanje *offshore* operacijama; upravljanje inter/multi/ko/sinhro-modalnim transportom [5]; e-maritime[4] servise; e-navigaciju; MSW[5] (Maritime Single Window, eng.); upravljanje bezbjednošću, odnosno, sigurnošću i dr.

[4] e-Maritime je web portal koji funkcioniše kao veza između predstavnika pomorskih kompanija putem interneta. Zahvaljujući ovom portalu - brodari, agenti, špediteri, kao i ostali pripadnici pomorske zajednice imaju medij za jednostavniju komunikaciju, u smislu smanjenja administrativnih barijera.
(Izvor: http://www.e-maritime.com/em/servlet/SvtUDefault, preuzeto: 05.06.2016)

[5] MSW je ICT koncept u razvoju koji ima za cilj digitalizaciju i pojednostavljenje procesa izvještavanja sa brodova, u skladu sa zahtjevima EU. (Izvor: http://www.sjofartsverket.se/en/Single-Window/, preuzeto: 06.06.2016)



Slika 4.1. Koncept pomorskog klauda (izvor: [4], adaptirano)

Novembra 2015. godine, primjera radi, U-Ming pomorska transportna korporacija, sa sjedištem na Tajvanu, angažovala je Eriksson da joj obezbijedi „end-to-end“, tj. potpuno konektovane brodove i rješenja za optimizaciju plovidbe [1, p.8]. Tako će Eriksson pomorski klaud obezbijediti U-Ming-u prikupljanje i procesuiranje podataka o lokacijama brodova i njihovim rutama, kao i automatsku optimizaciju brzine brodova s ciljem uštede u potrošnji goriva. Putem obezbjeđivanja protoka informacija u realnom vremenu, biće povećana vidljivost na relaciji brod-obala i obrnuto, uz obezbjeđivanje automatske podrške, što će smanjiti interne troškove U-Ming kompanije i donijeti eksterno benefite njenim klijentima i partnerima. Eriksson će takođe obezbijediti ovoj kompaniji visok kvalitet brod-obala VoIP i e-meil servisa za potrebe posade.

4.1. Pojmovno određenje, prednosti i nedostaci

Korisnici obično određuju klaud računarstvo kao nov, jeftiniji način korišćenja softverskih rješenja, koja se mogu iznajmiti po potrebi. IT eksperti definišu klaud računarstvo kao novi poslovni model, ili novu tehnološku platformu, koja omogućuje slanje, uskladištenje i čuvanje aplikacija i dokumentata sa bilo kod mjesta u svijetu na određeni server [6]. Kada koriste klaud, subjekti u pomorstvu ne kupuju nego iznajmljuju usluge, tako da na zahtjev dobijaju upravo ono što im je potrebno. Stoga, troškovi nisu veliki, a investiciona ulaganja u hardver i softver su svedena na minimum. U uslovima aktuelne recesije

u pomorstvu, klaud računarstvo može smanjiti finansijske i materijalne troškove broda i pomorske kompanije.

U okvirima klauda, aplikacije, platforme i infrastruktura se iznajmljuju korisnicima kao usluga, a ne kao proizvod. To je slično situaciji kada brod od luke zahtijeva usluge tipa snabdijevanja vodom, električnom energijom, telefonskom konekcijom, hranom, pićem i dr. Dakle, subjekti u pomorstvu koriste (crpe) računarske usluge putem interneta iz klauda, po sličnom principu po kome koriste vodu ili električnu energiju iz javnih mreža u luci. Zahvaljujući svojstvima klauda i posebnim uslugama koje on omogućuje, više nije pitanje da li ga koristiti, već koji model klauda bi bio najpodesniji za povećanje efikasnosti i bezbjednosti poslovnih procesa [7].

Prednosti korišćenja klaud računarstva u pomorstvu uključuju:

- niske cijene hardvera i softvera;
- pristup softverima i podacima sa bilo kog računara na brodu koji ima internet konekciju;
- niske troškove održavanja hardvera i softvera;
- mogućnost obezbjeđivanja usluga svim brodovima kompanije;
- mogućnost kontinuiranog nadgledanja procesa u pomorstvu posredstvom računara;
- povećanje efikasnosti posade/službenih lica na kopnu;
- prisutnost svih dokumenata i informacija na jednoj lokaciji, itd.

Pored pozitivnih strana klauda, identifikovane su i one negativne, tipa: nedostupnost servisa usljed nedostupnosti satelitske konekcije (ponekad, na nekim lokacijama, ili pri nepovoljnim vremenskim uslovima na moru); pitanja bezbjednosti i povjerljivosti podataka, zaštite intelektualne svojine, pouzdanosti, integriteta podataka, zavisnosti obično od samo jednog provajdera; nedostatak standardizovanih interfejsa, koji bi omogućavali transfer podataka i usluga iz jednog u drugi klaud, itd.

> *„Klaud računarstvo (u koje spada u određenoj mjeri i pomorski klaud) je model koji omogućuje sveprisutan (uvijek i svuda), odgovarajući, na zahtjev (tj. po potrebi) pristup mreži zajedničkih konfigurabilnih resursa (mrežama, serverima, memorijama, aplikacijama i servisisma) - brzo i jednostavno, uz minimalnu interakciju sa provajderom.“* [3]

Klaud računarstvu se daje poseban značaj u poslovnim procesima. Stoga EU uprava i industrija planiraju da ulože 45 biliona eura do 2020. godine u razvoj klaud servisa [7, p.81]. U skladu sa NIST [3] osnovni klaud računarski model se bazira na pet svojstava, tri osnovna modela pružanja usluga i četiri osnovna modela implementacije. Pet osnovnih svojstava po kojima se uočava jasna razlika između klaud i tradicionalnog računarstva su: samo-usluživanje po potrebi, korišćenje širokopojasnih veza za pristup, dijeljenje resursa, visok stepen prilagodljivosti i mjerljivost pruženih usluga [7].

4.2. Modeli pružanja usluga

Klaud računarstvo se bazira na tri osnovna modela pružanju usluga: kao softvera, platforme i hardvera. Ovi modeli su ukratko opisani u nastavku [7,8].

- *Softver kao servis* (SaaS - Software as a Service, eng.): korisnik ima pristup softverskim aplikacijama implementiranim u klaud infrastrukturu. Ovaj model omogućuje korišćenje jednostavnih aplikacija od strane pomorskih kompanija ili sličnih organizacija. Tu spadaju razne upravljačke aplikacije ili aplikacije koje se odnose na ljudske resurse. Servisi su dostupni svim računarima putem klijent servisa, odnosno web čitača (browser-a, eng.). Ovaj model omogućuje brodarskoj kompaniji da iznajmi potrebnu aplikaciju umjesto da kupi namjenski softver i instalira ga na svakom pojedinačnom računaru na brodu ili u kancelariji na kopnu. Ovo praktično znači da brodarska kompanija nema nikakvih investicionih troškova u smislu obezbjeđivanja licence, a uz to troškovi klauda su minorni u poređenju sa tradicionalnim troškovima održavanja brodskih servera. Primjeri SaaS modela su MESPAS R5 [9], Google Apps [10] i dr.
- *Platforma kao servis* (PaaS – Platform as a Service, eng.): korisnik u ovom modelu ima pristup razvojnoj platformi. Drugim riječima, korisnik sam razvija aplikacije, u skladu sa sopstvenim potrebama i preferencijama, vrši njihovu implementaciju u klaudu i upravlja odnosnom aplikacijom. Korisnik pri tome ima na raspolaganju razvojnu platformu, uključujući virtualne mašine i operativne sisteme. Ovaj vid servisa je ograničen, u smislu da korisnik nema pristup svim razvojnim alatima. Primjeri za ovaj model klauda su npr., Google App Engine Documentation [11] i Saleforce [12].
- *Infrastruktura kao servis* (IaaS – Infrastructure as a Service, eng.): korisnik ima mogućnost da koristi računarsku infrastrukturu. Pomorske kompanije i druge institucije u pomorstvu ne moraju da kupuju računare/servere, memorije i razne aktivne i pasivne komponente mrežne infrastrukture. IaaS operater upravlja kompletnom hardverskom infrastrukturom, dok je korisnik odgovoran za implementaciju servisa. Drugim riječima, korisnik nema kontrolu nad infrastrukturom u klaudu, ali ima kontrolu nad operativnim sistemom, čuvanjem podataka i razvojem aplikacija. Jedan od primejra IaaS modela je Amazon Elastic Compute Cloud [13].

Stalni razvoj klaud računarstva prati brz razvoj novih modela ili klaud koncepata tipa:

- Senzori i aktuatori kao servis (SAaaS – Sensing and Actuation as a Servise, eng.);
- Senzorska reakcija (događaj) kao servis (SEaaS – Sensor Event as a Service, eng.);
- Senzor kao usluga (SenaaS – Sensor as a Service, eng.);
- Baza podataka kao servis (DBaaS – Data Base as a Service, eng.);
- Podaci kao servis (DaaS – Data as a Service, eng.);
- Eternet kao servis (Ethernet as a Service, eng.);
- Identitetski menadžment kao servis (IDMaaS – Identity Management as a Service, eng.);
- Video nadzor kao servis (VSaaS – Video Surveillance as a Service, eng.), itd.

Više informacija o ovim nedavno razvijenim klaud servisima može se naći u referenci [14].

4.3. Modeli implementacije

Postoje četiri osnovna vida implementacije klauda, koja su opisana u nastavku [7;15, p. 203]:

- *Javni klaud* (Public Cloud, eng.) – je infrastruktura dostupna i otvorena za javnost, bez obzira da li se radi o individuama ili o organizacijama. Javni klaud održavaju nezavisni operateri i često se aplikacije različitih korisnika nalaze na zajedničkim serverima, memorijama i koriste zajedničke mrežne resurse. Termin „javni" ne znači uvijek da su klaud usluge ovog tipa besplatne, mada one mogu da butu besplatne ili veoma jeftine. Javni klaud ne znači da su podaci korisnika dostupni javnosti. Ope-rateri javnog klauda obezbjeđuju kontrolne mehanizme pristupa podacima svojim korisnicima. Dijelovi javnog klauda mogu biti namijenjeni samo jednom korisniku, što čini neki vid privatnog centra za čuvanje/obradu/prenos podataka. Prednost javnog klauda je u tome što je on većeg kapaciteta i potencijala u odnosu na kompanijski privatni klaud. On obezbjeđuje skalabilnost na zahtjev i transfer rizika vezanih za infrastrukturu, sa kompanije, na operatera javnog klauda.
- *Privatni klaud* (Private Cloud, eng.) – ova klaud infrastruktura je dostupna i otvorena samo za jednu kompaniju koja ima kompletan nadzor i kontrolu nad podacima, bezbijednošću i kvalitetom određenih usluga. Drugim riječima, IT resursi kompanije su objedinjeni u sopstvene centre podataka, koji se kasnije mogu optimizirati na principima distribuiranog računarstva i vizualizacije. Privatni klaud obično razvija i njime upravlja kompanijski IT sektor. Kada kompanija želi da se „otvori za javnost", tada se servisi obezbjeđuju posredstvom virtualnog privatnog klauda, koji je dostupan putem virtualne privatne mreže.
- *Zajednički klaud* (Community Cloud, eng.) – kod ovog klaud modela, IT infrastrukturu zajednički koristi nekoliko kompanija. Zajedničkim klaudom mogu da upravljaju, ili kompanije same, ili operater klaud usluga. Troškove korišćenja usluga, kompanije dijele u ovom slučaju. Zajednički klaud je obično javni i pod strogim je nadzorom i kontrolom. Kompanije često imaju zajedničke interese, vrlo slične poslo-vne procese (npr., brodarske kompanije u nekoj državi), što im omogućuje da krei-raju i koriste zajednički klaud. Ovo praktino znači da kompanije u jednoj državi koriste iste aplikacije i zajedničku bazu podataka [7, p.82]. Na ovaj način se izbjegavaju visoki troškovi kupovine hardvera, softvera i održavanja računarske infrastru-kture.
- *Hibridni (mješoviti) klaud* (Hybrid Cloud, eng.) – ova klaud infrastruktura je kompozicija javnog i privatnog klauda, koji su u principu odvojeni entiteti, ali međusobno komuniciraju putem standardizovanih interfejsa i pouzdane razmjene informacija i aplikacija. Hibridni klaud uvodi dodatnu složenost u smislu - kako optimalno distribuirati informacije i aplikacije između privatnog i javnog klauda. Prednosti hibridnog klauda su: prilagodljivost potrebama bilo koje kompanije, smanjenje kompanijskih IT troškova, kao i mogućnost prilagođavanja klaud resursa bilo kom krajnjem korisniku.

Pri dizajniranju klauda, treba voditi računa o distribuiranosti podataka, jer od načina na koji se podaci distribuiraju zavisiće njihova primjenljivost u perspektivi i bezbjednost. Svim resursima u klaudu se pristupa putem mreže. Stoga komunikacione veze treba da su bezbjedne i pouzdane, a poželjno je i da su udupljene (redudantne). Ono što se podrazu-

mijeva je pouzdan transfer podataka, zadovoljavajućom brzinom, uz visoku dostupnost (npr., korišćenjem alternativnih ruta) i uz malo kašnjenje.

Ovdje problem može ponekad da nastupi kod satelitskih veza na relaciji brod-obala. Konstantna povezanost s obalom se može postići paketnim slanjem podataka putem satelitske veze. Za brodarske kompanije, ovo praktično znači da će troškovi zavisiti ne od trajanja konekcije, već od količine prenesenih podataka.

4.4. Partneri u klaudu

Razlikuju se tri tipa partnera (učesnika, entiteta) u razvoju, implementaciji, održavanju i korišćenju klaud servisa. Na prvom mjestu su ***operateri*** koji pružaju usluge krajnjim korisnicima. Zavisno od vrste servisa, postoje tri tipa operatera: SaaS operateri (instaliraju, upravljaju i održavaju softver, tj. obezbjeđuju softversku podršku); PaaS operateri (upravljaju klaud infrastrukturom za potrebe razvijanja specifične platvorme); i IaaS operateri (održavaju računarske resurse u klaudu). Zatim, dolaze ***korisnici*** – fizička lica ili kompanije, koji koriste klaud usluge putem različitih korisničkih interfejsa. Ovdje su svakako neizostavni i ***dizajneri usluga***, koji kreiraju, objavljuju i nadgledaju klaud servise. Kooperacija između korisnika (pojedinaca i/ili kompanija) i operatera klaud usluga je od velike važnosti za postizanje poslovnog uspjeha. Ovaj odnos je regulisan sporazumom o nivou usluge (SLA – Service Level Agreement, eng.). SLA definiše korisničke zahtjeve i obeveze operatera u smislu vremenskih rokova, obezbjeđivanja privatnosti, bezbijednosti, dostupnosti, pouzdanosti, uključujući i procedure za povratak podataka. Više o SLA se može naći u referenci [16].

4.5. Primjene

Pomorci tradicionalno imaju otpor prema novim tehnologijama (zbog nepouzdanosti veza; još uvijek u potpunosti nestandardizovanih tehnologija i procedura; preopterećenja u radu i dr.), ali u nekim kompanijama su prihvaćene klaud aplikacije. Najčešće je riječ o SaaS-u i neke od ovih aplikacija su nešto detaljnije opisane u nastavku [7]:

- *Upravljanje posadom/flotom* – riječ je o softverskim aplikacijama koje su kreirane da zadovolje potrebe vezane za planiranje i praćenje izvršenja zadataka posade od strane oficira, na nivou broda ili cijele flote. Ova aplikacija se satoji od sljedećih modula: planiranja radnih zadataka; vođenja evidencije o validnosti sertifikata posade; planiranja i praćenja putovanja; *e-log* knjige, koja uključuje podatke o poziciji broda, navigaciji, pogonu, potrošnji goriva i dr.
- *Upravljanje održavanjem* – ova softverska aplikacija omogućuje planiranje i olakšava izvršenje procedura održavanja na brodu i upravljanje rezervnim dijelovima, kao i ostalim potrošnim dobrima na nivou broda ili čitave flote. Softverska podrška automa-tski obavještava posadu o pre-planiranim aktivnostima na održavanju, uključujući sve prateće informacije. Aplikacija se sastoji od sljedećih modula: *komponente* (glavne komponente i pod-komponente); *materijali* (popravljeni i rezervni dijelovi, potrošni materijal, hrana, piće, stanje na zalihama, transakcije i dr.); *održavanje*

(standardna upustva, planirane i korektivne aktivnosti, radna istorija, radni sati, planovi i dr.).

- *Nabavka* – ova softverska aplikacija je osmišljena tako da pojednostavi procese naručivanja, bilo da naručivanje vrši menadžment kompanije, oficiri ili članovi posade. Službenici u sjedištu kompanije imaju direktan uvid u potrebe i zahtjeve sa svih brodova. Ova aplikacija omogućuje transparentno upravljanje narudžbama na nivou čitave flote, čime se smanjuju ukupni troškovi. Korisnici imaju pristup svim važnim informacijama o dobavljačima, cijenama, fakturama, budžetu, tekućem statusu pojedinih narudžbi, itd. Na ovaj način se eliminišu greške, čitav proces naručivanja je ubrzan, smanjuje se potreba za brojem zaposlenih i sl. Aplikaciju čine tri modula: *narudžbe* (provjera naloga, direktno naručivanje, fakture i dr.); *alati za planiranje* (finansijske transakcije, stanje u budžetu, bilans i dr.); *autorizacija* (prava pristupa, uvid u finansije, pristupi „izvan kancelarije" i individualni pristupi).
- *Upravljanje dokumentima* – ova softverska aplikacija pomaže u upravljanju dokumentima (sređivanju dokumenata, njihovom arhiviranju, distribuciji i kontroli pojedinih verzija). Ovaj modul omogućuje siguran pristup dokumentima. Pristup je kontrolisan do određenog nivoa, npr., članovima posade dostupni su tekući i završeni poslovi, stanje na zalihama, kao i drugi dokumenti od značaja za upravljanje brodom; dok su zaposlenima u sjedištu kompanije dostupni pregledi zadataka na nivou čitave flote i sl.
- *Slanje izvještaja* – aplikacija koja podržava kreiranje dinamičkih standarda u pogledu kreiranja sopstvenih izvještaja, u skladu sa različitim zahtjevima, npr., o operativnom statusu opreme, aktivnostima na održavanju, narudžbama, finansijskoj kontroli, pregledu sertifikata posade i dr. Posredstvom ovih izvještaja se obezbjeđuje uvid menadžerima u trenutni status svakog broda u okviru flote.

Ovdje treba navesti da su u pomorskom klaudu dostupne dvije vrste podataka: *opšti podaci* (informacije o proizvođačima opreme, rezervnih dijelova, itd.) i *posebni podaci* (finansijski izvještaji za brod ili čitavu flotu, planovi za uvođenje novih servisa, planovi za kupovinu novog broda, itd.). Opštim podacima-informacijama mogu da pristupe svi zaposleni, dok pristup posebnim - zahtijeva autorizaciju.

U svakom slučaju, brodarske kompanije i druge institucije u pomorstvu moraju da izanaliziraju čitav skup pitanja, prije nego što se odluče da dio svog poslovanja izmjeste u klaud, npr.:

- Koji vid klauda će koristiti (SaaS, PaaS, IaaS, itd.)?;
- Koji model usluga će koristi (javni, privatni, zajednički, ili mješoviti)?;
- Koje bezbjedonosne mehanizme će primijeniti?;
- Koje informacije će smjestiti u klaudu? - kao i brojna druga pitanja.

Pored ovoga, kompanija treba da pronađe, izanalizira i uporedi što je moguće više operatera klaud servisa na IT tržištu, na osnovu njihovih referenci.

4.6. Prednosti implementacije na nivou brodarske kompanije

Korišćenjem klauda na nivou brodarske kompanije, postiže se sljedeće [7]:

- povećanje operativne transparentnosti brodarske komapnije;
- pregled tehničkih, finansijskih i materijalnih mogućnosti kompanije u realnom vremenu;
- efikasno prikupljanje i analiza podataka u cilju obezbjeđivanja podrške u odlučivanju;
- efektivno izvršavanje procesa (dobijaju se precizne i jasne instrukcije, uz automatsku sinhronizaciju svih aplikacija u klaudu i relativno malu količinu podataka koji se u te svrhe koriste);
- smanjenje ukupnih troškova (nema potrebe za kupovinom IT opreme, SLA ugovor uključuje apdejt i poboljšanje softverskih aplikacija, čime se povećava kvalitet u održavanju flote);
- integrisano upravlajnje flotom u tehničkom smislu;
- upravljanje snabdijevanjem brodova i kompanijskih službi na kopnu (posada i zaposleni na kopnu mogu brzo da pronađu dobavljače i uspostave sa njima direktnu komunikaciju, kao i da prate čitav proces nabavki), itd.

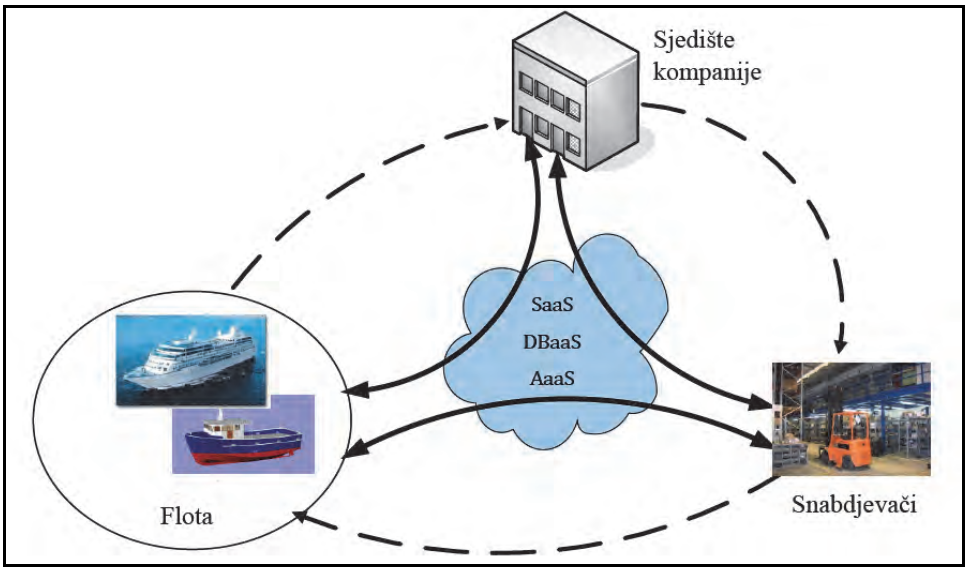
Sve ovo na određeni način smanjuje mogućnosti greške, ubrzava poslovne, odnosno, operativne procese, smanjuje broj zaposlenih i dr. Pri tome je tok podataka između brodova, službi na kopnu i snabdjevača i/ili proizvođača kontinualan (slika 4.2).

4.7. Arhitektura

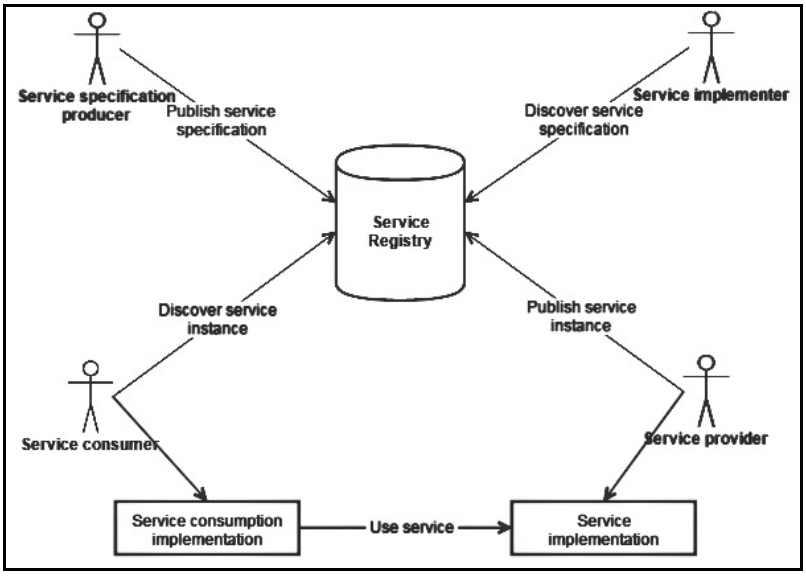
Pomorski klaud, u širem smislu od prethodno opisanog je digitalni ICT okvir koji čine standardi, infrastruktura i upravljanje, a koji omogućuje bezbjednu, interoperabilnu razmjenu informacija između stejkholdera u pomorskoj zajednici na bazi korišćenja *servisno orjentisane arhitekture* (SOA – Service Oriented Architecture, eng.). Jezgro pomorskog klauda čine tri ključne infrastrukturne komponente koje obezbjeđuju sljedeće okvirne servise:

- Registar servisa u pomorstvu;
- Registar identiteta u pomorstvu i
- Obezbjeđivanje informacija u pomorstvu.

Registar servisa u pomorstvu. Ovaj registar sadrži informacije o servisima u pomorstvu koji su dostupni korisnicima (slika 4.3). Pružaoci usluga u pomorstvu objavljuju informacije o uslugama koje nude, tako da korisnici mogu jednostavno da ih pronađu i zatraže uslugu. Ovaj registar će predstavljati repozitorijum specificiranih operativnih i tehničkih servisa, kao i pružaoca usluga, u skladu sa odgovarajućim strandardima. Namjera je da se ovim registrom pokrije čitav dijapazon usluga u pomorstvu, ne samo onih digitalne prirode, već i onih fizičke, tako da će on biti jedinstvena refernetna tačka za pronalaženje prave usluge, odnosno njenog provajdera i/ili izvršioca [17].



Slika 4.2. Shema pomorskog klauda na nivou brodarske kompanije, flote i snabdjevača (izvor: [17], adaptirano)



Slika 4.3. Koncept funkcionisanja registra servisa u pomorstvu (izvor: [17])

Legenda: Service specification producer – onaj koji definiše usluge; Service implementer – onaj koji implementira servise; Service provider – onaj koji obezbjeđuje servise; Servise customer – onaj koji koristi servise; Publish servise specification – objavljivanje specifikacije servisa; Discover service instance – pronalaženje servisa; Service implementation – implementacija servisa; Use service – korišćenje servisa (eng.)

Tabela 4.1. Akteri u pomorstvu (izvor: [17])

Brodovi/plovila	**Službe na kopnu**
– SOLAS brodovi; – Komercijalna turistička plovila; – Brza plovila; – Plovila VTS-a; – Pilotska plovila; – Plovila obalne straže; – SAR plovila; – Službena plovila (policije, carine, granične kontrole, službi za imigracije, ribarske inspekcije i dr.); – Plovila za pružanje nautičke podrške (tegljači, plovila za spasavanje, plovila za gašenje požara, itd.); – Plovila za mjerenje stepena zagađenja; – Ribarska plovila; – Plovila za rekreaciju; – Trajekti; – Plovila za bageražu; – Plovila AtoN organizacija; – Ledolomci; – *Off-shore* plovila (platforme, plovila za snabdijevanje, barže, plovila za izviđanje i dr.); – Plovila za hidrografska izviđanja/snimanja; – Okeanografski istraživački brodovi i dr.	– Brodovlasnici i operateri; – VTM organizacije; – VTS centri; – Obalne straže; – Pravna lica; – Nacionalne administracije; – Obalne administracije; – Lučke vlasti; – Lučke kapetanije; – Službe bezbjednosti; – Organizacije nadležne za incidentne situacije; – Organizacije zadužene za kontrolu zagađenja; – Vojne organizacije; – Vatrogasne službe; – AtoN organizacije; – Meteorološke organizacije; – Hidrografske službe/agencije; – Organizacije za pružanje logističkih usluga; – Informativne službe; – Istražitelji akcidenata; – Zdravstvene organizacije; – Osiguravajuće i finansijske organizacije; – Službe za zaštitu životne sredine; – Organizacije za ribarstvo; – Turističke agencije; – Snabdjevači energentima; – Okeanografski instituti; – Trejning centri; – Međunarodne organizacije; – Komercijalne službe; – Proizvođači i serviseri opreme i dr.

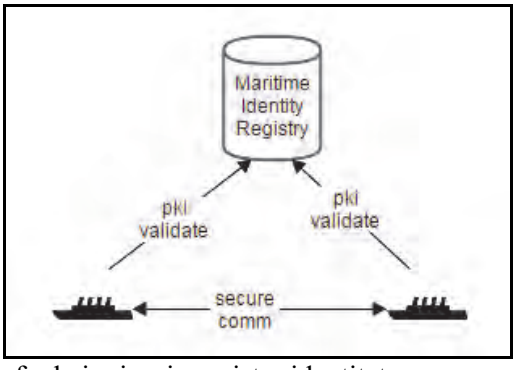
Registar identiteta (aktera) u pomorstvu. Brodovi se obično identifikuju putem imena broda i IMO broja. Kada su u pitanju komunikacioni sistemi, identifikaciona oznaka broda je pozivni znak ili MMSI (Maritime Mobile Station Identity, eng.). Ovi identifikatori su samo brojevi i nema garancije da signal identifikovan posredstvom odgovarajućeg pozivnog znaka ili MMSI-a odgovara određenom brodu. Ovakav način raspoznavanja

brodova ne uzima u obzir potrebu komuniciranja sa akterima pomorskog transporta koji nisu nužno brodovi i koji nemaju radio stanicu, npr., brodovlasnci ili razni pružaoci usluga u pomorstvu. U registru entiteta u pomorstvu svi akteri će imati sopstvene kontakt informacije (npr., VHF radni kanal, e-meil adresu, telefon, faks, itd.) uz, recimo, IMO/MMSI broj. Na ovaj način će SAR i VTS operateri imati pouzdane informacije o svim akterima u pomorstvu. Ovi podaci će biti *javni*, uz mogućnosti dinamičkog ažuriranja. Takođe, biće razvijeni odgovarajući mehanizmi enkripcije podataka i njihovog prenosa između različitih aktera u pomorstvu uz mogućnost digitalnog potpisivanja dokumenta i sl. (slično zaštiti podataka i vršenju transakcija u finansijskom sektoru).

Ovdje treba istaći da u pomorstvu postoji puno aktera, a samo neki od njih su nabrojani u tabeli 4.1, prema podacima sadržanim u IMO MSC 85/26/Add.1, ANNEX 20 dokumentu.

Registar identiteta u pomorstvu će obezbijediti svim stejkholderima tzv. *pomorski identitet* (MI – Maritime Identity, eng.) za autentifikaciju (slika 4.4), obezbjeđenje integriteta i povjerljivosti u transferu informacija/dokumenata, posredstvom korišćenja digitalnih sertifikata i sistema javnih ključeva (PKI – Public Key Infrastructure, eng.).

Važan koncept pomorskog klauda je tzv. *almanah*. Radi se *off-line* digitalnoj verziji javnih segmenata registra identiteta i registra servisa u pomorstvu. Ovaj sistem funkcionisaće kao „telefonski imenik" registrovanih aktera u pomorstvu, kao i pomorskih usluga i omogućavaće uspostavljanje bezbjednih komunikacija i pronalaženje odgovarajućih servisa. Pomorski klaud je prije svega *komunikaciona infrastruktura* koja treba da obezbijedi autorizovan transfer informacija na samom brodu, između brodova, između broda i obale i između obalnih službi i stejkholdera u pomorstvu. Pored ovoga, pomorski klaud je osnovni okvir za pružanje usluga upravljanju pomorskim saobraćajem (STM – Sea Traffic Management, eng.), *jedinstvenom prozoru* u pomorstvu (MSW – Maritime Single Window, eng.), e-Pomorstvom (e-Maritime, eng.), itd.



Slika 4.4. Shema funkcionisanja registra identiteta u pomorstvu (izvor: [17])
Legenda: Maritime Identity Registry, eng. – registar identiteta u pomorstvu, PKI validate, eng. – potvrda PKI, secure comm., eng. – bezbjedne komunikacije

Pomorski klaud će obezbijediti servisno orjentisanu arhitekturu (SOA – Service Oriented Architecture, eng.) putem infrastrukturnih servisa tipa obezbjeđivanja geo-referentnih podataka, bezbjednosti i upravljanja servisima. Ovaj klaud će takođe:

– Zahtijevati korišćenje jedinstvenih standarda;
– Obezbijediti servise e-Navigaciji, MSW, e-Maritime i sl.;

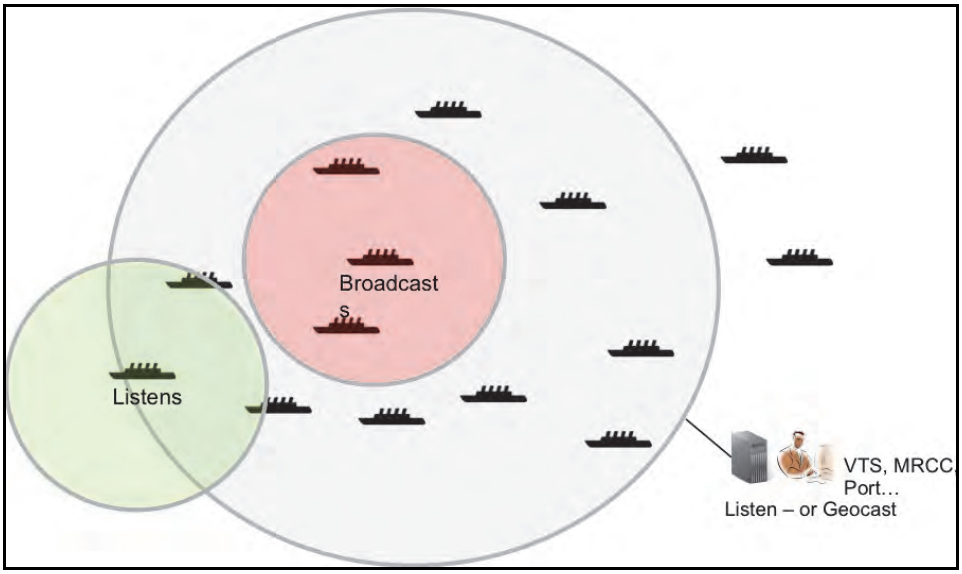
- Omogućiti pristup info-punktovima, koji će pružati odgovore na pitanja tipa: *ko, kada, što?*;
- Obezbijediti visok stepen automatizacije u razmjeni informacija;
- Omogućiti postepen prelazak sa postojećih na nove metode komunikacija;
- Pružati podršku u izboru najboljeg vida komunikacija;
- Uključiti pouzdane tehnologije i sopstevene hardverske i softverske resurse, koji će biti ujedno i troškovno efikasni, itd.

Pomorski klaud se trenutno razvija u okvirima EfficienSea 2.0[6] projekta, a njegova implemetacija je u fazi testiranja. Putem realizacije EfficienSea 2.0 projekta razvijaju se i implementiraju *pametna* rješenja za postizanje efikasnog, bezbjednog i održivog saobraćaja na moru, obezbjeđujući prije svega bolju povezanost brodova. Eksperimenti se vrše na Baltičkom moru, nad prvom generacijom koherentnih rješenja za e-Navigaciju. Kroz globalnu kolaboraciju, korišćenjem otvorenih softverskih arhitektura, sa eksplicitnom težnjom za standardizacijom, stvaraju se realni uslovi za iskorake u razvoju i implementaciji ovog koncepta [18].

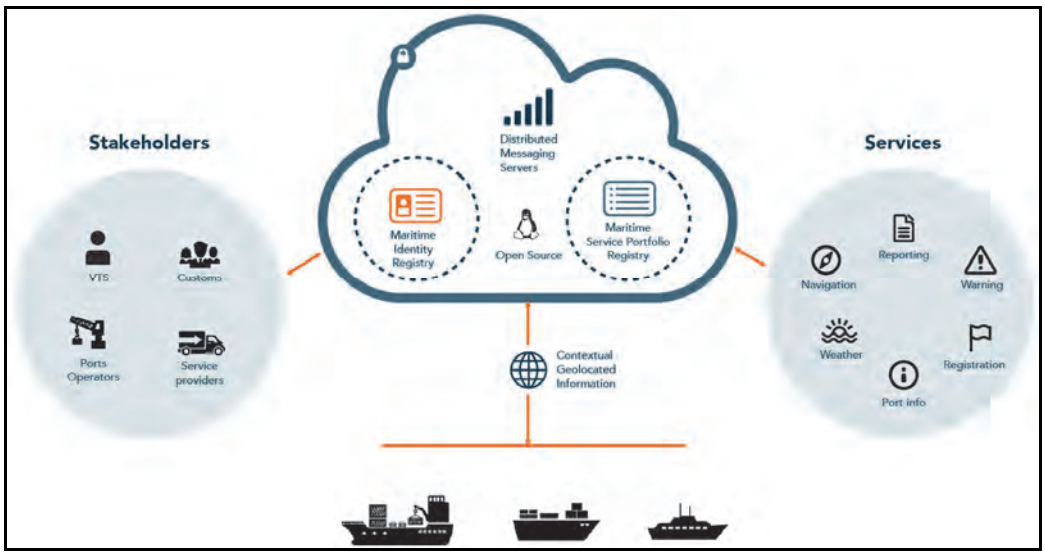
Obezbjeđivanje informacija u pomorstvu. Obezbjeđivanje informacija u pomorstvu (MMS – Maritime Messaging Service, eng.) je osnovni servis u okviru pomorskog klauda koji treba da omogući nesmetan prenos informacija. Iako je MMS u okviru pomorskog klauda baziran na internetu, brojni alternativni komunikacioni servisi mogu biti korišćeni za MMS putem gejtveja posebne namjene (dedicated gateways, eng.). Tako poruka poslata sa nekog broda, npr., putem INMARSAT-a, zahvaljujući MMS-u, može biti primljena posredstvom VSAT terminala na drugom brodu, ili putem HF prijemnika na trećem, od strane VTS operatera, ili korisnika DSL-a (Digital Subscriber Line, eng.) na kopnu i sl. Svaki komunikacioni servis će na neki način nametati određenu tehnologiju, kao i određena ograničenja u pogledu propusnog opsega kanala, veličine paketa podataka, kašnjenja i sl., ali će prenos teksta ili drugih oblika struktuiranih poruka (npr., XML), zahvaljujući MMS-u, biti u svakom slučaju omogućen. Tako, kada neki od aktera u pomorstvu želi da prenese informacije drugom akteru ili grupi aktera, koji nemaju kompatibilnu komunikacionu vezu/opremu, MMS može u takvim situacijama da omugući nesmetanu komunikaciju. U slučaju da neki od aktera trenutno nije dostupan, MMS može da memoriše informacije koje su mu bile upućene i da ih kasnije, po ponovnom uspostavljanju veze, isporuči. Ovaj mehanizam zahtijeva od svakog od aktera u pomorskom klaudu da održava stalnu komunikaciju sa MMS, u smislu da obezbijedi informacije o tome koje veze koristi i prema kojim akterima (slika 4.5).

Pri svakom uspostavljanju veze ili na regularnoj bazi, akteri u pomorstvu treba da daju svoju poziciju na nivou MMS protokola i tako obezbijede informacije o istoj svim ostalim učesnicima u MMS-u. Obezbjeđivanje informacija o geografskoj poziciji može biti podržano S-AIS-om ili nekim drugim sistemom (indirektnog) globalnog pozicioniranja.

[6] EfficienSea 2.0 – Getting Connected. [Internet]. (dostupno: 23.06.2016). URL http://efficiensea2.org/; Slogan projekta je: "Povezivanje s ciljem obezbjeđivanja efikasnog, bezbjednog i održivog saobraćaja na moru".



Slika 4.5. Koncept MMS koordinacije komunikacija u pomorstvu (izvor: [17])
Legenda: Listens – prijemnici; Brodcast – predajnici; VTS – službe na kopnu za kontrolu pomorskog saobraćaja; MRCC – centri za koordinaciju saobraćaja u slučaju opasnosti; Geocast – geokasting (eng.)



Slika 4.6. Ključne komponente pomorskog klauda (izvor: [21])

Legenda:

Stejkholderi u pomorstvu	***Ključni elementi pomorskog klauda***	***Servisi u pomorstvu***
- VTS - Lučke operacije - Pružaoci usluga - Korisnici, itd.	- Registar servisa u pomorstvu - Registar identiteta u pomorstvu - Distribucija informacija - Kontekstualne geolokacijske informacije - Brodovi, itd.	- Navigacija - Izvještavanje - Upozorenja - Registracija (aktera u pomorstvu) - Lučke informacije - Vremenske prognoze itd.

Informacije koje imaju poseban prioritet, npr., informacije vezane za bezbjednost na moru (MSI – Maritime Safety Information, eng.) zahtijevaće automatsku potvrdu prijema.

Službe na obali (npr., vojne ili službe za sprovođenje zakonske regulative) mogu da prate saobraćaj u određenoj oblasti koja ih zanima, a da pri tome ne moraju da obezbijede informacije o svojoj lokaciji.

Postojeći vid univerzalnih (globalno dostupnih) digitalnih komunikacija je AIS za potrebe ASM (Application Specific Message, eng.) servisa [19]. Ovaj servis nije dovoljan za potrebe e-Navigacije, zato treba dalje razvijati NAVDAT (Navigation Data, eng.) i VDES (VHF Data Exchange, eng.) sisteme [17,19]. Kako bi se ovo postiglo, koristi se u osnovi TCP/IP protokol. Ovaj protokol omogućuje slanje poruka akterima u pomorstvu na bazi pomorskog ID-a, ali je takođe *senzitivan* na geografske podatke i omogućuje slanje poruka svim prijemnicima u određenom geografskom području (tzv. *geokasting*).

Na slici 4.6 su objedinjena tri ključna segmenta (modula) koje pomorski klaud podržava: registar servisa u pomorstvu, registar identiteta (aktera) u pomorstvu i obezbjeđivanje samih informacija u pomorstvu.

4.8. Podrška e-Navigaciji

Koncept pomorskog klauda je razvijen s namjerom obezbjeđivanja tehničke podrške u realizaciji koncepta e-Navigacije. Čine ga standardi, infrastrukturne komponente i servisi. Pomorski klaud se, dakle, određuje kao: *„Komunikacioni okvir koji treba da obezbijedi efikasan, siguran, pouzdan i neprekidan tok informacija između različitih autorizovanih stejkholdera u pomorstvu, putem postojećih telekomunikacionih sistema.“* [21]

Pomorski klaud je dinamičan koncept, baziran na korisničkim potrebama i iskustvima sa nekoliko do sada realizovanih eksperimenata u domenu e-Navigacije. On omogućuje nesmetanu razmjenu informacija između različitih sistema u pomorstvu, putem različitih vidova telekomunikacionih veza. Podržan interfejsom visokog stepena automatizacije, on pruža brojne, pouzdane komunikacione mogućnosti i efikasniju razmjenu informacija po principu „od veza do veza“, kao i pomoćne servise, s ciljem postizanja bezbjednosti i sigurnosti na moru, uz zaštitu morskog ekosistema. Krajnji cij je obezbjeđivanje održivog sistema pomorstkog saobraćaja/transporta.

Implementacija pomorskog klauda je zamišljena kao evolutivni proces baziran na postepenoj tranziciji u pravcu servisno orjentisane informatičke infrastrukture. Prelazak na pomorski klaud će biti fleksibilan, uz povećanje nivoa kolaboracije u poslovnim domenima i omogućavanje zajedničkog rada sistemima za podršku, na principima otvorenih standarda.

4.8.1. Prednosti

Prednosti pomorskog klauda u kontekstu e-Navigacije, ogledaju se u sljedećem [21]:

– Mogućnosti korišćenja postojećih komunikacionih sistema, uz obezbjeđivanje nesmetanog protoka informacija između različitih sistema i omogućavanje tranzicije ka novim tehnologijama i servisima;

- Mogućnosti automatskog određivanja prioriteta saobraćaja, kada su u pitanju mobilni korisnici;
- Automatskoj optimizaciji kvaliteta komunikacionih veza i prenosa informacija u skladu sa postavljenim zahtjevima, uz obezbjeđivanje potvrde prijema kada se koristi MMS (Maritime Messiging Service, eng.);
- Verifikaciji autentičnosti izvora i sadržaja informacija, kao dodatnom servisu (koji u opštem slučaju nije neophodan);
- Omogućavanju automatskog pristupa posredstvom jednog „prozora“ na brodskom računaru nacionalnim MSW-a za izvještavanje i daljoj redukciji administrativnih zahtjeva i opterećenja nautičara administrativnim poslovima;
- Omogućavanju razvoja jedinstvenog komunikacionog terminala koji će moći da poveže različite kanale, da identifikuje krajne korisnike i smanji kompleksnost izbora odgovarajućeg komunikacionog sistema u zavisnosti od svrhe u koju se on koristi;
- Omogućavanju razvoja novih sistema, boljih u smislu performansi informatičkih servisa, baziranih na otvorenoj arhitekturi, koja omogućije distribuirano funkcionisanje memorijskih i servisnih resursa;
- Obezbjeđivanju okvira za brod-brod, brod-obala i obala-obala razmjenu informacija između RCC-a, VTS-a, luka, agenata, NSW-a i dr.;
- Omogućavanju dalje logističke integracije pomorskog sa drugim vidovima transporta, promovišući na taj način održivi sistem pomorskog transporta;
- Obezbjeđivanju privatnih i javnih komunikacija uz uzimanje u obzir pitanja kibersigurnosti itd.

4.8.2. Vidovi podrške

Ovdje su navedene neke glavne odrednice pružanja podrške daljem razvoju koncepta e-Navigacije posredstvom pomorskog klauda, kao komunikacionog *rama* koji uokviruje postojeće tehnologije i one u razvoju. Neke od njih su ukratko opisane u nastavku:

- Postojeće i nove komunikacione veze treba da omoguće nesmetanu razmjenu informacija u okvirima pomorskog klauda. Obezbjeđivanje obaveznih informacionih servisa, kao sto su MSI u okviru GMDSS-a, trenutno je omogućeno putem NAVTEX-a i SafetyNet-a. Međutim, ove tehnologije ne podržavaju S-100 standard za prikaz informacija na geografski orjentisanim displejima. S druge strane, za obavezno izvještavanje VTS-a koriste se VHF komunikacije i AIS. Poruke vezane za određene aplikacije (ASM – Application Specific Messages, eng.) poslate putem AIS-a, ili VDES-a u perspektivi, podržavaće ovu funkciju i ostaće i dalje besplatne za brodove.
- Komunikacije koje nisu direktno vezane za bezbjednost, a odnose se na različite vrste izvještaja, trenutno se realizuju korišćenjem različitih servisa: satelitskih veza, e-meila i sl. Ove komunikacione veze nisu obavezne i postoje brojne opcije za njihovo uspostavljanje. Širina propusnog opsega, dostupnost i troškovi zavise od određenih poslovnih potreba kompanije.
- Pomorski klaud omogućuje *geokast* MSI servis, koristeći ASM, putem besplatnih veza tipa AIS-a i bazira se na postojećim komunikacionim vezama. Ovaj sistem će u

buduće omogućavati brz prijem MSI putem *mašinske čitljivosti* i geografskog lociranja MSI, uz automatsko obezbjeđivanje potvdre kvaliteta prijema, u situacijama kada su dostupne dvosmjerne veze.

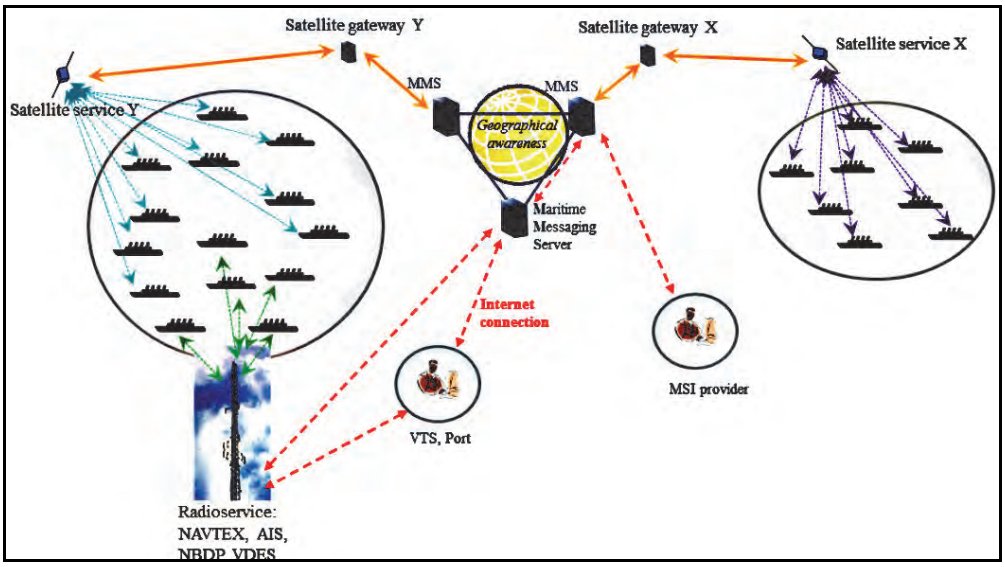
- Postojeći AIS sistem ima ograničen kapacitet, koji u nekim oblastima onemogućuje uvođenje dodatnih sevisa. U nastojanju da zaštite primarnu svrhu AIS-a, IALA i ITU ulažu napore da uvedu VDES. VDES će biti opcija koja će omogućavati ASM, koje su se prenosile AIS-om, da se transformišu u novu generaciju ASM na različitim kanalima i na taj način će biti zaštićeni kapacitet i primarna svrha AIS-a. Paralelno, biće omogućenoVDES-u da ima 10-30 puta veći kapacitet od AIS-a za brod-brod i brod-obala komunikacije. VDES će imati i satelitsku podršku. Ovaj servis će omugaćavati besplatan prenos obaveznih informacija sa *mašinskom čitljivošću*, u formatu koji odgovara VTS centrima, lukama i ostalim korisnicima na kopnu, sa inte-ncijom globalnog pokrivanja, uključujući i polarne oblasti.
- Nova tehnologija, nazvana NAVDAT, već je odobrena od strane ITU i biće testirana tokom narednih nekoliko godina. Ona će biti savremenija verzija NAVTEX-a. Koristiće postojeću infrastrukturu, ali će obezbjeđivati veću širinu propusnog opsega u emitovanju MSI, korišćenjem S-100 formata podataka.
- Obalne mobilne komunikacione veze (3G i 4G) će i dalje obezbjeđivati prenos podataka velikom brzinom na relaciji brod-obala. Preduslov za kombinovanje većine od ovih komunikacionih opcija biće osnovna zajednička infrastruktura, bez obzira što svaki akter na kopnu ima sopstevnu telekomunikacionu mrežu. Servisi *geokastinga* u pomorskom klaudu će obezbjeđivati postepeno uvođenje NAVDAT i VDES za pružanje obaveznih servisa, s težnjom da budu besplatni. Takođe koristiće se i komercijalno raspoloživi internet servisi, kako bi se postigla veća fleksibilnost.

Konceptualna shema podrške e-Navigaciji od strane pomorskog klauda data je na slici 4.6. Server pomorskih informacija predstavlja središte ovog sistema. Putem satelitskih i terestričkih telekomunikacionih veza, uključujući geografske informacione podatke, centralni server povezuje brodove, provajdere MSI, VTS-e, luke i ostale učesnike u pomorskom transportu. Jasno je da ovaj koncept čine postojeći (radio komunikacije, NAVTEX, AIS i dr.) i novi telekomunikacioni sistemi (npr. VDES, NAVDAT, NBDP[7] i dr.) koje pomorski klaud treba da objedini u interoperabilnu cjelinu s ciljem pružanja podrške prelasku na e-Navigaciju.

Više različitih rješenja u okvirima e-Navigacije će imati koristi od pomorskog klauda. U nastavku su navedeni samo neki od njih:

- Poboljšan, harmonizovan i prilagođen potrebama korisnika dizajn i konstrukcija komandnog mosta;
- Razvijanje standarda za automatsko generisanje i slanje izvještaja;
- Integracija i prezentacija podataka/informacija dobijenih putem telekomunikacionih uređaja na grafičkim displejima;
- Poboljšanje komunikacija sa VTS-ima i dr.

[7] NBDP – Narrow-Band Digital Printing, eng.



Slika 4.6. Shema pružanja komunikacione podrške e-Navigaciji putem pomorskog klauda (izvor: [21], dodatak, p.1)

4.9. Promjene koje će pomorski klaud usloviti

Pomorski klaud će donijeti brojne promjene. Prije svega na polju legislative. Registri u pomorskom klaudu, biće pod jurizdikcijom nacionalnih uprava i pomorski klaud će u tom dijelu biti takođe pod njihovim nadzorom. Postojaće potreba za uređenjem zakona o radio frekvencijama, posebno kada je u pitanju distribucija MSI. Niezostavno, trebaće riješiti pitanja upravljanja ključnim segmentima klauda, uključujući svakako i distribuciju informacija. Ne treba izgubiti iz vida da će razvoj i implemetacija pomorskog klauda, umnogome uticati na izmjenu načina rada/poslovanja aktera u pomorstvu. Doći će do brojnih promjena u načinu izvršenja poslova, procedura i standarda. Moraju se razviti i implementirati operativni i tehnički standardi koji će obezbijediti njegovu fleksibilnost i skalabilnost. Uvođenje pomorskog klauda zahtijevaće razvoj odgovarajuće infrastrukture na kopnu. Doći će do razvoja nacionalnih MSW-a u cilju pojednostavljenja izvještavanja sa brodova u skladu sa zahtjevima EU, itd.

U čitavom korpusu inovacija, uslovljenih razvojem e-Navigacije i pomorskog klauda, biće neophodno vršiti brojne kost-benefit analize i testiranja novih rješenja konkretnih problema u pomorskoj praksi.

I.4. Izvori

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5. AMOS

Skraćenica AMOS je sinonim za elekonsko upravljanje resursima. Izvorno, ovaj akronim je bio izveden od pojmova: „Administration, Management, Operations, and Spares" (eng.), što bi se u doslovnom prevodu odnosilo na administraciju, upravljanje, operiranje i rezervne dijelove. To je bila neka vrsta zajedničkog imenitelja za primarne funkcije ovog složenog sistema. S obzirom na njegov razvoj, ovaj naziv je revidiran u: „Asset Management Operating System" (eng.), što se može prevesti kao - ***operativni sistem za upravljanje resursima***. Sistem omogućuje kontrolu i upravljanje tehničkim i administrativnim poslovima u domenima: održavanja, rezervnih dijelova i zaliha, nabavki, kvaliteta i pouzdanosti, upravljanja putovanjem, kao i u domenu administrativnih poslova vezanih za zaposlene (u sjedištu brodarske kompanije), odnosno, posadu (na brodu) [1].

Prije svake analize ovog složenog i veoma sofisticiranog softvera, treba reći da je za njegov nastanak i razvoj najvećim dijelom zaslužna *SpecTec Group* kompanija. Riječ je o multinacionalnoj kompaniji, sa predstavništvima u preko dvadeset zemalja širom svijeta, specijalizovanoj za razvijanje i distribuciju AMOS-a. Ova kompanija radi za potrebe brodarstva, industrije nafte i gasa, odbrane, proizvodnje i distribucije energije i dr. Ovdje je akcenat stavljen na korišćenje AMOS-a u brodarstvu [2].

Pored razvijanja softvera, *SpecTec Group* takođe pruža usluge tipa izrade baza podataka, obuke korisnika, konsultantske usluge i sl. Nesumnjivo je ova kompanija IT *lider* u brodarstvu kada je u pitanju elektronsko administriranje na nivou broda i kompanije. *SpecTec* trenutno opslužuje oko 630 brodarskih kompanija (tj., preko 7000 brodova), od kojih je skoro polovina na Loyd-ovoj registarskoj listi [1,2]. U prvoj fazi razvoja, AMOS je bio relativno jednostavan program, sa svega nekoliko hiljada programskih redova i radio je pod tekst procesorom u MS-DOS okruženju. Sada ovaj dinamički softver ima milione redova koda i koristi ga nekoliko najvećih brodara i *off-shore* kompanija, pa je stoga postao *standard* u pomorstvu. *SpecTec* već godinama uspješno sarađuje sa svim ključnim subjektima u pomorstvu: brodovlasnicima, brodarima, menadžerima, regulatornim tijelima i klasifikacionim društvima. Tako da AMOS uspješno odgovora na sve veće zahtjeve u domenu legislative i olakšava sprovođenje propisa IMO-a (International Maritime Organization, eng.), uključujući MARPOL (International Convention for the Prevention of Pollution from Ships, eng.), ISM (International Safety Management, eng.), STCW (Standards of Training, Certification and Watchkeeping, eng.), ISPS (The International Ship and Port Facility Security Code, eng.), itd. Dodatno, AMOS utiče na poboljšanje operativne efikasnosti i profitabilnosti broda i kompanije.

Interesantno je pomenuti, da bez obzira na aktuelnu ekonomsku krizu u brodarstvu (od 2008. godine), nijedna od kompanija koje koriste AMOS nije potpala pod stečaj. Razlog je dijelom to što AMOS omogućuje striktnu kontrolu svih troškova. Kompanije opremljene AMOS-om već niz godina imaju prednosti, u smislu da posjeduju mogućnost uvida u sve svoje troškove, te ih tako mogu lakše kontrolisati. Postoje dokazi da kompanije koje koriste AMOS, uštede i do milion dolara godišnje na istim rutama, u poređenju sa brodovima (kompanijama) koji(e) to ne čine. Kompanije koje ulažu u ovaj softver i njegovu efikasnu primjenu, imaju veće izglede da prevaziđu aktuelni krizni period u brodarstvu. Radi se o promjeni metodologije rada, poštovanju procedura i sriktnoj kontroli svih aktivnosti.

5.1. Primjene AMOS-a

Prva primjena AMOS-a je bila u pomorstvu, prije više od 25 godina. Međutim, danas se ovaj složeni softverski sistem, može se slobodno reći – *standard za ekeltronsko upravljanje resursima*, primjenjuje i u nekoliko drugih djelatnosti. Neke od ovih primjena su ukratko opisane u nastavku.

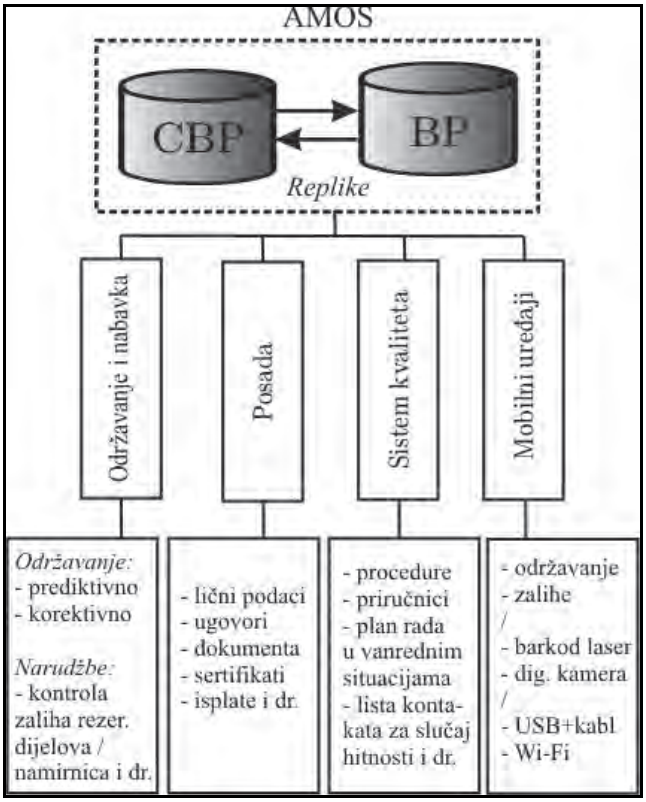
(a) Platforme za naftu i gas: Upravljanje i održavanje resursa na platformama za naftu i gas je komplikovan zadatak, pogotovu kada se radi o resursima raspoređenim na više lokacija širom svijeta. *SpecTec*, na bazi najnovijih IT resursa, ovo rješava veoma uspješno. Podaci se razmjenjuju između centralne baze podataka u centrali kompanije i udaljenih baza na platformama. Razmjena se odvija putem telefonskih linija i/ili satelitskih veza, uključujući i Internet putem satelita (ISAT – Internet over SATellite, eng.). Podaci na taj način mogu biti u potpunosti i redovno ažurirani po osnovu: održavanja, rezervnih dijelova, troškova i sl. Dakle, AMOS omogućuje potpuno praćenje eksploatacionog ciklusa resursa od nabavke, preko održavanja, logistike (naručivanja, isporuke, lagerovanja) rezervnih dijelova i ostalog.

(b) Energetika i industrija: AMOS je široko rasprostranjen u raznim energetskim sistemima, gdje se uglavnom koristi za kontrolu održavanja i nabavke rezervnih dijelova za veliki broj elektrana širom svijeta. AMOS sistem održavanja i nabavke raspolaže funkcijama projektnog planiranja i upravljanja dokumentacijom, a takođe je integrisan sa ilustrovanim instrukcionim knjigama proizvođača i katalozima rezervnih dijelova. Sistem koristi AMOS replike i automatski kontroliše sve transfere podataka između udaljenih (lokalnih i regionalnih) baza i centralne baze podataka. Zahvaljujući ažuriranju u realnom vremenu i centralizovanom planiranju održavanja, kao i efektivnom upošljavanju međunarodnih servisnih timova, postiže se veća pouzdanost u radu elektrana, kao i bolja kontrola logističkih procesa i obezbjeđivanje rezervnih dijelova u bilo kom trenutku. Tako je AMOS kroz svoju funkcionalnost u domenima održavanja i nabavke, kao i u procesu upravljanja radnim procesima, potvrdio potencijal i u drugim, brojnim područjima proizvodnje i transporta. Korisnički interfejs je često prilagođen određenim postrojenjima (uređajima), omogućujući tako operaterima da putem PC-a ili PDA-a (Personal Digital Assistant, eng.) odmah intervenišu u slučaju potrebe kod službe za održavanje i tako zajednički riješe problem. Ovdje treba naglasiti da AMOS može biti integrisan sa drugim sistemima i tako obezbijediti i održavanje prema stanju. Dodatno, sistem može da bude integrisan sa sistemima za finansijske, odnosno, *e-commerce* (eng.) transakcije i sl.

(c) Odbrana: *SpecTec* obezbjeđuje planiranje i upravljanje održavanjem, kao i kontrolu zaliha i na zahtjev mornarice, ili na zahtjev bilo koje slične odbrambene organizacije. AMOS radi samostalno na vojnom brodu (održavanje, kompletna logistika oko nabavke rezervnih dijelova, zaliha i dr.), dok se svi podaci repliciraju u centralnoj mornaričkoj bazi (Central Naval Base, eng.), što sistem čini veoma djelotvornim po pitanjima mornaričkih logističkih zahtjeva. Podaci se ažuriraju na brodu, a potom se kriptovani šalju centralnoj stanici, putem posebno zaštićenih kanala. Kada je u pitanju upravljanje održavanjem, treba napomenuti da AMOS omogućuje monitoring vibracija i analize rotirajuće opreme, zašto razvija softver i hardver, kao i baze podataka, uključujući tabele sa karakterističnim parametrima vibracija/rotacija, kao i razne forme odnosnih izvještaja [1,2].

5.2. AMOS aplikacije na brodu

AMOS se na brodu koristi za održavanje (preventivno i korektivno) brodskih tehničkih (pod)sistema, uključujući sve njihove sastavne dijelove; zatim, za nabavke: rezervnih dijelova, opreme, namirnica i dr.; za sprovođenje mjera sistema kvaliteta, uključujući pohranjivanje svih priručnika za praćenje i sprovođenje procedura kvaliteta, kao i najnovije konvencije u pomorstvu; za unos podataka automatski u bazu sa bilo kog mjesta na brodu (skladišta, stroja i sl.) putem mobilnog (ručnog) uređaja sa ugrađenim laserskim barkod čitačem ili digitalnom kamerom. Na slici 5.1 su prikazane, posredstvom odgovarajućeg blok dijagrama, ključne aplikacije AMOS-a na brodu.



Slika 5.1. Moduli i funkcije AMOS softvera na brodu

5.2.1. Održavanje i nabavka

Kada su u pitanju održavanje i nabavka (M&P – Maintenance and Purchasing, eng.), radi se o *Windows* aplikaciji za integralno upravljanje održavanjem na brodu, nabavkama (kontrola zaliha i narudžbi), kao i troškovima. *SpecTec* je razvila ovu aplikaciju za potrebe kompanija/organizacija sa dislociranim instalacijama (npr., sjedište brodarske kompanije - brodovi). Aktivnosti vezane za održavanje, praćenje zaliha i troškova izvršavaju se na udaljenim lokacijama, ali se prate iz centralnog sjedišta kompanije/organizacije. Sve

izmjene kada je u pitanju stanje na zalihama broda, takođe se automatski registruju u sjedištu kompanije. Veoma je važno da AMOS omogućuje korisnicima da vide koliko su novca potrošili na održavanje i rezervne dijelove, nabavku zaliha i potrošnih dobara, te kakvi su izgledi i planovi za buduću potrošnju. Ono što se može uraditi putem AMOS M&P softverske aplikacije, opisano je detaljnije u nastavku [3].

Planiranje održavanja:

- Specifikacija poslova koji se moraju redovno izvršavati;
- Utvrđivanje rasporeda održavanja;
- Štampanje radnih lista za poslove koji se moraju izvršiti u skorije vrijeme, sa čeklistama ili detaljnim opisom posla koji treba uraditi;
- Planiranje vanrednih pregleda uz obezbjeđivanje radnih naloga (Work Orders, eng.) i sl.

Kreiranje izvještaja o održavanju:

- Kreiranje izvještaja o realizovanom održavanju;
- Memorisanje izvještaja za potrebe inspekcijskog nadzora;
- Štampanje izvještaja;
- Kreiranje izvještaja o realizaciji neplaniranih (vanrednih) popravki i rutinskim provjerama i sl.

Kontrola zaliha:

- Pregled aktuelnog stanja na zalihama u svim skladištima;
- Direktno ažuriranje stanja nakon pregleda;
- Automatski prikaz svih transakcija *iz* zaliha pri održavanju i *u* zalihe pri nabavkama;
- Prikaz tekućeg stanja na zalihama u odnosu na maksimalno, minimalno, ili stanje pri prethodnom naručivanju;
- Automatsko izračunavanje količine zaliha, neophone da se one popune, u skladu sa nekim od prethodno navedenih nivoa;
- Memorisanje podataka o dobavljačima, cijenama i dr.

Kreiranje trebovanja:

- Kreiranje trebovanja za zalihe manuelno ili automatski na osnovu željenih količina i preferentnih dobavljača;
- Kreiranje trebovanja za potrošna dobra po istom principu kao u slučaju zaliha.

Praćenje narudžbi (automatsko generisanje odgovora na pitanja, od kojih su neka nevedena u nastavku):

- Jeli dobavljač primio narudžbu?
- Da li je narudžba procesuirana i potvrđena?
- Kada se očekuje isporuka?, itd.

Evidencija prijema:

- Markiranje isporuka prema narudžbama i automatsko ažuriranje stanja na zalihama.

Praćenje troškova (putem automatskog generisanja odgovora na pitanja koja slijede):

- Kolika je potrošnja (na brodu) za tekući mjesec?
- Kolika je potrošnja za tekuću fiskalnu godinu?
- Kolika je preostalo od planiranog budžeta za potrošnju u tekućoj godini? i sl.

Poželjno je takođe i automatsko praćenje troškova za neplanirane situacije (poslove), s ciljem poboljšanja programa preventivnog održavanja u perspektivi.

5.2.2. Posada

Modul namijenjen posadi (Personnel, eng.) je, zapravo, AMOS alat za upravljanje podacima o posadi. Osnovni podaci o posadi se unose u posebnu formu u sjedištu kompanije, a mogu da se ažuriraju i na brodu, u skladu sa stepenom ovlašćenja administratora. Sve izmjene i dopune podataka se realizuju u skladu sa AMOS sistemom repliciranja.

Forma za upravljanje podacima o posadi sadrži obično sljedeće stavke [4]:

– prezime i ime; ugovor; zvanje; adresu; aerodrom; fotografiju; dužinu staža; obrazovanje; sertifikate; zdravstvena dokumenta; pasoš; pomorsku knjižicu i dr.

Ovim osnovnim podacima mogu se pridružiti podaci o članovima familije, npr. Dodatno, AMOS aplikacija vezana za posadu, uključuje i vođenje platnog spiska, kao i prateće računovodstvene operacije, koje se odnose na troškove u kantini, isplate posadi unaprijed i dr. AMOS prati i vremenske periode angažovanja svakog od članova posade. Ove podatke prate obično i grafički prikazi. Takođe, AMOS kontroliše (automatski) validnost ličnih dokumenata članova posade, kao i njihovih sertifikata.

5.2.3. Kvalitet i bezbjednost

Kvalitet i bezbjednost (Q&S - Quality & Safety, eng.) je AMOS modul za integralno upravljanje sistemom kvaliteta i bezbjednošću, uključujući procedure sistema kvaliteta, cirkularna pisma, informacije o eventualnim neusklađenostima sa procedurama, informacije o akcidentima i sl. Q&S daje mogućnost kompaniji da sama razvija svoj (interni) sistem kvaliteta, ali koji mora biti usklađen sa zahtjevima regulatornih tijela i klasifikacionih društava. Demo baza podataka Q&S modula sardži listu predefinisanih procedura, uključujući i mogućnost praćenja njihovog statusa (npr., aktuelna/zastarjela). Ove procedure mogu poslužiti kao polazna osnova za kreiranje sopstvenog sistema kvaliteta i načina njegovog praćenja [5]. Procedure, ustvari, opisuju mjere koje treba primijeniti na određeni posao na brodu ili na brodski (pod)sistem, kako bi brod bio funkcionalan i bezbjedan, odnosno, kako bi kompanija poslovala u skladu sa predhodno postavljenim ciljevima sistema kvaliteta.

AMOS Q&S modul sadrži informacije o akcidentima (vezanim za teret, posebno opasan; povredama članova posade; oštećenjima na brodu; zagađenjima okoline i dr.). AMOS Q&S omogućuje pridruživanje odgovarajućih priručnika svakoj od procedura u sistemu kvaliteta. Ovi priručnici mogu biti sa neograničenim ili ograničenim pristupom, odnosno, rezervisani samo za određene grupe korisnika na nivou kompanije. AMOS Q&S sadrži i IMO konvencije, sortirane prema hijerarhijskoj strukturi: SOLAS (Safety of Life at Sea, eng.), SAR (Search and Rescue, eng.), COLREG (Collision Regulations, eng.) i dr. Takođe, postoji i poseban funkcionalni segment ovog modula namijenjen raznim zahtjevima (npr., za izmjenu uslova osiguranja). Postoji i mogućnost kreiranja i praćenja rasporeda radnih zadataka u okviru sistema kvaliteta. Još jedan važan funkcionalni segment AMOS Q&S modula je onaj koji je vezan za sistem hitnih intervencija (ERS – Emergency Response System, eng.). Ovaj segment sadrži liste kontakata relevantnih tijela za slučajeve hitnosti. Ovoj listi mogu biti dodati kontakti korisnika (naručilaca prevoza), regulatornih tijela, osiguravajućih društava, itd. ERS modul je realizovan u skladu sa među-

narodnim IMO standardima SOPEP (Ship Oil Pollution Emergency Plan, eng.), OPA (Oil Pollution Act, eng.) i dr.

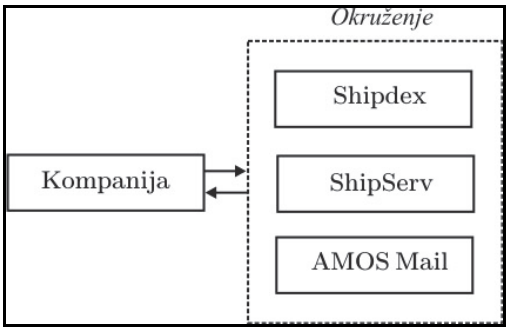
5.2.4. AMOS mobilni uređaji

AMOS mobilni (ručni) uređaj (Mobile Handset, eng.) omogućuje ažuriranje podataka u sistemu, direktno sa lica mjesta, bilo da je u pitanju održavanje ili praćenje stanja na zalihama. Uređaj omogućuje direktno učitavanje stanja nekog brojača ili vrijednosti sa neke određene mjerne pozicije na brodu. Radi pod *Windows Mobile* operativnim sistemom. Verzija 2.0.00, npr., podržava: englenski, italijanski, kineski, norveški, njemački i švedski jezik. Dakle, dvije ključne funkcije koje omogućuje ovaj uređaj su: održavanje i registrovanje stanja na zalihama. U ove svrhe AMOS mobilni uređaj koristi laserski barkod čitač ili digitalnu kameru. Na AMOS PC stanicu se ovaj uređaj može priključiti putem kabla, USB priključka i/ili putem Wi-Fi konektora [6].

5.3. AMOS korporacijske ekstenzije

Osim onih na brodu, AMOS podržava i brojne korporacijske aktivnosti, tj. aktivnosti na nivou brodarske kompanije i šire pomorske industrije. Neke od njih su samo okvirno prikazane u nastavku, dok je na slici 5.2 dat njihov blok dijagram.

- ***Shipdex***^{TM}: se odnosi na međunarodna pravila poslovanja (International Business Rules, eng.) ili Shipdex^{TM} protokol, koji je razvijen s ciljem standardizacije generisanja i razmjene tehničkih i logističkih podataka na nivou kompanije. Ovaj protokol se može jednostavno implementirati nad različitim IT platformama. Ono što je posebno važno, on obezbjeđuje automatsko (paralelno) ažuriranje dislociranih AMOS baza podataka [7].
- ***ShipServ***: je složena aplikacija koja omogućuje da svi zahtjevi i narudžbe kreirani u AMOS M&P modulu, budu automatski proslijeđeni *TradeNet* mreži [8]. Takođe, ova aplikacija obezbjeđuje da se pristigle ponude automatski učitavaju, izbjegavajući tako potrebu za manuelnim unosom i omogućujući bolje i iscrpnije analize. Ovo obezbjeđuje brže i preciznije naručivanje, bržu i povoljniju isporuku, pojednostavljuje i ubrzava postupak reklamacija i sl.
- ***AMOS meil***: je servis koji obezbjeđuje uštede u troškovima za satelitske komunikacije i do 80%, čak kada na raspolaganju stoje *Fleet Broadband* komunikacioni kanali koji podržavaju velike brzine prenosa podataka. AMOS meil je namijenjen prije svega brod-obala komunikacijama i kompatibilan je sa GSM, Iridioum, HF-radio, Inmarsat-B, -B HSD, -C, -M, -mini M, FleetNet-32, -55 & -77 telekomunikacionim sistemima. Zahvaljujući AMOS meil modulu, brod je danas neka vrsta "ploveće kancelarije" [9].



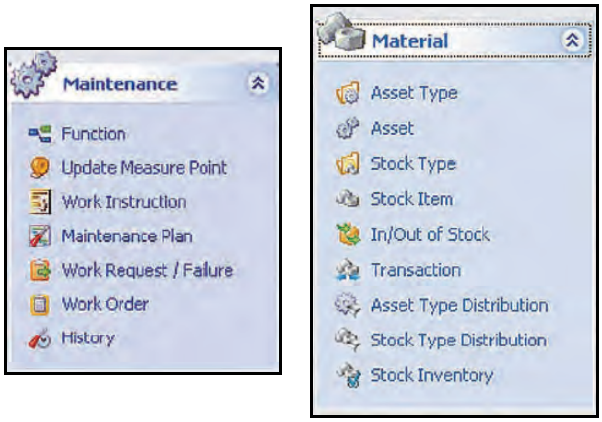
Slika 5.2. Blok dijagram osnovnih AMOS korporacijskih ekstenzija

Ovdje je dat okvirni prikaz AMOS softvera, sa posebnim osvrtom na njegovu brodsku, odnosno, brodarsku komponentu. Opisane su ukratko aplikacije vezane za održavanje i nabavke, upravljanje posadom, praćenje izvršavanja procedura sistema kvaliteta, bidirekcione komunikacije na relaciji brod-obala sl. Načinjen je takođe i kratak osvrt na ključne ekstenzije AMOS-a u multinacionalnom, dinamičnom koropративnom okruženju. U poglavljima koja slijede, biće dat nešto detaljniji opis funkcija osnovnih AMOS modula, kao i standarda na kojima se ovaj sistem bazira.

5.4. Neka svojstva modula za održavanje i nabavke

AMOS modul za održavanje i nabavke je *Windows* aplikacija namijenjena upravljanju materijalnim resursima i implementaciji procedura održavanja na brodu. Takođe, ova aplikacija prati stanje na zalihama, kao i naručivanje, odnosno, nabavku materijala i opreme [10].

Upravljanje materijalnim resursima. Moduli koje sadrži *Material Group*, namijenjeni su upravljanju fizičkim (materijalnim) dobrima i zalihama na brodu. Zavisno od licence koju brod ima, *Material Group* se sastoji od različitih kombinacija *Održavanje* (Maintenance, eng.) i *Materijal* (Material, eng.) funkcija. Prikaz nekih od ovih funkcija je dat na slici 5.3.



Slika 5.3. Funkcije modula *Održavanje* i *Materijal* (izvor: [10])

Centralizovano upravljanje je u osnovi modula koji se odnosi na upravljanje materijalnim resursima. Kako bi se obezbijedilo što efikasnije funkcionisanje ovog ključnog koncepta (centralizacije), korisnici na brodu treba da definišu kako će ovaj modul biti distribuiran, tj. *vidljiv* i/ili dostupan za različite entitete u sistemu (npr., druge brodove, sjedište kompanije i sl.).

Upravljanje radnim zadacima. Transakcije i akcije koje su dostupne korisniku zavise od konfiguracije *WorkFlow* modula, nivoa pristupa koji je omogućen pojedinim korisnicima i tekućeg statusa objekta koji korisnik eventualno hoće da promijeni. Modul *Work Flow* se može koristiti za promjenu statusa bilo kog objekta, u bilo kom trenutku, npr., planiran je radni nalog i funkcija je postala neaktivna, u tom slučaju korisnik može da da instrukciju kojom ponovo aktivira nalog i sl.

Fukcije. Funkcije (funkcionisanje) se vezuju najčešće za neki operativni kvar na brodu. Korišćenjem *Functions* prozora u *Maintenance Group* modulu, mogu se definisati sve funkcije koje izvršavaju pojedini uređaji (oprema) na brodu i može se jasno naznačiti koji uređaj izvršava koju funkciju i u koje vrijeme.

Mjerne tačke. Umjesto funkcija, mogu se identifikovati tzv. mjerne tačke. Ova opcija omogućuje mjerenje vrijednosti fizičkih veličina nezavisno od uređaja koji ih generiše, ili u zavisnosti od njih. Ove mjerne tačke mogu da rade na principu srednje ili trenutne vrijednosti veličine koju mjere. Predefinisane vrijednosti su povezane sa sistemom održavanja i alarma u oba slučaja.

Radne instrukcije. U AMOS-u, poslovi vezani za održavanje, nazivaju se radnim instrukcijama. Ovi poslovi moraju biti u skladu sa zahtjevima proizvođača. Instrukcije su bazirane na tzv. *Work Instruction Classes* i sadrže naziv, kod i korak-po-korak upustva vezana za određeni posao na održavanju. Obično su potrebne višestruke revizije, u skladu sa izvršenim radovima, ali samo jedna verzija revizije je važeća u datom trenutku.

Plan održavanja. Prozor namijenjen planiranju održavanja omogućuje planiranje i automatsko raspoređivanje i iniciranje aktivnosti na održavanju. Drugim riječima, korisnik na brodu ima na raspolaganju mogućnosti generisanja i upravljanja radnim zadacima, uključujući i automatsko aktiviranje naloga. Radni nalog u okviru plana održavanja, sadrži sljedeće informacije:

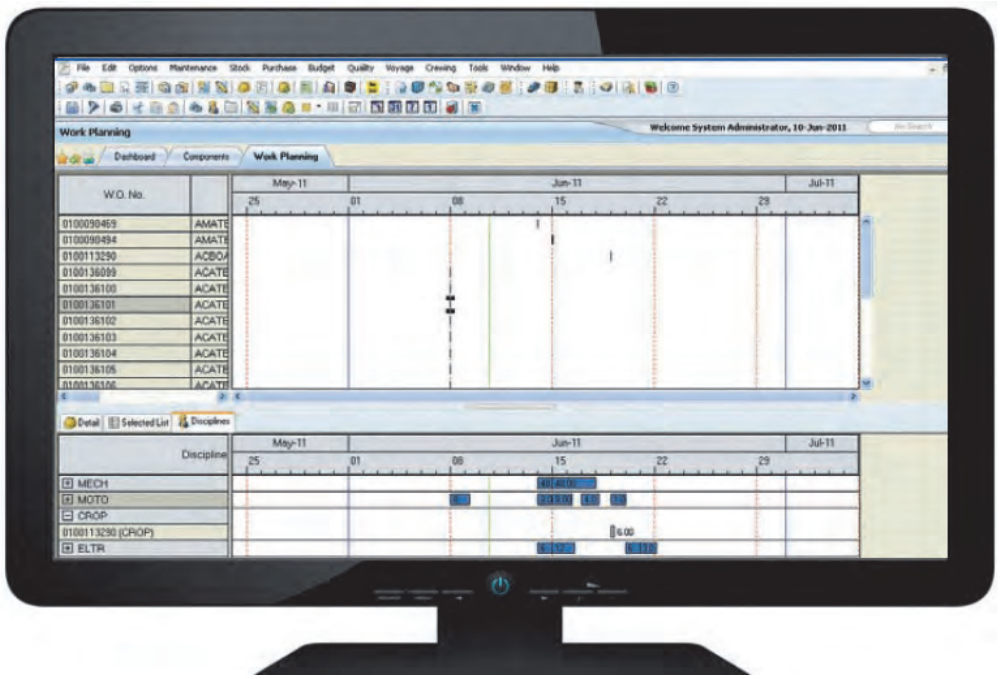
- Radnu instrukciju koja opisuje posao koji treba uraditi;
- Jedan ili više datuma kada ovaj posao treba izvršiti;
- Jedanu ili više mjernih tačaka koje treba uzeti u obzir;
- Jedan ili viže događaja koji (nužno) iniciraju određeni posao;
- Ljude, dijelove i alate koji su neophodni za izvršenje posla;
- Procijenjene troškove posla (uključujući maretijal i radne sate).

Raspored održavanja. Postoje tri načina putem kojih se mogu raspoređivati radni zadaci na održavanju:

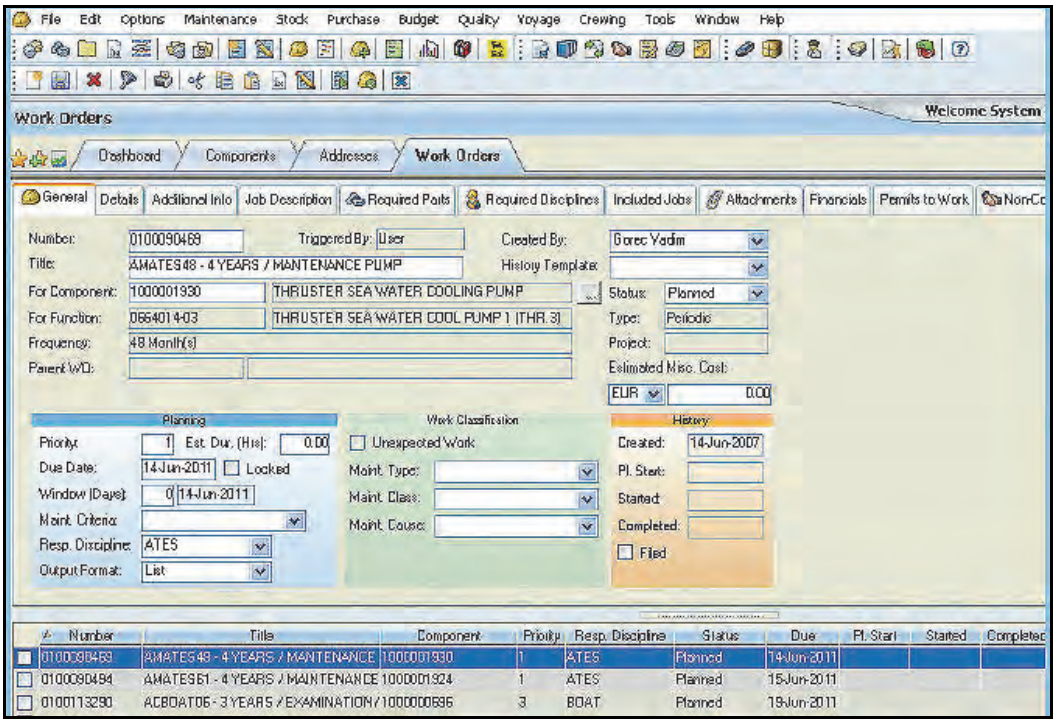
- Stanje mjernih tačaka;
- Kalendar održavanja i
- Određeni (neplanirani) događaji.

Radovi na održavanju se mogu raspoređivati i na osnovu kombinacije prethodno navedenih načina. U svakom slučaju, prije kreiranja radnog naloga za posao održavanja, jedna ili više mjernih tačaka se moraju povezati sa određenim vremenskim presjecima u kalendaru održavanja. Uvijek postoji intencija da se kreira što je moguće manje radnih naloga za određeni plan održavanja, tj. da se optimalno povežu radni zadaci i planirani datumi njihovog izvršenja. Na slici 5.4. je dat izgled prozora sa planom održavanja u AMOS-u.

Radni nalog. Radni nalozi se generišu automatski na osnovu plana održavanja i sadrže detaljan opis posla koji treba realizovati. Na slici 5.5 je dat primjer jednog radnog naloga sa koga se vidi da se radi o održavanju određene brodske pumpe, ko je i kada kreirao nalog, frekvencija i istorija održavanja i dr. Kada se radni nalog jednom kreira, AMOS će kasnije automatski kreirati naredni nalog, u skladu sa istim planom održavanja, pošto se status prethodnog naloga kompletira i zatvori.



Slika 5.4. Prozor sa planom održavanja u AMOS-u (izvori: [3,10])



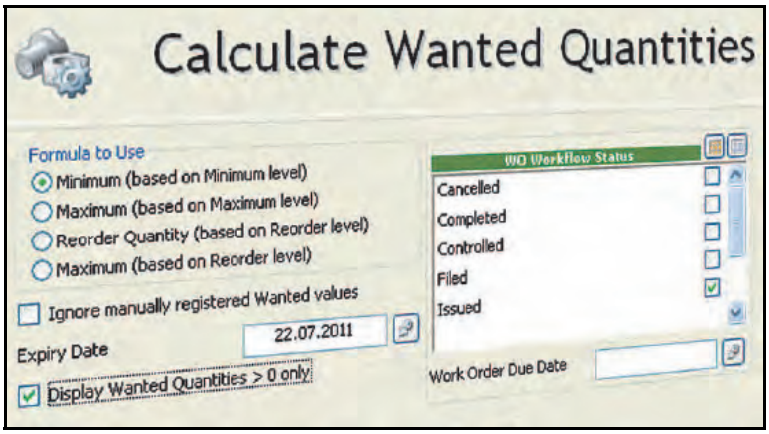
Slika 5.5. Primjer radnog naloga u AMOS-u (izvori: [3,10])

U okviru modula sa radnim nalozima, moguće je izdvojiti one naloge koji se odnose na korektivno održavanje, tj. na situacije kada se djeluje pošto se desio kvar. U tom slučaju je riječ o tzv. *Corrective Work Orders*.

Istorija. Prostor *Istorija* (History, eng.) u meniju *Održavanje* sadrži sve izvještaje o prethodno obavljenim poslovima na održavanju.

Narudžbe. Korišćenje ovog modula, omogućuje: kreiranje formi sa trebovanjem, uključujući očekivane cijene i vrijeme isporuke, naručivanje potrebnih dobara/usluga, kao i praćenje isporuka i ažuriranje stanja na zalihama (u slučaju naručivanja dobara). Može se naručiti dobro (materijal, namirnica), neka od stavki na zalihama, ili neka vrsta posla na održavanju/opravci. AMOS podržava tri načina naručivanja: (i) *trebovanje* – inicijalni dokument koji sadrži zahtjev u smislu koja roba/dobra/potrepštine i/ili usluge su potrebni; (ii) *potraživanje* – forma koja omogućuje traženje informacija o cijenama i rokovima isporuke i (iii) *narudžba* – dokument kojim se službeno lice na brodu obavezuje na će robu/dobra/potrepštine i/ili usluge preuzeti/kupiti od isporučioca kome je dokument poslat. Sve tri forme naručivanja su dostupne u *WorkFlow* meniju.

Zahtjevi za materijalom. Ovi zahtjevi se kreiraju uz pomoć *Materijal* modula na dva načina: ručno ili automatski. U prvom slučaju korisnik sam unosi materijal koji mu treba, dok se u drugom slučaju zahtjev kreira automatski na osnovu stanja na zalihama. Pri tome se može prethodno podesiti po kom principu će se kreirati zahtjevi, tj. da li u odnosu na minimalni, srednji ili maksimalni dopušteni nivo zaliha (slika 5.6).



Slika 5.6. Automatsko računanje količina dobara koje se naručuju (izvor: [10])

AMOS omogućuje automatsko transformisanje zahtjeva u narudžbu. Takođe, program ima funkcije za pružanje informacija korisniku o najpovoljnijim ponudama, odnosno, dobavljačima. Program ima ugrađene napredne funkcije, putem kojih može na optimalan način da podijeli jednu narudžbinu na više dobavljača, kako bi se maksimalno smanjili troškovi.

Isporuke. Kada zahtjev za isporuku stigne u registar *Isporuke*, podaci se automatski ažurirarju u vidu: broja paketa, mase, sadržaja svakog paketa, datuma isporuke i dr. Isporuka teorijski može da ima neograničen broj stavki i da dolazi od različitih dobavljača, skladišta, agenata, itd. Takođe, isporuke se mogu podijeliti na one koje su urgentne i one koje to nisu.

Prijem. Kada isporuke stignu na brod, podaci o njima se automatski ažuriraju, tj. transakcioni logovi se kreiraju u *Stock Transactions* prozoru, dok se stavke koje se prethodno nisu nalazile na lageru, automatski unose kao nove u odgovarajući registar.

Budžet. U AMOS-u se može planirati budžet i na period duži od godinu dana, pri čemu je moguće izdvojiti i posebno pratiti pojedine periode. Budžet je obično direkto povezan sa troškovima nabavke. Pri svakoj nabavci može se odmah dobiti informacija o raspoloživom stanju u budžetu. Takođe, putem sistema tzv. *vaučera* moguće je pratiti i sva ostala, npr., kreditna zaduženja broda.

5.5. Neka svojstva modula za praćenje podataka o posadi

AMOS podsistem za upravljanje podacima o posadi sadrži podatke o članovima posade, uključujući tu njihova zvanja i raspored rada. Posredstvom prozora *Zaposleni* mogu se unijeti u bazu svi relevantni podaci tipa [11]:

- Zdravstvenih (eventualnih bolesti, vakcina, testova na droge i dr.);
- Ličnih (članovi porodice, npr.);
- Sertifikata (koje posjeduje svaki od zaposlenih i do kada su oni validni);
- Dokumenata (ID, pasoš i sl.);
- Zvanja, istorije poslova (poslovi koje zaposleni trenutno pokriva i/ili je pokrivao), itd.

Prikaz funkcija koje sadrži prozor *Zaposleni*, dat je na slici 5.7. Na osnovu registrovanih pozadinskih podataka o svakom od članova posade, drugi vezani moduli, omogućuju korisniku da automatski dobije informacije o: slobodnim i *pokrivenim* pozicijama na brodu (u kompaniji), ažurira prisustvo/odsustvo određenog člana posade sa broda, generiše spisak obaveznih sertifikata koje članovi posade imaju i da prati njihovu validnost u realnom vremenu. Takođe, administrator na brodu može putem ovog modula automatski da planira i postavlja radne smjene, plan posade, zamjenu (člana) posade i dr.

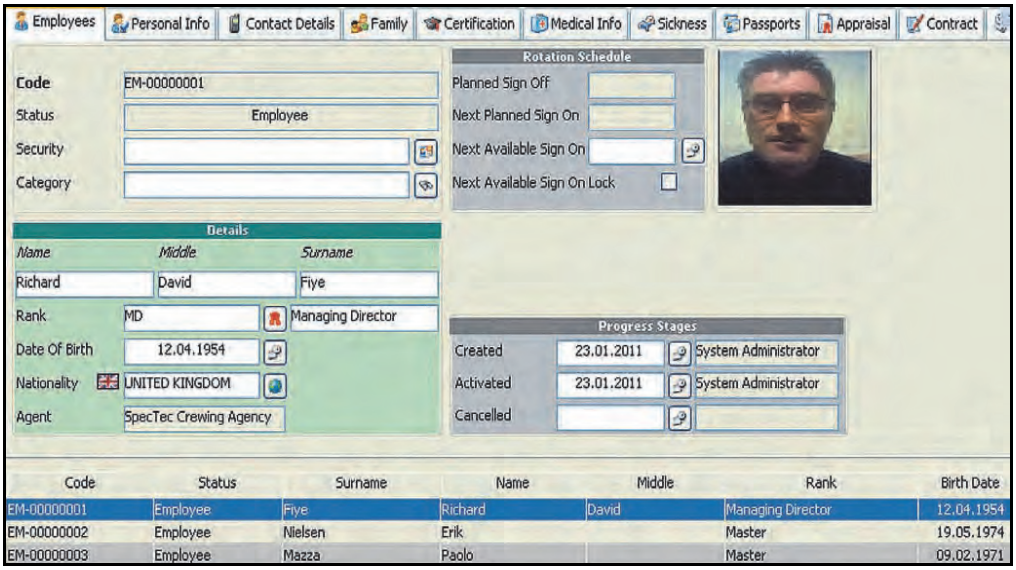
Slika 5.7. Funkcije dostupne u okviru AMOS-ovog modula *Zaposleni* (izvor: [11])

U zavisnosti od tipa licence, moduo za upravljanje posadom, može da sadrži sve ili samo neke od sljedećih podmodula:

- Pozicija u kompaniji (zvanje na brodu);
- Potrebni sertifikati (ovlašćenja);
- Planiranje sastava posade;
- Promjena posade;
- Zahtjev za promjenu (člana) posade;
- Istek važenja sertifikata, itd.

Pozicija u kompaniji. Administrator u modulu *Zapozleni*, odnosno, u podmodulu *Pozicija u kompaniji*, ima pregled svih pokrivenih i nepokrivenih radnih mjesta. Za pokrivene pozicije vezuju se odgovarajući zaposleni. Takođe, administrator može da dobije uvid koliko neki zaposleni radi, a koliko je slobodan (npr., 2 mjeseca na brodu, 2 mjeseca odsustva), kao i da da predlog za zamjenu nekog zaposlenog kada je to potrebno i kad za to postoji mogućnost. Na slici 5.8 dat je prikaz prozora *Zaposleni*, na kome se vide svi relevantni podaci o zaposlenom, planu angažovanja, ko je unio/ažurirao i kada podatke, uključujući i kompletnu istoriju prethodnih izmjena i dr.

Jezičci (kartice) u gornjem dijelu prozora daju mogućnosti unosa nekih dodatnih ličnih informacija: npr., kontakt podataka, podataka o porodici, sertifikatima, zdravstvenom stanju, ugovorima i sl.



Slika 5.8. Prozor *Zaposleni* u AMOS-u (izvor: [11])

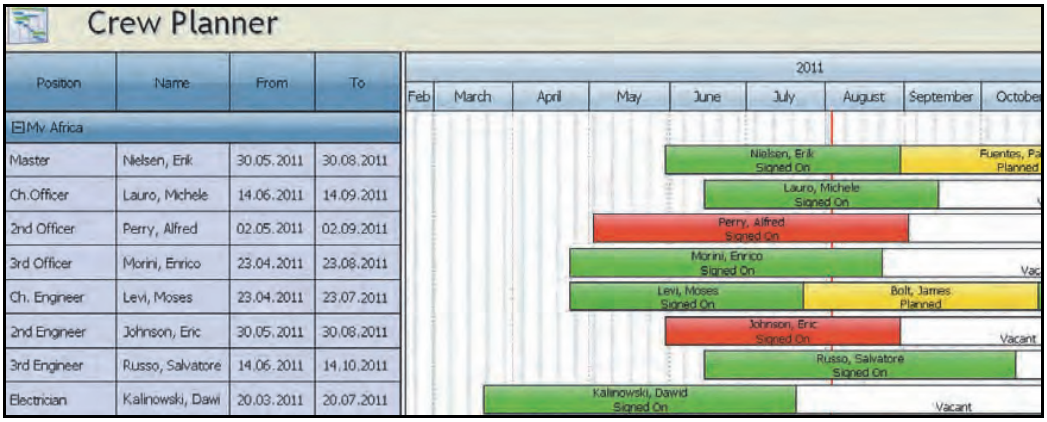
Potrebni sertifikati. AMOS omogućuje prikaz potrebnih sertifikata (ovlašćenja) u četiri nivoa i to u zavisnosti od:

- *Vrste broda* – Ovdje su izlistani sertifikati koji su neophodni za određenu vrstu broda. Na primjer, na tankerima, svi članovi posade moraju imati sertifikat o uspješno završenom osnovnom kursu za bezbjednost na tankerima;
- *Određenog objekta* – Ovdje su izlistani svi sertifikati i dokumenti koje članovi posade moraju da imaju na određenim objektima (brodovima). Na primjer, svaki član posade na m/v Africa mora imati SAD vizu;
- *Pozicije u kompaniji* – Ovdje su dati sertifikati neophodni za pokrivanje određene pozicije u kompaniji, na bilo kom objektu (brodu). Na primjer, zapovjednik mora obavezno da ima licencu prvog oficira palube;
- *Pozicije na određenom objektu* – Ovdje je riječ o sertifikatima koji se zahtijevaju kako bi se na odgovarajući način pokrila neka pozicija na određenom objektu (brodu) u kompaniji. Na primjer, zapovjednik na m/v Africa mora imati napredni kurs o tankerima, itd.

Planiranje posade. Opcija *Crew Planer*, daje administratoru na brodu grafički prikaz, u smislu koji je od članova posade raspoređen na koji zadatak, kada će početi/prestati sa radom i koju poziciju (mjesto) pokriva. Dužina angažmana se računa automatski prema rasporedu rotacija (smjena) posade koja je definisana u prozoru *Company Position/Type*. U prozoru zadataka (slika 5.9) slotovi su označeni:

- *Crveno* – Ukoliko planiranom članu posade za određeno mjesto nedostaje neki od obaveznih sertifikata;
- *Žuto* – Ukoliko nekom od planiranih članova posade za određenu poziciju nedostaje neki od neobaveznih serifikata;
- *Zeleno* – Ukoliko je planirani član posade u potpunosti raspoloživ, tj. nema nikakvih konflikata u smislu validnosti sertifikata koje posjeduje.

Svaka kompanija može sama da konfiguriše, u određenoj mjeri, prozor za planiranje posade, u zavisnosti od individualnih potreba i preferencija. Sa funkcijom planiranja posade direktno je povezan registar *Crew List* (ili popis posade) koji se obavezno šalje u svaku luku pristajanja.



Slika 5.9. Prozor za planiranje rasporeda posade (izvor: [11])

Promjena posade. Promjena članova posade se obično vrši na nivou kompanije, tako da administrator na brodu ima uvid u raspored posade koji je već napravljen. Sve izmjene u *Crew Change* prozoru, automatski se prenose u *Crew Planner* prozor, čime je posao administratora na brodu umnogome olakšan.

Zahtjev za promjenu posade. Do ovog zahtjeva može da dođe zbog isteka ugovora, na zahtjev samog člana posade ili iz nekog drugog razloga. Takođe, neki od članova posade može da traži produženje ugovora. Ove zahtjeve zapovjednik treba da provjeri prije svakog putovanja, kako bi se izbjegle neplanirane promjene itinirera. Ukoliko tokom putovanja, neko od članova posade zahtijeva da napusti brod, zapovjednik mora poslati takav zahtjev kompaniji na odobrenje.

Istek važenja sertifikata. Prozor *Certificate Expiry* daje pregled svih sertifikata koji su istekli ili su pred istekom. Administrator može da pregleda: sve sertifikate koji su istekli; samo one koji će isteći na određeni dan; sve sertifikate koji su istekli određenog dana i sl. Sertifikati se kontinuirano provjeravaju u sistemu i svaki koji istekne, automatski se uključuje u odgovarajuću listu.

Graf dijagram organizacije kompanije. Na ovom graf dijagramu su dati podaci o strukturi organizacije kompanije, kao i imena lica koja *pokrivaju* određene pozicije.

Planirani događaji. AMOS omogućuje *postavljanje* planiranih događaja u sistem, npr., kontrola, pregleda, provjera i sl. Planirani događaji se pojavljuju u prozoru *Planned Events* i podsjećaju administratora na važne datume, tj. unaprijed planirane važne događaje (ova opcija nije vezana isključivo za posadu, već i za održavanje, sistem kvaliteta i dr.).

5.6. Neka svojstva modula za praćenje sistema kvalieta i bezbjednosti

Korišćenjem AMOS modula za praćenje sistema kvaliteta i bezbjednosti, u mnogome se smanjuje opterećenje posade administrativnim poslovima i postiže se bolja usaglašenost sa različitim standardima u domenima sistema kvaliteta i bezbjednosti. *Obezbjeđenje kvaliteta* (QA – Quality Assurance, eng.) je sastavni dio sistema koji omogućuje usaglašavanje odnosnih standarda sa procedurama i politikama kompanije, radnim instrukcijama, formama i sl. *Upravljanje dokumentima* je posebna aplikacija kreirana u okviru ovog modula. Ona obezbjeđuje da se operacije izvršavaju konzistentno i ispravno na svakom radnom mjestu uz detaljna objašnjenja procedura i politika kompanije, čime se postižu ciljevi postavljeni sistemom kvaliteta. *Distribucija dokumenata* je takođe jedna od opcija u okviru ovog modula, koja, kao što joj sam naziv kaže, obezbjeđuje efikasnu distribuciju dokumenta svim entitetima u okviru kompanije. Dokumenti se mogu prosljeđivati određenom entitetu (zasebno), ili grupi entiteta (istovremeno). Opcija *Effective Distribution* omogućuje optimalno kombinovanje ove dvije mogućnosti [12].

Radne instrukcije. Radne instrukcije u okviru QMS modula opisuju koji su radni zadaci vezani za koje radno mjesto (entitet i/ili objekat) u okviru kompanije. Takođe, ovi zadaci (poslovi), moraju biti u skladu sa međunarodnim standardima.

Radni nalozi. AMOS koristi radne naloge da bi omogućio povezivanje radnih naloga i instrukcija, u smislu identifikovanja radnih instrukcija koje treba sprovesti i vođenja evidencije o obavljenim poslovima.

Propusti (greške). Korišćenjem AMOS-a, moguće je identifikovati sve interne i/ili eksterne propuste (greške) koji se dese. Praćenje propusta (greški) omogućuje otkrivanje uzroka njihovog nastanka, odnosno, nepoštovanje određenih procedura i preduzimanje korektivnih radnji. Analizom propusta (greški) u dužem vremenskom periodu, mogu se razviti i odgovarajuće preventivne mjere.

Praćenje incidenata/akcidenata. AMOS modul za praćenje incidenata/akcidenata, omogućuje praćenje i analiziranje odnosnih podataka, kao i preduzimanje određenih mjera za poboljšanje upravljanja bezbjednošću. Incidenti/akcidenti se mogu klasivikovati kao: povrede na radu, zagađenja, problemi sa teretom, mehanizacijom i dr. Takođe, postoji opcija *umalo izbjegnuti* (near miss, eng.) incidenti/akcidenti. Ova opcija omogućuje prikupljanje podataka o odnosnim događajima i sprečavanje dešavanja istih ili sli-čnih u perspektivi.

Upozorenja. AMOS daje i opšti prikaz upozorenja (slika 5.10). Odnosni prozor pruža informacije o ukupnom broju: umalo izbjegnutih incidenata/akcidenata; otvorenih (aktuelnih) propusta (grešaka) u sistemu; aktuelnih observacija (primjedaba); otvorenih (aktuelnih) glavnih neregularnosti (grešaka u sistemu) i sl.

Slika 5.10. Prozor sa prikazom broja različitih upozorenja (izvor: [12])

Sistem upozorenja i alarma se može konfigurisati u skladu sa individualnim potrebama i preferencijama. Upozorenjima/alarmima se mogu pridružiti različiti nivoi prioriteta, boje na ekranu, SQL upiti koji se vezuju za odnosne incidente/akcidente, itd.

Modul za samoevaluaciju. Ovaj moduo omogućuje kompaniji da izvrši samoevaluaciju u skladu sa, npr., TMSA (Tanker Management and Self Assessment, eng.) i sličnim zahtjevima i standardima. Takođe, posredstvom ovog modula moguće je vršiti automatski procjenu poboljšanja izvršenja u određenom vremenskom periodu. Zahvaljujući ovom modulu moguće je automatski pripremiti dokumentaciju za eksternu evaluaciju, odnosno, za potrebe inspekcijskih pregleda.

U ovom kontekstu, veoma su važni tzv. *ključni indikatori performansi* (KPIs – Key Performance Indicators, eng.). Svaki od ovih indikatora je povezan za određeni aspekt poslovanja kompanije (posadu, upravljanje ili procedure u slučaju hitnosti/opasnosti). Primjeri ovih indikatora su „Upravljanje, vođenje i odgovornost“ („Management, Leadership and Accountability“, eng.) i „Spremnost na opasnost i planiranje reagovanja u nepredviđenim situacijama“ („Emergency Preparedness and Contigency Planning“, eng.). KPIs su ustvari kratki opisi minimalnih zahtjeva koje mora da zadovaljava svaki od elementa/ entiteta na nivou kompanije. Korisnici moraju periodično da procjenjuju KPIs u skladu sa postojećim stanjem, kao i da vrše poređenje novog sa starim (prethodnim) stanjem, u cilju evaluacije progresa u izvršenju.

Upravljanje rizikom. AMOS sistem za upravljanje rizikom, pruža podršku kompaniji u sprječavanju potencijalnih incidenata/akcidenata razvojem odgovarajućih mehanizama za kontrolu i maksimano smanjenje rizika. Ovaj sistem olakšava organizaciji ispunjavanje obaveznih mjera bezbjednosti i pruža posadi interaktivne alate za identifikaciju rizika, dokumentovanje istih i snimanje podataka o preduzetim akcijama. Dakle, AMOS modul za upravljanje rizicima omogućuje sljedeće:

- Identifikaciju rizika;
- Analizu rizika (procjena potencijalne opasnosti i konsekvenci);
- Kontrolu rizika (planiranje odgovarajućih mjera i troškova vezanih za njihovo preduzimanje);
- Analizu troškova (u slučaju dešavanja rizične situacije vs. mjera za njeno sprečavanje);
- Davanje preporuka (menadžentu, npr., nakon procjene reagovanja u kriznoj situaciji);
- Reevaluaciju (utvrđivanje koliko su preduzete mjere na sprečavanju rizika bile efektne) i dr.

Generisanje martica rizika. U okviru AMOS-a, postoje razni alati za kreiranje matrica rizika. Naime, nakon određenih preliminarnih procjena [12], moguće je odrediti *specifičan indeks rizika* za svaki od entiteta/objekata, ili brodova, u okviru određene kompanije. Ovi indeksi zavise od vrste broda i stepena opasnosti koje se vezuju za njegovo operiranje.

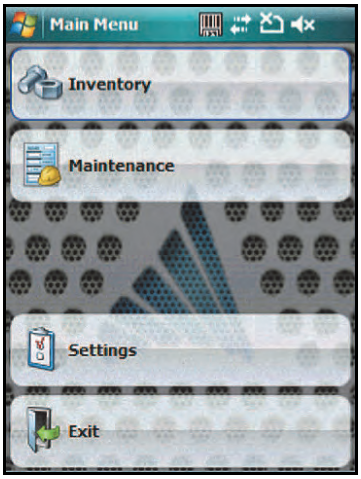
5.7. Neka svojstva mobilnog (ručnog) čitača

AMOS mobilni (ručni) čitač/skener, ili *AMOS Mobile*, čine dva modula: *Zalihe* i *Održavanje* (slika 5.11). Baza podataka samog uređaja, sadrži sve podatke unijete od strane korisnika kao i kopiju svih već postojećih podataka u AMOS bazi na određenoj lokaciji/objektu. Putem ovog uređaja, korisnici mogu da snimaju stanje na zalihama, apdejtuju stanje brojača i kreiraju radne zadatke.

Za uređaj su vezane tri baze podataka: *pokretna* baza podataka na samom uređaju, *office* konsolidovana baza podataka (Sybase) i AMOS baza podataka (Oracle, Microsoft, Sybase). Ovakva struktura sistema ima određene prednosti [13]:

- Sprječava unos nekorektnih podataka sa mobilnog uređaja u AMOS tabele (fajlove);
- Verifikuje tok podataka u skladu sa AMOS procedurama;
- Sprječava koliziju u situacijama kada se podaci apdejtuju istovremeno na nivou AMOS baze i na nivou samog mobilnog uređaja;
- Omogućuje izbjegavanje transfera velikih količina podataka *od* i *ka* mobilnom uređaju i dr.

Na slici 5.12 je dat shematski prikaz strukture i funcionisanja AMOS mobilnog uređaja.

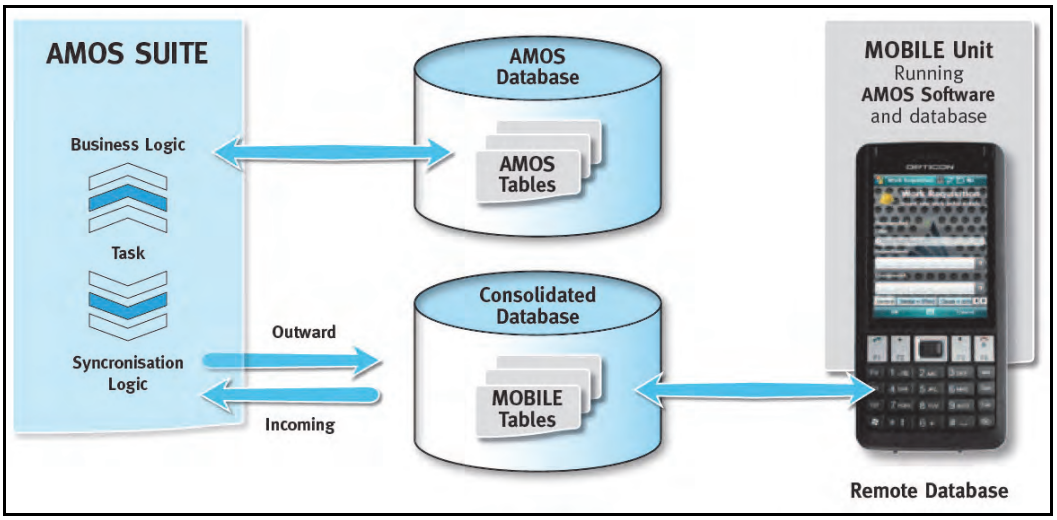


Slika 5.11. Osnovni moduli AMOS mobilnog uređaja: *Zalihe* i *Održavanje* (izvor: [13])

Barkod čitač. AMOS mobilni uređaj je kompatibilan sa barkod laserskim, ili bilo kojim drugim čitačem. Međutim, sam AMOS mobilni uređaj ne procesuira barkod podatke, tako da ih je prethodno potrebo *prevesti* u format „čitljiv" za ovaj uređaj.

Digitalna kamera. Neki AMOS mobilni uređaji imaju ugrađenu digitalnu kameru. Kada korisnik, npr., želi da kreira radni nalog, može da fotografiše uređaj za koji se vezuje nalog i proslijedi fotografiju sistemu. Pri tome će rezolucija, naravno, zavisiti od kvaliteta ugrađene kamere.

Komunikacija između uređaja (mobilnog uređaja i pristupne tačke na brodu). Zavisno od svojstava ovih mobilnih uređaja, komunikacija se može ostvariti putem kabla, USB priključka i/ili Fi-Wi modula.



Slika 5.12. Blok shema strukture/funkcionisanja AMOS mobilnog uređaja (izvor: [13])
Legenda: AMOS suite, eng. – skup AMOS programa; Busines Logic, eng. – poslovna logika; Synchronization logic, eng. – logika sinhronizacije; Outward, eng. – izlaz; Incoming, eng. – ulaz; Database, eng. – baza podataka; Tables, eng. – tabele (datoteke); Remote database, eng. – *daljinska* baza podataka (na samom mobilnom uređaju)

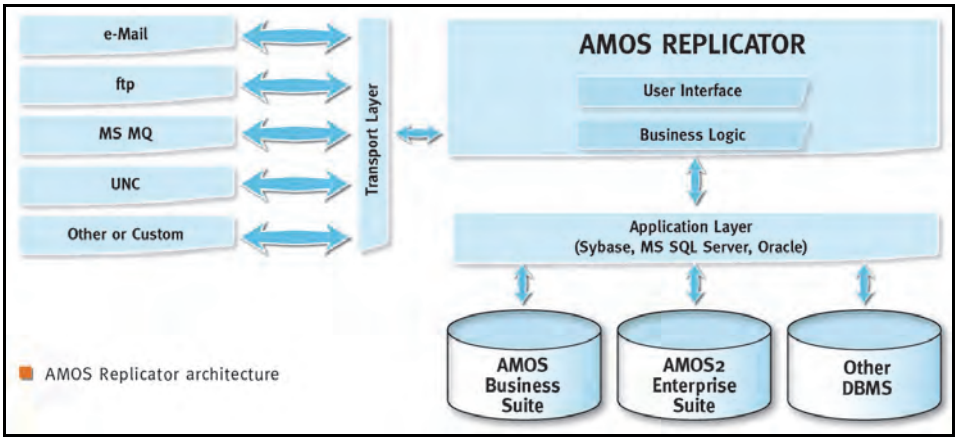
Nabavka. Sistem nabavke je dosta fleksibilan i preporučuje: nabavku *moćnijeg* uređaja, kako bi se izbjegle česte izmjene na nivou softvera; konfiguraciju uređaja na *nižem nivou*, ako se planira da on radi sa manjim količinama podataka; nadgradnju AMOS mobilnog uređaja na način koji ne zahtijeva nužno i nadgradnju AMOS centralnog skupa programa i sl.

Prednosti. Korišćenjem AMOS mobilnog uređaja, postižu se brojne prednosti, kao što su:

- *Tačnost* – Pošto se unosi realizuju na licu mjesta, smanjuje se vjerovatnoća da se zaboravi što je urađeno i što treba uraditi;
- *Barkod* – Povećava se tačnost podataka i eliminiše potreba ručnog unošenja kodova;
- *Kamera* – Zahvaljujući svojstvu pridruživanja fotografije radnom zadatku – nalogu, dobija se jasan pregled/uvid problema koji treba riješiti.
- *Fleksibilnost* – Korišćenjem AMOS ručnog uređaja, članovi posade se oslobađaju potrebe da na radno mjesto nose lap-topove i omogućen im je automatski unos snimljenih podataka u sistem;
- *Integritet podataka* – AMOS sistem obezbjeđuje korektan unos podataka u konsolidovanu (centralnu) bazu;
- *Jednostavnost pri korišćenju* – Intuitivan interfejs, jednostavna navigacija i automatski unos/ažuriranje podataka su velika olakšica za korisnike;
- *Sinhronizacija „u hodu“* – Korišćenjem Wi-Fi-a moguća je automatska sinhronizacija sa centralnim uređajima;
- *Brzina* – ukoliko se prethodno optimizira količina podataka sa kojom AMOS mobilni uređaj radi, omogućuje se automatski odziv i sl.

5.8. AMOS replikator

AMOS replikator je aplikacija koja se sastoji od skupa programa koji omogućuju korisniku da instalira i konfiguriše softver, importuje i eksportuje podatke, da prati ove procese, kao i da prati istoriju kreiranja replika (kopija) podataka. Transfer podataka je baziran na eksternim pravilima koja regulišu komunikacije između različitih aplikacija i baza podataka. Ova pravila se mogu duplirati i prilagoditi određenim poslovnim strategijama korisnika. AMOS replikator obezbjeđuje slanje i prijem podataka putem nekoliko specifičnih metodologija. Osnovna arhitektura sistema, shematski je prikazana na slici 5.13. Fleksibilnost sistema se postiže korišćenjem „lejera“ koji upravljaju transferom podataka između različitih aplikacija.



Slika 5.13. Arhitektura AMOS replikatora (izvor: [14])

Konfigurisanje. *Čarobnjak* (Wizard, eng.) za AMOS replikator omogućuje kreiranje, modifikovanje i brisanje replikator mehanizama i servisa. Ovaj program, dakle, obezbjeđuje: kreiranje novih replikator mehanizama i servisa, apgrejd baze podataka, apgrejd licence, uklanjanje postojećih servisa, pregled i konfigurisanje određenih servisa itd.

Pokretanje. AMOS replikator funkcioniše u principu kao svaki standardni program za repliciranje podataka. Ima dva moda rada - za eksportovane i za importovane podatke. U skladu sa odgovarajućim pravilima i procedurama, replikator eksportuje podatke, pri čemu ih kompresuje u odgovarajuće pakete u XML-u, dijeli ih u manje segmente i šalje na mjesto prijema. Na mjestu prijema AMOS mehanizam ponovo spaja segmente paketa podataka, vrši njihovo raspakivanje i importuje podatke u sistem na prijemnoj strani. Oba moda rade samostalno, s tim što sistem prati čitavo vrijeme uspješnost, odnosno, tačnost izvršenja procesa.

Klasterizacija. U okviru AMOS replikatora moguće je izvršiti podjelu servisa na klastere: aplikacije, procesi i destinacije. Konfiguracije je moguće vršiti posebno za svaku sesiju slanja/prijema podataka, ili uopšteno. Takođe, moguće je koristiti *default* konfiguraciju, ili je usklađivati sa individualnim potrebama.

Osnovne prednosti AMOS replikatora su skalabilnost i elastičnost. Replikator može da procesuira oko 25 000 stavki u sekundi pri eksportovanju, odnosno, oko 1 000 stavki u sekundi pri importovanju. Dodatno, omogućuje distribuciju podataka putem različitih komunikacionih kanala. Dakle, radi se o fleksibilnoj konfiguraciji, koja može da ispuni različite zahtjeve u pogledu bezbjednosti podataka i performansi samog sistema.

5.9. AMOS podrška za održavanje prema stanju

AMOS modul za podršku održavanju prema stanju (CBM – Condition Based Monitoring, eng.) omogućuje kompletnu podršku pri kontroli postrojenja/uređaja na brodu prema stanju. Radi se, zapravo, o softveru za pružanje podrške korisniku u izbjegavanju otkaza, smanjenju troškova održavanja i povaćanju operativnog kapaciteta. Ovaj moduo se koristi za prikupljanje, memorisanje, analizu i prikaz stanja svih postrojenja/urađaja na brodu, uključujući njihove performanse i trenutni status u smislu održavanja.

Ovaj softver se koristi za kontrolu svih aspekata održavnja i radi kao AMOS ekstenzija modula za održavanje i narudžbe (M&P). Obezbjeđuje potpunu transparentost kada su u pitanju informacije o stanju pojedinih postrojenja/uređaja, alarme u slučaju potrebe, jednostavno kreiranje i održavanje baze podataka o stanju/održavanju itd. Zahvaljujući ovom modulu, AMOS danas pruža, takoreći, savršene mogućnosti održavanja na brodu [15].

5.10. AMOS SFI standard

SFI – Group System[8] je klasifikacioni sistem koji ima široku primjenu u pomorstvu i *off-shore* industriji širom svijeta. Riječ je o međunarodnom standardu, koji obezbjeđuje funkcionalnu podjelu tehničkih i finansijskih informacija o brodovima i platformama. SFI čini strukturu kodova koja pokriva sve aspekte brodova/platformi i može se smatrati osnovnim standardom u pomorstvu i *off-shore* industriji. Više od 6000 SFI sistema je instalirano širom svijeta. SFI koriste takođe brodogradilišta, konsultantske kuće, distributeri softvera, upravni organi u pomorstvu i klasifikaciona društva [16]. Ovdje se njegove osnove razmatraju kao vid fizičke *podloge* ili osnova strukture podataka koje koristi AMOS.

SFI – Group System je prvi put realizovan 1972. godine, kao rezultat projekta norveškog Istraživačkog instituta za brodove (Ship Research Institute of Norway, eng.). Danas je prodaju, marketing i razvoj SFI – Group System-a, preuzela *SpecTec* kompanija. Svrha SFI je da pruži podršku, prije svega, brodarskim i *off-shore* kompanijama u kontroli operacija, na način što objedinjuje procedure vezane za naručivanje, računovodstvo, održavanje, tehničke evidencije, itd. Ovaj sistem ima brojne prednosti kada su u pitanju:

- Komunikacije;
- Kooperacija;

[8] SFI – Group System (System for classification of technical and economic ship information, eng.) – sistem za klasifikaciju tehničkih i ekonomskih informacija o brodu.

– Kontrola troškova;
– Kontrola kvaliteta;
– Uvođenje računara;
– Razvoj (uopšte);
– Obrazovanje i obuka;
– Standardizacija, itd.

Kada je SFI grupa osnovana, namjera je bila da ona omogući svim brodovima i platformama jedinstveni standard za razmjenu informacija sa kompanijama u brodarstvu i *off-shore* industriji. Sistem je trebalo da bude nezavisan od organizacije, metoda gradnje, operiranja, održavanja i remonta broda/platforme.

Kako bi zadovoljili svrhu i zahtjeve ovog sistema, brodovi/plarforme su podijeljeni simbolički na funkcije. Funkcije su zajedničke za sve one koji su uključeni u projektovanje, gradnju i operiranje brodova/platformi. Kao svojevrsnu dopunu SFI standarda, svaki korisnik može da razvije specifičan kod, koji se tiče finansija i računovodsvenog plana, odnosno, kontrole ukupnih operativnih troškova. Brodogradilišta koja koriste SFI za planiranje i kontrolu proizvodnje, moraju da imaju dopunski kompanijski WBS[9] sistem. Dodatno, brodarske kompanije koje koriste SFI za planiranje i kontrolu operacija i održavanje, moraju da imamju dodatan sistem kodovanja za potrošni materijal.

5.10.1. Kontrola brodarskih i *off-shore* operacija

SFI poboljšava kontrolu i nivo kvaliteta kada su u pitanju aktivnosti tipa: održavanja, naručivanja, računovodstavnih poslova, vođenja tehničke evidencije, kako u brodarskim, tako i u *off-shore* operacijama. SFI obezbjeđuje brodarskim i *off-shore* kompanijama, brodogradilištima, pomorskim upravama, snabdjevačima i konsultatima, zajednički plan (okvir) za poslove, tipa:
– Specifikacija;
– Procjena;
– Nacrta;
– Upravljanja materijalnim resursima;
– Održavanja i planiranja popravki;
– Instrukcionih matreijala (knjiga);
– Budžeta i kontrole troškova;
– Vođenja dokumentacije i sl.

Područja korišćenja SFI se stalno šire, tako da je sistem znatno doprinio poboljšanju efikasnosti u pomorskoj industriji. SFI je postao posebno koristan alat kada su u pitanju procedure u okviru sistema kvaliteta ISO 9004.

Specifikacije. Specifikacije se rade na različitim nivoima, u pogledu detalja koje sadrže: nacrti, ugovori, izgradnja, opravke i dr. Tehnički opisi komponenti, treba da su dio specifikacije i da prate SFI detaljan kod. SFI baza podataka daje svojevrsnu podršku razvoju pojedinih specifikacija.

[9] WBS – Work Breakdown Structure, eng.

Procjene. Procjene su bazirane na specifikacijama i obično prate isti strukturni model. One se sastoje od troškova materijala i radnih sati. Primjer jedne procjene je dat u tabeli 5.1.

Tabela 5.1. Primjer SFI procjene (izvor: [16])

Specifikacija	Operacija	Sati	Materijal (nj.)
73	Sistem za kompresiju gasa		
731	Pokretanje sistema	200	
731.001	Pokretanje kompresora		150 000
731.003	Pokretanje rezervnog kompresora		98 000
731.005	Pokretanje separatora za vodu/ulje		17 000
731.010	Pokretanje tankova sa gasom		33 000
731.012	Pokretanje boca sa gasom		9 500
731.014	Pokretanje rashladnog sistema		12 000
731.016	Pokretanje uređaja za prigušivanje buke		5 000

Nacrti i vođenje dokumentacije. Nacrti mogu biti jednostavno numerisani prema SFI specifikaciji, dok se složeniji nacrti, izrađeni u CAD-u, mogu podijeliti u lejere i prikazivati detalje pojedinih segmenata konstrukcije. Identifikacija nacrta može da uključuje SFI sistemski broj. Standardni broj nacrta ima formu tipa: 179-731-001 (broj broda-broj SFI podgrupe-slijedni broj). Nacrti treba da su numerisani u skladu sa SFI podgrupama, ukoliko je to moguće. Nivo grupe ili glavne grupe se obično koristi za označavanje sistemskih nacrta, po sljedećem principu:
179-100-000: Glavni nacrti;
179-200-001: Nacrti presjeka broda i palube;
179-350-000: Nacrti ukrcajno-iskrcajnih uređaja;
179-446-001: Nacrti strojarnice i dr.

Narudžbe. Kod narudžbi rezervnih dijelova, brodarska kompanija mora da identifikuje SFI detaljni kod i slijedne brojeve (ukupno 9-10 cifara). S druge strane, kada narudžbe vrši brodogradilište, ono mora da specificira svaku pojedinačnu komponentu SFI detaljnim kodom (6 cifara).

Upravljanje materijalima. Kada naručuje rezervne dijelove, brodarska kompanija obično koristi sistem označavanja koji predstavlja kombinaciju SFI detaljnog koda i slijednih brojeva, npr.: *731.001 Startni kompresor; *731.001.001 HP cilindar; *731.001.002 LP cilindar; *731.001.003 HP glava cilindra; *731.001.004 LP glava cilindra, i sl.

Održavanje. Sistem za operiranje i održavanje obično uključuje registar svih jedinica za održavanje na brodu. Ove jedinice odgovaraju komponentama SFI detaljnog koda, npr.: *731.001. Startni kompresor; Oznaka: ...; Vrsta: ...; Serijski br.: ...; Kapacitet:... i sl.

Procedure za preventivno održavanje su takođe obuhvaćene SFI kodom, npr.: *731.001 Startni kompresor br.1; *Job A*: nakon 3000 radnih sati; *Job B*: pregled, ili sl.

Sve stavke vezane za preventivno i korektivno održavanje nalaze se u priručnicima za održavanje. Tehniči sistemi AMOS za održavanje i narudžbe se, takođe, u potpunosti oslanjaju na SFI Group System.

Opravke. Specifikacije opravki su obično bazirane na sistemu održavanja. Račun za opravku mora da bude u skladu sa prethodno pripremljenom specifikacijom opravke. Uobičajeno je da brodogradilište navodi cijene brodarskoj kompaniji na nivou podgrupe.

Operativni budžet. Pri planiranju budžeta u obzir se uzimaju održavanje, rezervni dijelovi, popravke i potrošni materijal. Plan budžeta i sve odnosne specifikacije treba striktno da su u skladu sa SFI Group System standardima. Pri tome se kontrola troškova rada ili popravki obično sprovodi na nivou podgrupe i detaljnog SFI koda. Primjer jedne direktne narudžbe koja je u domenu SFI detaljnog koda, dat je u tabeli 5.2.

Tabela 5.2. Obračun troškova u skladu sa SFI detaljnim kodom (izvor: [16])

Materijal (nj.)			
*731.001 Startni kompresor	Planirano: 150 000	Stvarno utrošeno:158 000	Razlika: +8 000

Izvještaji o radnim satima se obično realizuju u skladu sa standardima na nivou podgrupe. Moraju biti uključene i aktivnosti kojima se prati napredovanje posla. Primjer evidencije o utrošenim satima na popravci je dat u tabeli 5.3.

Tabela 5.3. Obračun radnih sati na popravci u skladu sa SFI na nivou podgrupe (izvor: [16])

Sati			
*731.001 Startni kompresor	Planirani:200	Stvarno utošeni: 210	Razlika: +10

Obezbjeđivanje kvaliteta. U cilju ispunjavanja ISO 9000 standarda i IMO zahtjeva za bezbjedno operiranje broda/platforme, neophodno je uspostaviti procedure koje ispunjavaju zahtjeve nadležnih institucija i klasifikacionih društava. Ovo je neophodno, prvenstveno, u cilu postizanja bezbjednosti. Priručnici za nadzor i instrukcione knjige na brodu/platformi moraju biti klasifikovani u skladu sa SFI.

Unos podataka. SFI Group System se obično koristi kao podloga za unos podataka (dokumenata) sa broda ili *off-shore* kompanije u sistem. SFI obezbjeđuje dobro strukturirane forme unosa nacrta, priručnika, izvještaja i publikacija. Ovdje još spadaju:

- Procedure vezane za testiranje i puštanje u rad pojedinih uređaja/postrojenja;
- Priručnici za praćenje rada, pokretanje i zaustavljanje uređaja/postrojenja;
- Procedure za otkrivanje kvarova;
- Popisi rezervnih dijelova;
- Popisi alata;
- Liste nacrta;
- Sertifikati;
- Podaci o agentima i dr.

5.10.2. Struktura SFI kodiranja

SFI Group System je strukturno trocifreni decimalni sistem kodiranja. Brodovi / platforme koriste deset glavnih grupa, od 0 do 9. Pri tome su samo glavne grupe od 1 do 8 u upotrebi. Korisnici mogu da se služe 0 i 9 grupom, kako bi klasifikovali glavne komponente koje nisu pokrivene SFI standardom. Svaka glavna SFI grupa (1 cifra) sastoji se od 10 grupa (2 cifre), a svaka grupa je podijeljena u 10 podgrupa (3 cifre). Primjer strukture glavne grupe je dat na slici 5.14.

Slika 5.14. Primjer strukture glavne SFI grupe (izvor: [16])

Glavna grupa (prva cifra) SFI za brodove je opisana nešto detaljnije u nastavku.
Glavna grupa 1: Brod uopšteno. Može se odnositi na bilo koju funkciju vezanu za brod, npr., opšte poslove, sistem kvaliteta, porinuće, dokovanje, garancije i dr.
Glavna grupa 2: Trup. Struktura trupa i materijali za zaštitu trupa.
Glavna grupa 3: Oprema za teret. Oprema i mehanizacija vezana za rukovanje teretom, uključujući sam teret, prekrcajne sisteme, vitla, grotla i dr.
Glavna grupa 4: Brodska oprema. Specifična brodska oprema i mehanizacija, navigaciona oprema, manevarska mehanizacija, oprema za sidrenje, komunikaciona oprema i dr. Ova grupa takođe uključuje i specifičnu opremu, kao što je, npr., oprema za ribolov.
Grupa 5: Oprema za posadu i putnike. Oprema, mehanizacija, sistemi i sl., ono što služi posadi i putnicima, npr., oprema za spasavanje, brodski namjestaj, oprema za ketering, sanitarni sistemi i dr.
Grupa 6: Glavne komponente postrojenja. Primarni uređaji u strojarnici, npr., glavni i pomoćni motori, propeleri, kotlovi, generatori i dr.
Grupa 7: Glavne komponente sistema i uređaja. Sistemi koji opslužuju glavna postrojenja, npr., sistemi goriva i maziva, sistemi za pokretanje glavnog motora, sistemi izduvnih gasova, sistemi za automatsku kontrolu i dr.
Grupa 8: Zajednički sistemi na brodu. Centralni brodski sistemi, npr., sistem za balastne i kaljužne vode, protivpožarni sistem, sistem za pranje, elektro-energentski sistem i dr.

Kada su u pitanju platforme, grupe se odnose na sljedeće:
Glavna grupa 1: Platforma uopšteno;
Glavna grupa 2: Trup i konstrukcija;
Glavna grupa 3: Sistemi i oprema za bušenje;
Glavna grupa 4: Oprema za platformu;
Glavna grupa 5: Oprema za posadu;
Glavna grupa 6: Glavne komponente postrojenja;
Glavna grupa 7: Glavne komponente uređaja;
Glavna grupa 8: Zajednički sistemi na platformi.

SFI kodovi vezani za detalje i materijale. Kodovi vezani za detalje i materijale pokrivaju komponente i materijale koji su povezani sa pojedinim podgrupama. Kako bi se došlo do nivoa komponenti, nekada je neophodno podijeliti podgrupe korišćenjem detaljnog koda. Ovaj detaljan kod još uvijek nije standardizovan, zbog raznovrsnosti opreme na brodovima i zbog razlike u kodovima brodogradilišta i brodarskih kompanija.

Obično postoje dvije različite klase komponenti i materijala koji se koriste: jedna klasa sadrži komponente i materijale koji se naručuju direktno za potrebe broda, a druga sadrži komponente koje se naručuju za potrebe skladišta. Kodovi su podijeljeni u dva dijela:

– *Detaljan kod*: komponente koje se naručuju direktno za potrebe naručioca, tj. broda. Ovaj kod se koristi da označi određenu komponentu i/ili opremu koji su u funkciji određenog podsistema. U detaljnom kodu, saplementarni kod se gradi od cifara: 001-099.
– *Kod materijala*: Ovaj kod se odnosi na materijal koji se naručuje za skladište.

Relacije između ovih kodova su prikazane na sljedećim primjerima: SFI Group System + *Detaljan kod*: 731.000-731.099 i SFI Group System + *Kod materijala*: 731.100-731.999 [16].

Značaj. Klasifikacioni sistem SFI Group System znatno doprinosi unifikaciji i boljoj organizaciji informacija koje se odnose na brodove/platforme i poboljšava komunikacije na nivou same kompanije i između kompanije i spoljnih partnera. SFI Group System čini kompanijske i *off-shore* operacije efikasnijim kroz uštede u resursima i smanjenje mogućnosti nastanka greški. SFI se s toga može smatrati zajedničkim imeniteljem za različite poslove brodarskih kompanija i *off-shore* operatera [16].

I.5. Izvori

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6. MSW

Svrha koncepta MSW (Maritime Single Window, eng.) je digitalizacija i pojednostavljenje administrativnih procedura prije uplovljenja/isplovljenja broda u/iz luku(e), u skladu sa zahtjevima EU Direktive o formalnostima pri izvještavanju (RFD - Reporting Formalities Directive, eng.), ili skraćeno Direktive 2010/65/EU [1]. *Dakle, MSW ima za cilj pojednostavljenje i harmonizaciju administrativnih procedura u pomorstvu, standardizovanjem elektronske razmjene informacija i racionalizacijom formalnosti pri uplovljenju/isplovljenju broda u/iz luku(e).* Kako bi se ovo postiglo, koriste se posebne forme za unos podataka, prilagođene za učitavanje u MSW, odnosno, NMSW[10] sistem. Detaljna upustva za korišćenje NMSW, npr., u UK, mogu se naći na webu [2].

U nastavku je ukratko opisano ko je u obavezi da koristi NMSW i kada, kao i koji uslovi pri tome moraju biti ispunjeni. Ova pravila će najvjerovatnije pretrpjeti određene izmjene u perspektivi, s obzirom da se trenutno koristi pilot verzija NMSW sistema[11].

6.1. Izvještavanje s brodova

U izvornom obliku, IMO FAL Konvencija[12] obuhvata sve komercijalne brodove koji plove međunarodnim vodama. Slijedeći EU i UK legislativu po pitanju carine, taksi, imigracija, sigurnosti, zdravlja i bezbjednosti, kao i upravljanja otpadom, u UK mogu postojati dodatni, detaljniji zahtjevi od onih koje FAL propisuje. Međutim, NMSW je novi mehanizam za obezbjeđivanje određenih elektronskih izvještaja i ne proširuje skup i sadržaj postojećih zahtjeva za izvještavanjem.

Obaveza izvještavanja. Zapovjednik broda, ili ovlašćena osoba, a to je najčešće brodski agent, su odgovorni za pripremanje i slanje izvještaja sa broda. Brodski agent obično ulaže izvještaj u ime i za račun zapovjednika. Originalni dokumenti mogu biti unijeti u sistem u vidu priloga, kada je to potrebno. Korisnik NMSW mora prvo biti registrovan, kako bi pristupio sistemu. Potom mora da unese podatke o kompaniji i kontakt podatke, uključujući i e-meil adresu. NMSW pristup je zaštićen i podaci o registrovanom korisniku se ne prosljeđuju neautorizovanim stranama. Kontakt podaci se koriste u slučaju da treba kontaktirati korisnika, npr., kada se očekuje ili planira prekid u radu sistema.

Vrijeme izvještavanja. Direktiva o formalnostima pri izvještavanju (RFD) zahtijeva da se u NMSW unesu relevantni podaci najmanje 24 časa prije uplovljenja broda u UK luku. Ukoliko je putovanje kraće od 24 časa, izvještaje treba poslati tokom isplovljenja broda iz prethodne luke. Ako se sljedeća luka uplovljenja promijeni tokom putovanja, ili se ne zna u trenutku isplovljenja, izvještaj treba poslati onog trenutka kada informacija o

[10] Kao sinonimi za MSW (Maritime Single Window, eng.), na nacionalnom nivou, u literaturi se koriste nazivi: NMSW (National Maritime Single Window, eng.), M(N)SW (Maritime (National) Single Window, eng.) ili NSW (National Single Window, eng.). Takođe, u širem značenju koriste se termini SW (Single Window, eng.) ili SWE (Single Window Environment, eng.). U daljem tekstu će biti opisane neke od razlika u tumačenju ovih pojmova.

[11] Sve u nastavku (do poglavlja 6.5) odnosi se uglavnom na UK.

[12] FAL Konvencija (The Convention on Facilitation of International Maritime Traffic, eng.) uključuje popise informacija/dokumenta koje treba dostaviti, ili koje organi vlasti mogu da traže prilikom uplovljenja/isplovljenja broda u/iz luku(e) [3].

sljedećoj luci postane izvjesna. Vrijeme primanja izvještaja je ono sadržano u meilu, poslatom korisniku nakon uspješnog učitavanja izvještaja u sistem. Lučke uprave zahtijevaju da im se dostave informacije o dolasku broda u luku, kako bi se blagovremeno pružile potrebne usluge, ali ovaj zahtjev je trenutno izvan okvira NMSW-a. Pri isplovljavanju iz UK luka, brodovi moraju da pošalju tzv. „Exit Check". Ovaj izvještaj se šalje u trenutku napuštanja luke, putem NMSW portala i mora obavezno da sadrži FAL 1 (Opštu deklaraciju) i FAL 5/6 (Manifest ili listu posade/punika) [1, p.7].

Dostupnost. Ukoliko NMSW iz nekog razloga nije dostupan, izvještaje treba poslati čim sistem postane dostupan. Planirani prekidi u radu se unaprijed objavljuju na stranici za pristup korisnika, a obično se planiraju za periode kada je saobraćaj rjeđi. U slučaju dužeg prekida, izvještaji se mogu poslati faksom ili meilom.

Prelazni period. Pilot NMSW je otvoren za unos izvještaja januara 2016. godine. U toku ove faze, postojeći načini izvještavanja su i dalje raspoloživi. Pilot NMSW će, dakle, raditi paralelno sa postojećim metodima (kanalima) izvještavanja do septembra 2016. godine, a riječ je o tzv. *dual-running*-u (eng.). Neposredno pred ovaj planirani rok, biće izdato obavještenje o zvaničnom prestanku funkcionisanja izvještavanja u papirnoj formi, faksom i/ili e-meilom [1, p.7].

Formati izvještavanja. Korisnici mogu koristiti Excel forme dostupne u okviru NMSW-a za unos podataka. Detaljna upustva o načinu popunjavanja formi (na primjeru FAL 1 i FAL 5/6) mogu se naći na NMSW web sajtu. Važno je naglasiti, da treba koristiti isključivo one forme koje su dostupne na NMSW portalu. Drugi dokumenti, u Word-u, Excel-u, PDF-u i sl., mogu biti učitani jedino kao „Supporting Documents".

Odredišta izvještaja. Izvještaji poslati sa brodova UK NMSW-u, prosljeđuju se:

- *Graničnoj policiji* za potrebe bezbjedonosnih i imigrantskih procedura (FAL 1, 5/6) i
- *HMRC* (Her Majesty's Revenue and Customs, eng.) carinskoj službi (FAL 1, 5/6).

Potvrda o prijemu se šalje na zvaničnu e-meil adresu korisnika. Korisnici mogu dati i alternativnu e-meil adresu, na koju će im takođe biti poslata potvrda o prijemu.

Dostupnost. Trenutno, izvještaji poslati putem pilot verzija UK NMSW nisu dostupni:

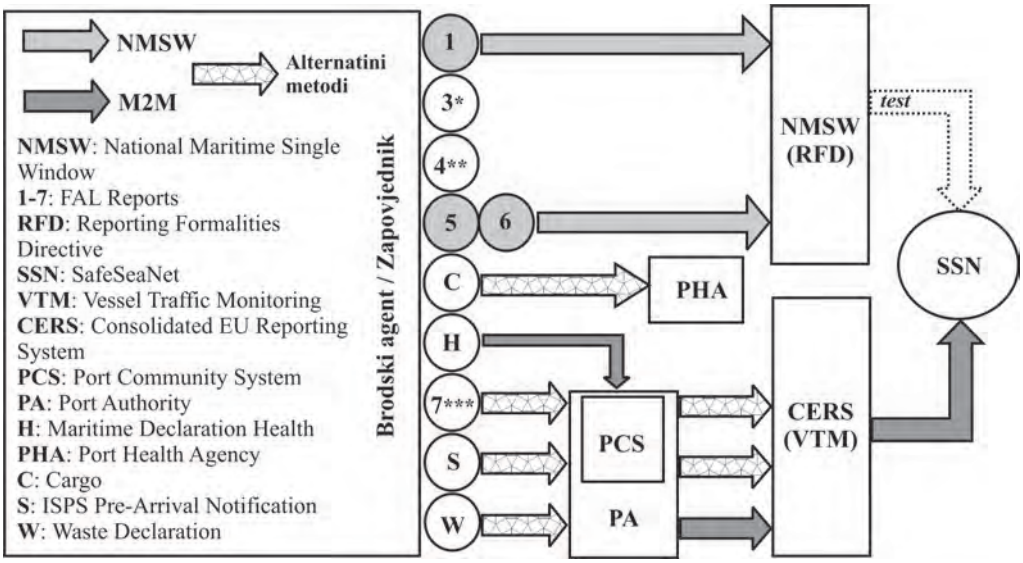
- Lukama;
- Lokalnim vlastima;
- Logističkim operaterima;
- Trgovačkim tijelima i unijama;
- Brodarima;
- Korisnicima brodova, posadi/putnicima, kao ni brodovlasnicima;
- Niti bilo kojoj drugoj neautorizovanoj strani [1, p.8].

Sva dokumenta (izvještaji) namijenjena prethodno navedenim entitetima, moraju se i dalje slati postojećim kanalima, tj. e-meilom, faksom i/ili klasičnom poštom.

6.2. Procedura slanja izvještaja

Shematski prikaz slanja izvještaja u pravcu NMSW-a i VTMIS-a, odnosno SSN, dat je na slici 6.1. Kako bi se lakše pratio tok informacija, u nastaku su data neka osnovna objašnjenja vezana za NMSW, odnosno, NSW, VTMIS i SSN [4].

VTMIS (Vessel Traffic Monitoring and Information Service, eng.) ima za cilj povećanje bezbjednosti i efikasnosti pomorskog transporta (roba i putnika) i pomorskog saobraćaja (brodova) na bazi regularnog informisanja, razmjene i dijeljenja informacija. VTMIS čini bazu elektronske platforme za razmjenu informacija na nivou EU (SSN). VTMIS uključuje aspekte koji se odnose na pomorstvo: bezbjednost, sigurnost, zaštitu životne sredine, kontrolu, odnosno, sprječavanje zagađenja mora i priobalja, kontrolu ribolova, kontrolu granica i dr., uz poštovanje zakonskih propisa. **VTMIS** se većim dijelom vezuje za **fizičku kontrolu saobraćaja brodova**.



Slika 6.1. Tok informacija od broda ka NMSW i CERS na primjeru UK (izvor: [1])
Legenda: *Izvještaj o zalihama na brodu koji se ne unosi u sistem, ali mora biti dat na uvid inspekciji kada dođe na brod (FAL 3); **FAL 4 treba da postoji na brodu; ***VTM nije dio RFD; M2M – Machine-to-Machine, eng. ili sistem-sistem komunikacija

RFD (Reporting Formalities Directive, eng.) ima za cilj pojednostavljenje i usaglašavanje administrativnih procedura koje prate operacije u pomorstvu, putem harmonizacije elektronskih informacionih standarda i racionalizacije formalnosti kod izvještavanja. Zahtjev RFD je uvođenje NSWs (National Single Windows, eng.) u svim zemljama članicama EU, počev od 01. juna 2015. godine[13]. Obavezno izvještavanje s broda treba da ide elektronskim putem, dok će izvještaji u papirnoj formi postati neprihvatljivi. NSWs povezuju sve entitete koji prate uplovljenje broda u luku (pomorske, lučke, carinske, granične, bezbjedonosne, zdravstvene i dr.) na način što se relevantni podaci o brodu, posadi/ put-

[13] Treba napomenuti da po ovom pitanju ima određenih kašnjenja na nivou EU.

nicima i teretu šalju u elektronskoj formi, samo jednom. RFD takođe obavezuje zemlje članice EU da harmonizuju svoje NSWs sa SSN kako bi mogla nesmetano da se vrši razmjena informacija. **RFD** se odnosi većim dijelom na **administrativno praćenje/ kontrolu broda pri uplovljenju/isplovljenju**.

SSN (SafeSeaNet – Using the Union Maritime Information and Exchange System, eng.) ima za cilj korišćenje jedinstvenog sistema na nivou EU za razmjenu informacija u pomorstvu (6.5.1).

Na osnovu prikazanog toka informacija sadržanih u fomama FAL 1-7, PAN (Pre-Arrival Notification, eng.) i Deklaraciji o otpadu, jasno je da se forme FAL 1 i FAL 5/6 obavezno unose u NMSW, dok su ostale forme (najave/deklaracije) opcione i komuniciraju posredstvom PCS[14]-a (Ports' Community Services, eng.) i lučkih vlasti sa VTMIS-om na nacionalnom, odnosno, sa SSN-om na EU nivou.

6.3. Vrste izvještaja

U ovom odjeljku su opisane vrste izvještaja, odnosno, oni izvještaji (forme) koje je neophodno učitati u pilot verziju NMSW u UK; oni koji nisu neophodni; oni koji se šalju određenim entitetima/službama posebno, tj. drugim kanalima; kao i oni koji moraju da postoje na brodu, ali ne postoji obaveza da se šalju drugim entitetima.

6.3.1. FAL 1 (Opšta deklaracija)

FAL 1 (Opšta deklaracija) je obavezna pri izvještavanju putem NMSW. Ova deklaracija se odnosi na uplovljenje/isplovljenje broda, putovanje, broj članova posade/putnika, izjavu o teretu, kao i naznaku koje druge FAL forme treba da čine konačan paket izvještaja. Podaci poslati putem pilot verzije NMSW, biće dostupni jedino graničnoj policiji i HMRC. Za slanje ovih podataka drugim entitetima, treba koristiti postojeće alternativne kanale. U situacijama kada je potrebno dobiti ovjerenu FAL 1 formu nazad, kao izlaznu deklaraciju, moraju se i dalje koristiti postojeći metodi. Ova mogućnost ne postoji u pilot verziji NMSW-a.

[14] PCS (Port Community System, eng.) je elektronska platforma koja omogućuje razmjenu informacija između stejkholdera u luci i olakšava lučke i logističke administrativne procedure [5].

6.3.2. FAL 2 (Deklaracija o teretu)

FAL 2 (Deklaracija o teretu) nije generalno u upotrebi kada je u pitanju NMSW. Umjesto ove deklaracije manifest tereta se elektronski prosljeđuje putem PCS-a, na koji su povezani HMRC i MCA[15] (Maritime and Coastguard Agency, eng.). Dodatno, neke opšte informacije o teretu su sadržane u posebnom odjeljku FAL 1 forme.

6.3.3. FAL 3 (Deklaracija o zalihama na brodu)

FAL 3 (Deklaracija o zalihama na brodu) se u principu ne unosi u NMSW sistem. Ranije se zahtijevalo da brodovi dostave izvještaje o svim zalihama koje podliježu carinjenju. Danas carinski službenici dolaze na brod i njima se direktno daju na uvid ove informacije. Ukoliko na brodu ima vatrenog oružja, tada se informacije o tome unose u polje „Remarks“ FAL 1 izvještaja.

6.3.4. FAL 4 (Deklaracija o ličnim stvarima članova posade)

FAL 4 (Deklaracija o ličnim stvarima članova posade) treba da postoji na brodu, ali se ne unosi kao obavezna u NMSW sistem. Svaki član posade treba da ispuni ovu deklaraciju za sebe i ona mora da postoji na brodu u slučaju HMRC inspekcije. Takođe, u NMSW-u postoji posebno polje „Crew's Effects“, koje se može aktivirati na zahtjev. Ukoliko neko od članova posade posjeduje vatreno oružje, kao što je prethodno rečeno, ono se mora prijaviti u polju „Remarks“ FAL 1 forme.

6.3.5. FAL 5 (Lista posade) / FAL 6 (Lista putnika)

FAL 5 (Lista posade) / FAL 6 (Lista putnika) se obavezno unose u NMSW. Kombinovana FAL 5 i FAL 6 forma je dostupna na NMSW portalu. Lista putnika, tj. FAL 6, se ne ispunjava ukoliko nema putnika na brodu. Manifest posade i putnika je neophodan zbog bezbjedonosnih, imigrantskih i carinskih procedura. Ukoliko ne sadrži FAL 5/6, poslati izvještaj neće biti prihvaćen kao validan. Kompletna FAL5/6 forma se šalje putem NMSW graničnoj policiji i HMRC. Svima ostalima, kada je to potrebno, ovi manifesti (liste) se šalju alternativnim kanalima.

[15] MCA (The Maritime and Coastguard Agency, eng.) je UK izvršna agencija zadužena prvenstveno za sprječavanje gubitaka ljudskih života na moru. Takođe, odgovorna je za primjenu Britanskog i Međunarodnog pomorskog prava i bezbjedonosnih politika. Od 2015. godine, nadležna je za akcije traganja i spasavanja. Više o MCA, može se naći na web lokaciji: www.gov.uk/government/organisations/maritime-and-coastguard-agency (pristup: 27.07.2016).

6.3.6. FAL 7 (Deklaracija o opasnom teretu)

Kada je u pitanju FAL 7 (Deklaracija o opasnom teretu), zapovjednici/agenti svih brodova koji prevoze opasan teret su u obavezi da ga prijave putem ove deklaracije. Ona se šalje luci, posredstvom VTM-a (Vessel Traffic Monitoring, eng.). U proširenoj verziji NMSW, FAL 7 deklaracija bi trebalo da se unosti i posredstvom samog sistema.

6.3.7. ISPS bezbjedonosna deklaracija

Prema ISPS (International Ship and Port Facility Security, eng.) kodu, brodovi koji plove međunarodnim vodama, moraju luci da pošalju najavu dolaska (PAN - Pre-Arrival Notification, eng.) Ovo pravilo važi za sve putničke i teretne brodove preko 500 [gt]. PAN se za sada dostavlja direktno luci (ili preciznije, PFSO – Port's Facility Security Officer-u, eng.). Nova verzija MCA (Maritime and Coastguard Agency, eng.) CERS[16] (Consolided European Reporting System, eng.) će prihvatati elektronski PAN deklaraciju. Takođe, biće razmotrene i mogućnosti interakcije sa NMSW sistemom [1, p.14].

6.3.8. Pomorska zdravstvena deklaracija

Pomorsku zdravstvenu deklaraciju, prema zakonskim propisima Svjetske zdravstvene organizacije (WHO – World Health Organization, eng.), zapovjednik (agent) dostavlja zdravstvenoj inspekciji u luci, ukoliko zna ili pretpostavlja da na brodu postoji neki vid (opasne) zarazne bolesti. Po pravilu, zapovjednik (agent) ovu deklaraciju dostavlja direktno zdravstvenoj inspekciji u luci, ali ukoliko to smatra potrebnim, dodatnu kopiju može dostaviti i putem NMSW u vidu saplementa.

6.3.9. Deklaracija o otpadu

U skladu sa planom upravljanja otpadom u luci, trenutno se zahtijeva da sa broda deklaracija o otpadu bude upućena direktno luci, osim ako brod ne potpada pod kategoriju "uobičajen saobraćaj sa čestim i regularnim dolascima". Ukoliko želi, zapovjednik može ovu deklaraciju, kao dodatak, da unese u NMSW. Naredna verzija MCA CERS će zahtijevati elektronski unos deklaracije o otpadu, a takođe će se razmatrati mogućnosti interakcije sa NMSW.

[16] CERS (Consolidated European Reporting System, eng.) prikuplja i kontroliše informacije o brodovima koji plove UK vodama, a koji prevoze opasan teret. Više o CERS se može naći na web lokaciji: https://data.gov.uk/dataset/consolidated-european-reporting-system-cers (pristup: 27.07.2016).

6.3.10. Kompletiranje izvještaja

Putem NMSW portala treba obavezno unijeti FAL 1 i FAL5/6 kombinovanu formu. Ukoliko se otkrije tehnička greška pri unosu/učitavanju, izvještaj će biti vraćen pošiljaocu. Greške moraju da budu korigovane i ispravljene forme ponovo učitane u sistem. Postoje detaljna upustva za ove postupke [1,2].

6.4. Neka pitanja i odgovori vezani za NMSW

U ovom odjeljku je dato nekoliko pitanja i odgovora koji se odnose na (UK) NMSW.

Zašto treba koristiti NMSW? - Svrha NMSW je, prije svega, dostavljanje elektronskih umjesto papirnih dokumenata. Takođe, korisnici dobijaju automatski potvrdu ukoliko su poslata dokumenta ispravno primljena. Dokumenta prima istovremeno više entiteta. Sistem je dizajniran tako da je prilagođen korisniku, tj. jedostavan je i logičan za korišćenje. Putem NMSW izbjegavaju se neki problemi, tipa: nečitkosti rukopisa, nejasnoća kod izvještavanja, nepouzdanosti ili neispravnosti opreme za slanje dokumenata i sl. U UK se trenutno koristi pilot verzija NMSW u kojoj se kao obavezni izvještaji traže forme FAL 1 i FAL5/6, koje su prethodno opisane.

Kako se NMSW koristi? - Detaljna upustva za ispunjavanje FAL formi, nalaze se, kako je već rečeno, na NMSW oficijelnom web sajtu [2]. Dodatno, biće obezbijeđeni treninzi za korišćenje NMSW širom UK, za sve korisnike sistema, u kolaboraciji sa graničnom policijom i trgovačkim asocijacijama. Povratne informacije o iskustvima u korišćenju NMSW-a, poželjno je slati na e-meil: NMSW@dft.gsi.gov.uk [1, p.16].

Koje forme treba učitati u sistem? - U pilot fazi korišćenja NMSW-a, obavezne su FAL 1 i FAL 5/6 kombinovana forma. U sistem se kao dodatni mogu učitati svi oni dokumenti koje zapovjednik, odnosno, agent smatraju relevantnim. Forme su jednostavne i sadrže zaglavlje sa opštim podacima o brodu, koje se može kopirati, tj. koristiti u istoj formi pri svakom narednom izvještavanju, čime se smanjuje obim administrativnog posla na brodu i na kopnu.

Koliko dugo će se još koristiti alternativni vidovi izvještavanja? - Budući da je NMSW još uvijek u eksperimentalnoj fazi, najvjerovatnije će do ljeta 2016. godine [1, p.17] ovaj sistem biti korišćen paralelno sa već postojećim kanalima izvještavanja. Detaljnije informacije o tome biće blagovremeno dostupne na web portalu.

Zašto i kako NMSW koegzistira sa MCA/CERS[17]*?* - NMSW i MCA/CERS su trenutno odvojeni i služe različitim, ali ne nepovezanim svrhama. NMSW se koristi za izvještavanja sa brodova, obično posredstom agenata, u pravcu policije i carine. CERS je vezan za pojedine luke i usmjerava VTM izvještaje (PAN) ka MCA, prvenstveno u bezbjedonosne svrhe. CERS ima takođe pristup PCS-u. CERS je u fazi apgrejda i nova verzija će moći da prihvati FAL 7, Deklaraciju o otpadu i ISPS PAN od strane luka. MCA radi sa lukama u smislu definisanja metoda za automatsku razmjenu informacija. U budućnosti, razmatraće se mogućnosti interakcije NMSW i CERS, a svaka odluka po ovom pitanju, biće prosljeđena korisnicima oba sistema. Za sada, postoji samo eksperimentalni hipe-rlink između NMSW-a i CERS-a.

[17] MCA/CERS - Maritime and Coastguard Agency, eng. / Consolidated European Reporting System, eng.

Da li će luke koristiti NMSW? - Luke neće koristiti NMSW. Dok je agent *u akciji*, informacije poslate luci, u luci će se i zadržavati, ili će biti upućivane upravnim institucijama korišćenjem postojećih metoda, uključujući CERS.

Kako se mogu poslati povratne informacije NMSW-u? - Korisnici mogu poslati povratne informacije, kao što je već pomenuto, na e-meil: NMSW@dft.gsi.gov.uk. Pošto je NMSW trenutno u pilot fazi, sve povratne informacije dobijene od strane korisnika, biće uzete u obzir u postupku daljeg razvoja sistema.

Kako se može unijeti potpis u FAL formu? - Ukoliko korisnik to želi, može da učita Word dokument sa potpisom zapovjednika, kao „Supporting Information" za svaku FAL formu (6.14.1).

Da li ima sankcija u slučaju neblagovremenog izvještavanja? - Postoje kaznene mjere definisane od strane pojedinih HMG (Her Majesty's Government, eng.) tijela, čija će se primjena u slučaju neblagovremenog izvještavanja sprovoditi u neizmijenjenom obliku.

Da li je zagarantovana povjerljivost podataka unijetih u NMSW? - NMSW je bezbjedan sajt, zaštićen sistemom lozinki i predmet je zaštite sigurnosnih protokola na državnom nivou. Podaci unijeti u ovaj sistem ne prosljeđuju se niti jednoj neautorizovanoj strani [1, p.18].

6.5. Prototip na nivou EU

Razvoj MSW/NSW[18] prototipa počeo je 2013. godine, kao dio projekta integralne pomorske politike (IMP – Integrated Maritime Policy, eng.). Projektom rukovodi EMSA (European Maritime Safety Agency, eng.) u saradnji sa šest zemalja članica: Bugarskom, Grčkom, Italijom, Maltom, Rumunijom i Norveškom. Ostale zemlje članice imaju pristup zajedničkom NSW prototipu kako bi se familijarizovale sa implementiranim funkcijama sistema [6]. EMSA obezbjeđuje hosting NSW prototipova. Neke zemlje članice za potrebe NSW koriste sopstveno IT okruženje (npr., UK).

Prototip omogućuje članicama da odaberu rješenje koje najbolje odgovara njihovim individualnim potrebama i znatno smanjuje troškove i vrijeme implementacije, putem korišćenja tehničke dokumentacije i softverskih komponenti koje je već razvila EMSA. Softvrske komponente NSW, web i M2M (sistem-sistem) interfejsi, razvijeni su u cilju:

- Implementacije NSW-a, tj. obezbjeđivanja njegove on-line dostupnosti korisnicima (zapovjednicima, odnosno, brodskim agentima), drugim nacionalnim sistemima i SSN-u;
- Implementacije zajedničkih funkcija NSW-a, npr., generisanja, slanja i procesuiranja izvještaja/deklaracija i dr.;
- Obezbjeđivanja servisa koji su povezani sa referentnim bazama podataka, tj. geografskim lokacijama i pojedinostima o brodovima, kao i
- Testiranja kompilacije podataka o geografskoj poziciji broda i relevantnih podaka iz izvješataja, putem grafičkog interfejsa.

[18] U nekim EU i EMSA dokumentima, koji su ovdje korišćeni kao izvori, za MSW (Maritime Single Window, eng.) se koristi sinonim NSW (National Single Window, eng.). Pogledati fusnotu [1], takođe.

6.5.1. SafeSeaNet (SSN)

SafeSeaNet (SSN) je zajednički sistem za razmjenu informacija o brodovima i njihovim putovanjima, između članica EU, kako bi se EU Komisiji obezbijedile važne informacije u skladu sa zakonskim propisima i kako bi se zadovoljili zahtjevi po pitanju razmjene bitnih operativnih informacija.

Cilj SSN sistema je, dakle, podrška EU Komisiji i članicama u aktivnostima vezanim za bezbjednost i sigurnost na moru, kao i u lukama; zaštitu životne sredine; efikasnost pomorskog transporta i saobraćaja i dr. SSN je mreža nacionalnih NSW sistema članica, koji su povezani na centralni SSN host, kojim upravlja EMSA. SSN ima različite interfejse, prilagođene različitim vidovima prenosa podataka. Dodatno, SSN ima centralnu bazu podataka sa referentnim informacijama o geografskim lokacijama i svojstvima brodova [6].

SafeSeaNet (SSN) je informacioni sistem za praćenje saobraćaja brodova, čija je svrha:

- Bezbijednost na moru;
- Sigurnost na moru i u lukama;
- Zaštita mora i priobalja;
- Efikasnost pomorskog saobraćaja i transporta.

Sistem predstavlja mrežu putem koje se razmjenjuju podaci u pomorstvu i koja povezuje pomorske uprave širom EU. SafeSeaNet (SSN) omogućuje EU članicama slanje i prijem informacija o brodovima, njihovim putovanjima, kao i o opasnim teretima. Sistem prikuplja i obezbjeđeje korisnicima sljedeće informacije:

- AIS informacije o pozicijama brodova (koje se apdejtuju svakih 5-6 minuta);
- Istoriju pozicija brodova (za nekoliko dana unazad);
- Dodatne informacije na osnovu AIS izvještaja, tipa: identifikacije i imena broda, zastave koju vije, dimenzija, tipa, brzine i sl.;
- Očekivano vrijeme dolaska/odlaska (ETA/ETD);
- Detalje o opasnom teretu na brodu;
- Informacije o incidentima koji mogu da ugroze bezbjednost broda;
- Informacije o zagađenju mora;
- Detalje o otpadu koji brod treba da iskrca (od juna 2015. godine);
- Bezbjednonosne informacije vezane za brod (takođe, od juna 2015. godine);
- Informacije o oštećenjima na brodovima;
- Informacije o brodovima kojima je zabranjeno uplovljenje u EU luke;
- Digitalne mape sa više lejera, koje obezbjeđuju informacije o dubinama, navigacionim uređajima, saobraćajnim separacionim shemama, sidrištima, lokacijama AIS stanica, itd. [7]

SSN obezbjeđuje državnim lučkim upravama informacije 72 [h] ili 24 [h] o dolasku broda u luku, kao i aktuelne informacije o očekivanim vremenima dolaska i odlaska. Ovo olakšava kontrolu pomorskog saobraćaja, a takođe i planiranje aktivnosti u lukama. Preklapanjem AIS i SAR (Synthetic Aperture Radar, eng.) informacija, SSN omogućuje identifikaciju brodova koji ispuštaju nedozvoljeno otpad i njihovo pozivanje na odgovornost. Takođe, SSN u mnogome pomaže u pripremama u slučaju opasnosti od zagađenja mora i akcijama za sprečavanje, odnosno, uklanjanje poslje-

dica. SSN olakšava upravljanje incidentnim situacijama, prati i kontroliše saobraćaj brodova u priobalnim zonama, vrši analize rizika i tako obezbjeđuje važne statističke pokazatelje; olakšava upravljanje otpadom; povećava bezbjedonosne mjere na moru; podržava „Blue Belt“ pilot projekat (6.14.1) i sl. [8]

6.6. Glavne funkcije prototipa

Glavne funkcije NSW prototipa su:

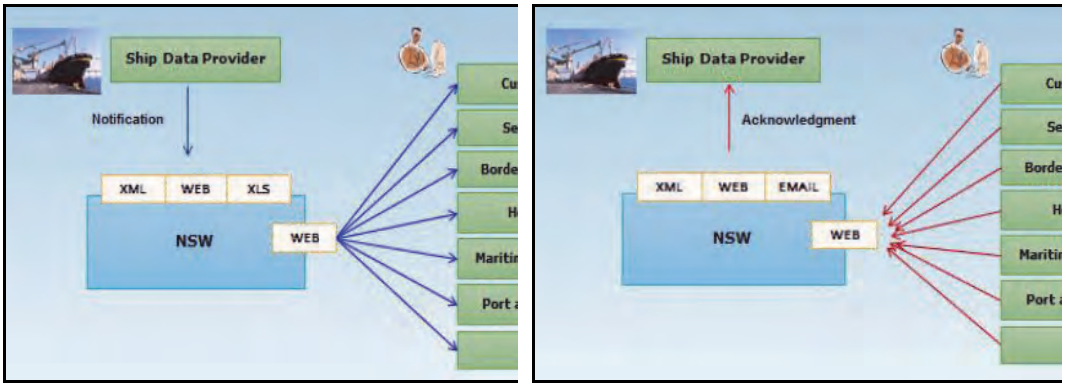
- Prikupljanje informacija kroz proces izvještavanja s brodova prije/nakon uplovljenja/-isplovljenja u/iz luku(e);
- Distribucija ovih informacija relevantnim nacionalnim i lokalnim upravama;
- Snimanje potreba, primjedbi, odobrenja i dr., poslatih od strane nacionalnih uprava, kao i prosljeđivanje istih korisnicima na strani brodova, tj. zapovjednicima, odnosno, agentima.

Dodatno, NSW je povezan sa SSN sistemom, kako bi se omogućilo „povlačenje“ relevantnih informacija o brodu, posadi, putnicima i teretu, poslatih prethodnoj luci dolaska u drugoj zemlji članici EU.

Podaci o brodovima se dostavljaju putem XML interfejsa (baziranog na 28005 standardu) ili putem web-a, koji omogućuje učitavanje XLS fajlova. Nacionalnim i lokalnim upravama, relevantne informacije su dostupne putem web interfejsa [6].

U svakom trenutku izvještaj može biti sačuvan kao draft (radna verzija). Radne verzije se ne šalju nacionalnim upravama, ali ih zato pošiljalac s broda može u svakom trenutku apdejtovati. Izvještaji se šalju upravama jedino pošto se učitaju u sistem. Potvrda prijema sa komentarima od strane uprava, prosljeđuje se korisniku na strani broda putem XML-a i web interfejsa.

E-meilovi se sistemski šalju nacionalnim upravama i korisnicima na brodovima, kako bi se obavijestili o prispijeću novog obavještenja, izvještaja, odnosno, potvrde prijema (slika 6.2).



Slika 6.2. NSW: tok informacija *od* i *ka* korisnicima na strani brodova (izvor: [6])

Legenda: Ship Data Provider, eng. – agent/zapovjednik; Customs, eng. – carina; Security, eng. – sigurnost (policija); Board control, eng. – granična kontrola, Health, eng. – zdravstvena inspekcija; Maritime Safety, eng. – služba pomorske bezbjednosti, Port authority, eng. – lučke vlasti

6.7. Izvještavanje

Sljedeće forme izvještaja se u principu mogu slati posredstvom NSW-a:

- Izvještaji bazirani na zakonskim aktima EU:
  1. Obavještenje da je brod uplovio/isplovio u/iz luku/e zemlje članice (čl.4 Direktive 2002/59/EC, koji utvrđuje Zajednički monitoring pomorskog saobraćaja i informacioni sistem);
  2. Granična kontrola osoba (čl.7 Odredbe (EC) No. 562/2006 – Šengenski granični kod);
  3. Obavještenje o opasnom ili zagađujućem teretu na brodu (čl.13 Direktive 2002/59/EC o zajedničkom monitoringu pomorskog saobraćaja i informacionom sistemu);
  4. Obavještenje o otpadu (čl.6 Direktive 2002/59/EC o lučkom upravljanju otpadom generisanim na brodu i ostacima tereta);
  5. Obavještenje o bezbjedonosnim mjerama (čl.6 Odredbe (EC) No. 725/2004 o pružanju podršci brodovima i bezbjednosti lučkih postrojenja);
  6. Skraćena deklaracija ulaska (Odredba Vijeća (EEC) No. 2913/92 – Zajednički korisnički kod i Odredba (EC) No. 450/2008 – Poboljšan korisnički kod).

Takođe, iako to nije pomenuto u Aneksu Direktive 2010/65/EU, NSW prototip uključuje zahtjeve Direktive 2009/16/EC o lučkoj kontroli:

  7. Obavještenje o dolasku broda u luku 72 [h] prije dolaska, za brodove koji podliježu proširenoj inspekciji (čl.9);
  8. Standardno obavještenje o dolasku/odlasku broda (čl.24).

- FAL forme i druge formalnosti koje su reziltat nacionalnih zakonskih instrumenata:
  1. FAL forma 1: Opšta deklaracija;
  2. FAL forma 2: Deklaracija o teretu;
  3. FAL forma 3: Deklaracija o brodskim zalihama;
  4. FAL forma 4: Deklaracija o ličnim stvarima članova posade;
  5. FAL forma 5: Lista posade;
  6. FAL forma 6: Lista putnika;
  7. FAL forma 7: Deklaracija o opasnom teretu;
  8. Pomorska zdravstvena deklaracija.
- Informacije koje se traže na bazi nacionalnog zakonodavstva:
  1. Formalnosti vezane za teret: Deklaracija o privremenom skladištenju i manifest tereta;
  2. Potvrda o isporuci otpada;
  3. Potvrda o gorivu na brodu;
  4. Potvrda o građanskoj odgovornosti za zagađenje izazvano izlivanjem nafte;
  5. Potvrda o građanskoj odgovornosti za slučaj oštećenja tankova nafte;
  6. Oštećenja na brodu.

Svi podaci iz ovih formi se opisuju korišćenjem struktuiranih podataka ili alfanumeričkih karaktera i tretiraju se kao individualni ili grupni elementi podataka [6, p.7].

6.8. Tok informacija

Informacije se šalju NSW kao obavještenja prije uplovljenja broda u luku (arrival notification, eng.), prije isplovljenja iz luke (departure notification, eng.) i kao obavještenje o uplovljenju/isplovljenju (arrival/departure notication, eng.) putem web korisničkog interfejsa i sistemskog interfejsa. Podaci se mogu poslati kao posebna obavještenja od strane jednog ili više korisnika na strani broda. Korekcije prethodno poslatih informacija se u principu prihvataju, s ciljem obezbjeđivanja tačnosti finalnih podataka/informacija.

Na svaki primljeni izvještaj NSW *odgovara* se potvrdom prijema (receipt, eng.). Potvrda prijema znači da je izvještaj primljen od strane NSW-a i da će biti proslјeđen relevantnim entitetima/upravama. Povratna informacija od entiteta/uprava se realizuje putem posebnog odobrenja (acknowledgement, eng.). Podaci koje sadrži izvještaj zavise od vrste obavještenja (uplovljenje ili isplovljenje). Samo ona polja koja su relevantna, ispunjavaju se u formama korisničkog web interfejsa. Kada primi izvještaj putem sistemskog interfejsa, NSW uzima u obzir samo bitne elemente, a ostale odbacuje. U zavisnosti od konfiguracije, NSW koristiti sve elemente podataka ili grupe elemenata podataka. Konfiguracija NSW zavisi od legislative i zahtjeva u određenoj zemlji članici. Važno je napomenuti i to, da jedna ili nekoliko kargo deklaracija mogu biti uključene u jedan isti izvještaj. Jedna kargo deklaracije, opet, može da bude sasatavljena od više pošiljki. U okviru podataka o teretu moraju biti unijeti detalji o opasnom i zagađujućem teretu, ukoliko ga ima na brodu. NSW kontroliše ispravnost podataka samo u tehničkom smislu. Pozitivan *receipt* (potvrda) znači da su podaci ispravno unijeti u on-line forme, a na državnoj upravi je da procijeni i ispita vjerodostojnost podataka, koja se potom potvrđuje pozitivnim *acknowledgement*-om, ili odobrenjem.

6.9. Ponovno korišćenje istih informacija

NSW omogućuje korisnicima ponovno korišćenje (*re-use*, eng.) informacija. Korisnik, naime, može da koristi prethodne izvještaje u svrhu pripremanja novih. Jedino što korisnik u tom slučaju treba da uradi, jeste da provjeri ispravnost ranije unijetih podataka.

NSW takođe omogućuje korisnicima na strani broda da ponovo koriste SSN podatke za pripremanje PAN izvještaja. U ovom slučaju, podaci se samo prenose iz SSN u NSW izvještaj (ovo, npr., nije slučaj kod UK MNSW, gdje postoji samo eksperimentalni hiper link između SSN i NMSW-a, ali još uvijek ne i funkcionalna veza). SSN informacije pri tome uključuju:

- Indentifikaciju i opis broda;
- Opis putovanja;
- PAN informacije o uplovljenju/isplovljenu;
- Detalje o opasnom i zagađujućem teretu;
- Detalje o odlaganju otpada;
- Bezbjedonosne mjere i
- Informacije o posadi i putnicima[19].

[19] Ponovno korišćenje informacija o posadi i putnicima je moguće samo u svrhe tesitanja novog NSW prototipa, ali ne i u operativne svrhe.

6.10. Potvrde/Odobrenja

U okviru NSW-u postoje tri modela slanja potvrda o prijemu:

- *Nema slanja potvrde*. NSW u ovom slučaju ne šalje potvrdu korisniku. Komunikacija sa vlastima/upravanim organima se odvija izvan NSW-a;
- *Prećutna potvrda*. *Negativna* potvrda se šalje korisniku jedino ako je izvještaj odbijen. U protivnom se ne šalje.
- *Sistemska potvrda*. Potvrda se uvijek šalje korisniku, bez obzira na konačnu odluku nadležnih vlasti/upravnih organa.

U principu, određeni NSW podržava samo jedan od ovih modela, koji se konfiguriše prilikom instaliranja sistema. Odobrenja izvještaja se mogu dobiti od jednog ili više nadležnih entiteta. Status odobrenja može biti: „prihvata se“ ili „ne prihvata se“. Ova odobrenja se dobijaju pošto nadležni organi procijene validnost dostavljenih podataka u izvještaju i bilo da su pozitivna ili negativna, treba da sadrže odgovarajuća objašnjenja.

6.11. Struktura prototipa

U nastavku je dat kratak opis NSW prototipa, koji uključuje:

- Zajedničku *kapiju* (gateway, eng.) za izvještavanje (CRG - Common Reporting Gateway, eng.), koja obezbjeđuje standardizovan interfejs putem koga korisnici na strani broda mogu da šalju svoje izvještaje upravnim organima na kopnu i dobijaju povratne informacije u smislu potvrde/odobrenja poslatih izvještaja;
- Modul za razmjenu informacija između samih upravnih organa (AIE – Authority Information Exchange, eng.), koji ima poseban interfejs i komunicira sa SSN-om;
- Podsistem namijenjen tehničkoj administraciji resursa (RC – Resources Core, eng.), koji upravlja zahtjevima korisnika i sistemskom konfiguracijom. Ovaj podsistem u okviru NSW ima poseban interfejs (Resources Mng. UI, eng.);
- Grafički interfejs (GI – Graphical Interface, eng.), koji omogućuje prikaz brodova i izvještaja poslatih sa njih na mapi, korisnicima CRG i AIE. Grafički interfejs je povezan sa SSN bazom podataka i dostupan je samo NSWs kojima hosting pruža EMSA. Postoji takođe poseban sistem repliciranja podataka između SSN i NSW, koji omogućuje da izvorni podaci o brodovima u SSN, npr., podaci o poziciji, budu replicirani u NSW-u.

  Za sada, NSW prototip je implementiran u dva oblika, tj. kao:
- Verzija koja koristi *zaštićeni softver* (Oracle za baze podataka i Oracle WebLogic za aplikacioni server), kao i
- Verzija koja koristi *open-source softver* (PostgreSQL za baze podataka i Apache Tomcat za aplikacioni server) [6, p.13].

Direktiva EU koja se odnosi na formalnosti vezane za slanje izvještaja sa brodova (RFD – Reporting Formalities Directive, eng.) ili **Direktiva 2010/65/EU**, usvojena je od strane EU Parlamenta i Vijeća, 20. oktobra 2010. godine [9].

Cilj RFD je da pojednostavi i harmonizuje administrativne procedure u pomorskom transportu. Ova direktiva je stavila u zadatak zemljama članicama da uspostave NSW za

potrebe elektronskog izvještavanja pri uplovljenju/isplovljenju brodova, do juna 2015. godine, za 14 formi izvještavnja datih u dodatku RFD.

Komisija je 25. juna 2014. godine podnijela izvještaj EU Parlamentu i Vijeću o implementaciji ovog sistema [10]. U izvještaju su navedeni rezultati koje su zemlje članice po ovom pitanju postigle, ali su takođe navedene i poteškoće u pojedinačnom finansiranju i tehničkoj realizaciji, tako da se pokazala potreba za zajedničkim rješavanjem problema. U izvještaju se insistira na tome da članice pojednostave i usaglase svoje aktuelne procedure kako bi se približile realnom rješenju.

U cilju pružanja podrške u implementaciji RFD, EU Komisija je formirala ekspertsku grupu čiji je zadatak bio da pojednostavi administrativne procedure i prateće elektronske servise. Riječ je o eMS grupi – čija je misija identifikovanje poslovnih procesa i razvoj specifikacija za NSWs. Grupa je sastavljena od predstavnika nacionalnih pomorskih uprava. Predstavnici industrije – EU udruženje brodovlasnika, EU udruženje luka, Svjetsko vijeće brodara, FEPORT i Međunarodno PCS udruženje, su prisustvovali sastancima eMS. EMSA je takođe dala svoj aktivan doprinos u radu eMS, pri osmišljavanju funkcionalnih i tehničkih specifikacija, kao i načina testiranja sistema. Dodatno, brojni entiteti u domenu transporta, carine, granične kontrole, bezbjednosti, sigurnosti, zdravstva i zaštite životne sredine su učestvovali u radu eMS, tj. harmonizaciji poslovnih procesa i jedinstvenog skupa NSWs podataka u skladu sa važećom regulativom i postojećim standardima. Ovo je rezultiralo NSW smjernicama, koje je verifikovala eMS grupa 17. aprila 2015. godine [11]. Ekspertska grupa eMS je 25. februara 2015. godine usvojila Izvještaj o mapiranju podataka, koji predstavlja opšti skup podataka za slanje informacija ka NSW. Elementi su identifikovani ranije od strane posebnih radnih podgrupa u skladu sa nacionalnim administrativnim zahtjevima. Skup ovih podataka se sastoji od 177 elemenata podataka, koji su prvo jasno definisani, a onda mapirani u okvirima ISO 28005 XML standarda i Svjetskog carinskog organizacionog modela podataka (World Customers Organisations Data Model, eng.) [12][20].

Jasno je da je koncept MSW veoma ambiciozno zamišljen, a da se kasnije pokazalo da je realizacija prilično komplikovana, pa se krenulo sa pojednostavljenjima i racionalizacijom primarno postavljenih zahtjeva. U nastavku je dat prikaz ovog koncepta u nešto širem kontekstu, na osnovu koga se vidi o koliko složenom projektu se zapravo radi, posebno ako se imaju u vidu heterogeni akteri sa divergentnim interesima. Naime, IT ne mogu samostalno da izvrše „pomirenje“, bez prethodno uspostavljenog političkog, ekonomskog i organizacionog „pomirenja“, odnosno, usaglašavanja na regionalnim, nacionalnim i nadnacionalnim nivoima, između različitih stejkholdera u pomorstvu.

6.12. Zahtjevi u skladu sa EU Direktivom 2010/65/EU

U skladu sa Direktivom 2010/65/EU biće neophodno sljedeće:

– Zemlje članice će morati da intenziviraju saradnju sa kompetentnim upravama, kao što su carina, granična kontrola, predstavnici javnog zdravstva, transporta i drugih, u pravcu daljeg pojednostavljenja i harmonizacije izvještavanja unutar Unije i efikas-

[20] Više informacija se može naći na web lokaciji: http://ec.europa.eu/transport/modes/maritime/e-maritime_en.htm (dostupno: 31.07.2016).

nijeg korišćenja elektronskog prenosa podataka i sistema za razmjenu informacija, uz simultano eliminisanje barijera unutar jedinstvenog evropskog pomorskog prostora;
- Ubuduće, trebalo bi što intenzivnije koristiti elektronski transfer dokumenata, a FAL forme u papirnoj verziji prihvatati jedino u izuzetnim slučajevima;
- Zemljama članicama će biti dostupni ekonomski podsticajni mehanizmi u promovisanju i širenju standardizovanog elektronskog transfera dokumenata;
- Strane uključene u trgovinu i transport treba da budu opremljene IT uređajima za prihvatanje i pohranjivanje standardizovanih elektronskih formi, kako bi ispunile zahtjeve izvještavanja u okvirima standardnih NSW formata. Pri tome, individualni elementi podataka treba samo jednom da se unose u sistem;
- U cilju obezbjeđivanja nesmetanog elektronskog realizovanja formalnosti oko izvještavanja u pomorstvu na nivou EU, sistem mora da je interoperabilan i da omogući nesmetano funkcionisanje unutar evropskog pomorskog prostora bez barijera [13]. Drugim riječima, od nacionalnih administricaja se zahtijeva da obezbijede: *„NSW putem koga će korisnici (brodski operateri, zapovjednici i/ili autorizovani agenti) da proslјeđuju neophodne informacije (FAL forme, deklaracije, obavještenja i dr.) samo jednom, dok će sistem biti osposobljen da interpretira, kombinuje i distribuira informacije u svrhe njihovog daljeg procesuiranja u SafeSeaNet-u i u nacionalnim agencijama."* [13, p.4]

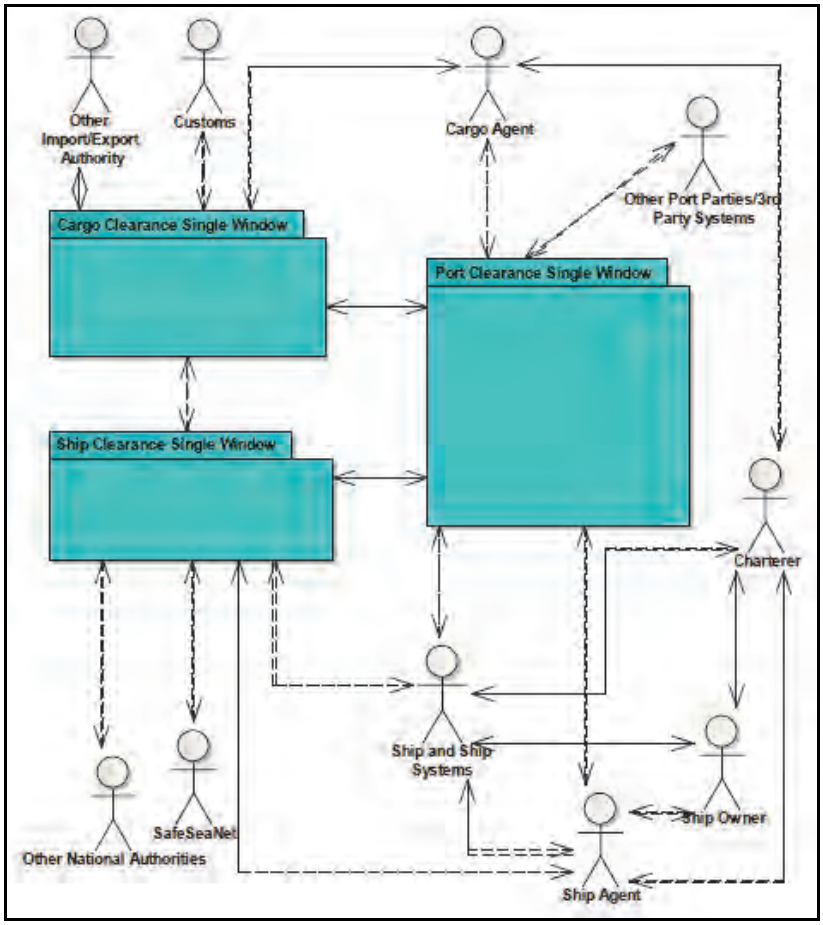
Dakle, NSW treba da obezbjeđuje nesmetan protok informacija između NSW, brodarske industrije, javnih uprava i SSN-a. Pod pojmom brodarska industrija, ovdje se misli konkretno na: brodara, zapovjednika, brodskog agenta, ili drugo ovlašćeno lice koje komunicira sa NSW. S druge strane, NSW komunicira sa različitim nacionalnim upravama, koje su zadužene za poslove: pomorske bezbjednosti i sigurnosti, carinjena, granične kontrole, zdravstvene i fitopatološke kontrole i dr. NSW koji pripadaju različitim zemljama članicama EU, komuniciraju sa SSN kao krovnim sistemom koji je pod nadležnošću EMSA-e. U komunikacijima između ovih entiteta koriste se sljedeći vidovi interfejsa: (a) M2M (machine to machine, eng.) ili sistem-sistem interfejs između NSW i SSN; (b) korisnički web baziran interfejs na relaciji NSW – upravni ograni; kao i (c) sistem-sistem i web baziran korisnički interfejs na relaciji brodarska industrija (brod) – NSW [11].

6.13. (M)SW-a u širem kontekstu

„Single Window" (SW) koncept su formalizovale UN kroz svoj Centar za trgovinu i elektronsko poslovanje (UN/CEFACT 2005) [14,15] s ciljem postizanja efikasne razmjene relevantnih informacija između trgovačkih organizacija i državnih subjekata. Tako da koncept SW ima bazično utemeljenje u domenu formalnog olakšavanja trgovine i carinjenja. Prvenstveno je ovaj sistem bio fokusiran na povećanje efikasnosti uvozno-izvoznih mehanizama i procedura, gdje se moraju dostavljati detaljne informacije o teretu pri realizaciji svih prekograničnih aktivnosti. Dakle, izvorno, SW je bio usmjeren na efikasne, kolaborativne elektronske transakcije između trgovačkih i državnih/upravnih entiteta u prekograničnim poslovima.

Međutim, koordinacija SW i njegovo fukcionisanje se razlikuju u zavisnosti od toga da li ga posmatramo i analiziramo: (a) kao sistem u čijem je centru **carinjenje**, tj. uvoz-

no/izvozno aktivnosti; (b) kao sistem koji je orjentisan na **luku i brod** sa fokusom na poslove pomorskog transporta; ili (c) kao sistem u čijem su središtu **povećanje bezbjednosti i sigurnosti** (pomorskog) transporta i saobraćaja [16]. Takođe, postavlja se pitanje da li je SW: javan, privatan ili je u tzv. javno-privatnom vlasništvu. Sa stanovišta troškova, postavlja se pitanje da li su usluge koje sistem vrši besplatne za korisnike ili se plaćaju, odnosno, ko ih i koliko plaća. Sa organizacionog stanovišta, SW može se analizirati sa međunarodnog, nacionalnog, regionalnog ili lokalnog aspekta, itd. Na slici 6.3 je prikazana pojednostavljena shema organizacionog modela SW koji uključuje administrativno (i fizičko) praćenje tereta, brodova i lučkog poslovanja.



Slika 6.3. SW taksonomija (izvor: [16])

Legenda: Cargo, eng. – teret, Ship, eng. – brod, Port, eng. – luka, Clearance, eng. – odobrenje, Import/export authority – uvozno/izvozni upravni organi, Customs, eng. – carina, Agent, eng. – agent, Owner, eng. – vlasnik, itd.

Ima, dakle, nekoliko modela postojećih i SW u razvoju. SW može, npr., da pokriva aktivnosti vezane za izvještaje o teretu, u slučajevima kada glavnu ulogu igraju uvozno-izvozne deklaracije. Drugi vid SW može da bude organizovan oko broda, kada su u pitanju odobrenja koja brod treba da dobije od određenih državnih organa. Odobrenja se dobijaju na osnovu obaveznih izvještaja koji se sa strane broda dostavljaju nacionalnim up-

ravnim organima prilikom uplovljenja/isplovljenja. Treći model SW se odnosi na luku i može se identifikovati sa PCS.

Sve članice EU, kao i pridružene članice, povezane su (ili će uskoro biti) na centralni SSN sistem. Svaka zemlja treba da odredi nacionalno tijelo koje će biti oficijelna veza sa SSN, za koji je odgovorma EMSA [16].

Lučki SW se u mnogim slučajevima poistovjećuje sa PCS. To je sistem zasnovan na integrisanim procedurama, pravilima, standardima i ICT rješenjima koja podržavaju automatsku razmjenu podataka, odnosno, dokumenta koja se odnose na brod, posadu, punike i teret, prilikom uplovljenja, boravka u luci i/ili isplovljenja broda. PCS podržava zahtjeve nacionalnih agencija, ali takođe i onih entiteta zainteresovanih za teret. PCS *pokriva* zahtjeve za carinjenjem i rukovanjem teretom, kao i razmjenu informacija vezanih za servise koji se u luci pružaju brodu i teretu. Jasno je da PCS stavlja akcenat na privatne i komercijalne informacije vezane za naručivanje i naplatu lučkih usluga, prije nego na samo praćenje broda. S druge strane, EPC (Electronic Port Clearance, eng.) je koncept koji se više vezuje za brodove i njihovo elektronsko upravljanje formalnostima vezanim za dokumentaciju i procedure pri uplovljenju/isplovljenju, odnosno, tokom boravka broda u luci. Ovo važi za sve brodove koji plove međunarodnim vodama. EPC nastoji da zamijeni postojeću dokumentaciju FAL formama [16].

Na slici 6.3 je interesantno primijetiti, npr., da brodovlasnici (Ship Owners, eng.) i unajmitelji (Charterers, eng.) ne komuniciriju direktno sa SW, već posredstvom pojedih podsistema SW, ali su bez obzira na to obuhvaćeni sistemom u širem smislu.

U tabeli 6.1 je dat pregled tri vida SW, skoncentrisanih oko tereta, broda i luke.

Tabela 6.1. Vrste SW-a (izvor: [16])

SW - Teret	
Opis	SW koji je fokusiran na procedure carinjenja i obuhvata informacije o teretu pri uvozu i izvozu.
Korisnici	Korisnici su: pošiljalac, primalac, carina i agent.
Svojstva	Svrha SW u ovom slučaju je carinjenje tereta. Drugim riječima, teret mora da dobije dozvolu za dalje transportovanje sa uvozno/izvozne zone na terminalu.
Ciljevi	Informacije o teretu: vlasništvo, porijeklo, upustva za rukovanje, opšte informacije o stanju i sl.
Funkcionalnost	Registri: Grupe koje se odnose na teret, lokaciju, kod taksi i sl. Automatizacija: XML i web baziran korisnički interfejs, kontrola pristupa. Mehanizmi za komunikaciju s drugim SW rješenjima.
SW - Brod	
Opis	SW za davanje odobrenja brodu. Sadrži informacije o samom brodu, putovanju, teretu, putnicima, posadi, kao i informacije koje se zahtijevaju od strane SafeSeaNet-a (SSN-a).
Korisnici	Korisnici su sam brod, zapovjednik/agent, snabdjevači broda, upravni organi kojima je potrebno dostaviti informacije o statusu broda u kontrolne, odnosno, brojne bezbjedonosno-sigurnosne svrhe. Upravni organi su: policija, obalna straža, obalna administracija, zdravstvene i sanitarne inspekcije i dr.
Svojstva	Svrha SW u ovom slučaju je dobijanje jasnog uvida u bezbjednost i sigurnost pomorskog transporta. U pitanju može biti sprječavanje akcidentnih situacija, ili kontrola da li se, npr., podaci o nekom od putnika

	ili članova posade, poklapaju sa podacima neke sumnjive osobe i sl.
Ciljevi	Informacije o brodu, informacije o teretu, informacije o posadi/putnicima, informacije o putovanju, posebna obavještenja ve-zana za opasan i/ili zagađujući teret ukoliko ga brod prevozi, (eventualno) postojanje zarazne bolesti na brodu i sl.
Funkcionalnost	Registri: Grupe koja se odnose na teret, brod, lokaciju i sl. Automatizacija: XML i web bazirani korisnički interfejs, izvještaj o prihvatanju, razna odobrenja (automatsko slanje) i sl. Korišćenje senzorskih podataka u kontrolne svrhe. Naručivanje servisnih usluga, npr., pilotaže. Mehanizmi za komunikaciju sa drugim SW rješenjima kao i sa pružaocima servisa.
SW - Luka	
Opis	SW za odobrenja pri uplovljenju/isplovljenju broda u/iz luku(e). Takođe, ovdje mogu biti uključene i informacije klasifikovane kao privatne, tj. one informacije koje se odnose na komercijalne aspekte poslovanja.
Korisnici	Brod, operater broda, agenti, lučki menadžement, pružaoci lučkih usluga i dr.
Ciljevi	Ovaj vid SW se prvenstveno koristi za davanje odobrenja brodu od strane luke. Luka koristi informacije koje dobije od zapovjednika/agenta u cilju pružanja efikasnih i bezbjednih usluga brodu, putnicima, posadi i teretu. Takođe, na osnovu ovih informacija luka obračunava troškove koje korisnik treba da plati. Radi se o javnim i/ili privatnim informacijama.
Funkcionalnost	Registri: Grupe koje se odnose na teret, brod, lokaciju, lučke usluge i sl. Automatizacija: XML, web interfejs, izvještaji/odobrenja (automatski), najave (automatske) i dr. Korišćenje senzora za svrhe bezbjednosti-sigurnosti i sl. Naručivanje lučkih usluga i kontrola raspoloživosti lučkih kapaciteta. Mehanizmi za komunikaciju sa drugim SW rješenjima, kao i pružaocima servisnih usluga u luci; razmjenu opštih informacija o luci, statistika, zakonskih akata i dr.

Jedan od izazova pri specifikaciji SW je donošenje odluke o tome koje dimenzije će sistem imati, tj. koliko geografsko područje će pokrivati: internacionalni, nacionalni, regionalni ili lokalni nivo. Takođe, u ovom pogledu su moguća i *ad-hoc* rješenja [16]. Za svaku od ovih dimenzija postoje različite potrebe i različiti pravni okviri. Brod s druge strane, prekoračuje dimenzije ovoga tipa, samim tim što plovi međunarodnim vodama. Tako da uvijek postoji potreba za uspostavljanjem nesmetanih komunikacija između heterogenih sistema unutar SW konteksta. U tabeli 6.2 je dat pregled različitih SW rješenja koja koriste neke EU luke. Pregled je rezultat izvještaja EU eMAR[21] projekta.

[21] The e-Maritime Strategic Framework and Simulation based Validation (eMAR) Project, eng.

Tabela 6.2. Pregled korišćenja SW-a u EU lukama (izvor: eMAR Konzorcijum,2013)

EU luka / SW	Port SW	PCS	NSW	Harbour Authority System	Cargo Community System	Polish Harbours' Information and Control System	Single Point of Contact,
Antwerp	x	x	x				x
Copenhagen-Malmoe	x	x					
Cyprus Port Authority	x						
Dunkerque				x	x		
Bordeaux	x		x				
Esbjerg		x					
Hamburg		x					
Klaipeda	x						
Livorno Port Authority	x						
Koper	x						
Rauma			x				
Sautampton							
Stockholm	x	x	x				
Szczecin						x	

U literaturi se susreću različiti modeli za razvoj metodologije i taksonomije pri projektovanju i implementaci SW okruženja, kao što su na primjer: Zachman-ov okvir [17]; CIMOSA (Computer Integrated Manufacturing Open System Architecture, eng.) [18]; SOA (Service Opened Architecture, eng.) [18,19]; SoaML (Service oriented architecture Modeling Language, eng.) [20] i dr. Svaki od ovih modela ima određene prednosti i nedstatke kada je u pitanju primjena na SW okruženje.

6.14. Izazovi implementacije i komercijalna rješenja

Iako su ciljevi i rok za uvođenje (N)MSW-a (1. jun 2015. godine) jasno definisani, implementacija je većim dijelom ostavljena zemljama članicama EU. Kako danas postoji veliki broj IT mogućnosti, povećava se i mogućnost nepoželjnog *preklapanja* nekih rješenja slične namjene (npr., NSW opšte namjene; eCustoms; PCS; raznih trgovačkih informacionih portala i dr.), tako da postoji opasnost ulaska u debatu „bez kraja“ po pitanjima:

- Da li MSW treba da bude dio NSW[22]?
- Može li se MSW proširiti i postati NSW?
- Da li bi MSW i NSW trebalo da budu potpuno odvojeni projekti?
- Da li veza sa SafeSeaNet-om treba da bude sastavni dio MSW projekta?
- Treba li i može li, zapravo, MSW biti dio PCS?, itd.

[22] Primarno, ideja (N)SW-a se odnosila na olakšavanje prekogranične trgovinske razmjene. “Jedinstveni prozor” u ovom slučaju omogućuje učitavnje svih dokumenata vezanih za uvoz/izvoz (carinska deklaracija, zahtjevi za odobrenje uvoza/izvoza, potvrde o porijeklu robe, trgovački ugovori i sl.). (N)MSW je u osnovi ova ista ideja, samo *translirana* u domen razmjene podataka/informacija/dokumenata u pomorskom transportu i saobraćaju.

Kako bi se ovo izbjeglo, uputno je angažovati kompaniju sa bogatim iskustvom u odnosnom domenu i tako lakše razriješiti neke dileme i doći prije do konkretnih rješenja. U nastavku je ukratko prezentirano ono na čemu je uspješno radila međunarodna INTRASOFT kompanija, koja bi mogla, npr., pružiti podršku i obezbijediti konkretna rješenja na nacionalnom nivou pri implementaciji, održavanju i razvoju MSW-a.

6.14.1. Neka INTRASOFT rješenja

Multinacionalna kompanija INTRASOFT [13], koja je među prvima radila implementaciju SafeSeaNet-a za EMSA-u, ima bogato iskustvo u domenima operacija i komunikacija u pomorstvu. Konkretno, INTRASOFT kompanija je radila na SafeSeaNet-u, kao centralnom EU serveru za:

- Monitoring saobraćaja brodova u EU vodama;
- Monitoring usklađenosti brodova sa VTS standardima;
- Snimanje podataka o putovanju broda (VDR – Voyage Data Recording, eng.);
- Izvještavanje u slučaju incidenata/akcidenata na moru i sl.

Dodatno, relevantni pilot projekti koje je INTRASOFT radila za EMSA-u su:

- Integracija VMSs, FMCs (Fisheries Monitoring Centers, eng.) i SSN na bazi AIS-a;
- Praćenje i nadzor „Blue Belt“[23] brodova unutar EU pomorskog tržišta i izvještavanje autorizovanih EU centara;
- (N)MSW za elektronsko slanje izvještaja s brodova, uz definisanje formata poruka i mehanizama za razmjenu. Ovaj informacioni sistem omogućuje:
  - Elektronsko slanje dokumenata (FAL formi i saplementa) s broda ka (N)MSW, kao i potvrda o primitku, odnosno, odobrenja u povratnom smjeru, putem korisničkog web baziranog i sistem-sistem interfejsa;
  - Komunikaciju između (N)MSW i relevantnih nacionalnih uprava putem korisničkog web interfejsa;
  - Distribuciju informacija od (N)MSW do SSN centrale i od SSN centrale ka pojedinim (N)MSWs putem sistem-sistem interfejsa i dr.

INTRASOFT ima, takođe, bogato iskustvo u lučkim *pozadinskim* poslovima vezanim za (N)MSW. Riječ je višegodišnjem iskustvu u luci Pirej (Grčka) na implementaciji i održavanju ovog i podržavajućih sistema, kao i u radu sa carinskim upravama (eCustoms, eng.).

Zahvaljujući svom profesionalnom iskustvu, INTRASOFT nudi neka napredna rješenja kada je u pitanju (N)MSW. Na primjer, naprednu sigurnosnu funkciju elektronskog potpisivanja dokumenata (XML Digital Signatures, eng.), koja omogućuje pošiljaocima autentifikaciju i obezbjeđuje integritet podataka pri učitavanju dokumenata u sistem. Ova mogućnost je bazirana na tzv. infrastrukturi javnih ključeva (PKI - Public Key Infrastructure, eng.). INTRASOFT dodatno radi sa fino podešenom *mašinom za orkestraciju* komunikacija i transfera dokumenata. Ovaj mehanizam obezbjeđuje koordinaciju između (N)MSW-a i spoljnih, pozadinskih sistema i mreža, od trenutka kada se informacija učita

[23] EU Komisija je 2013. godine kreirala okvir za tzv. “Blue Belt” (plavi pojas) okruženje. U ovoj oblasti, (neki) brodovi bi trebalo slobodno da saobraćaju, uz minimalne administrativne zahtjeve [21].

u sistem dok se ne procesuira. INTRASOFT[24] nudi na *IBM Sterling B2B Integrator*-u bazirana MSW rješenja, koja omogućuju bezbjedno i nesmetano izvršenje više poslovnih procesa istovremeno i dr.

6.15. Prednosti MSW-a

Bez obzira na brojne probleme u implementaciji[25], u nastavku je izdvojeno nekoliko ključnih prednosti, na osnovu dva sekundarna izvora, koje bi MSW trebao da obezbijedi brodarskoj industriji i upravnim organima na kopnu uključenim u pomorski transport/ saobraćaj na nivou EU.

Izvor 1:

- MSW je fleksibilan i *user-friendly* (eng.) alat za automatsko povezivanje relevantnih informacija o brodovima, putnicima, posadi i/ili teretima, vezanim za izvještavanje sa broda ka obali i u obrnutom smjeru;
- Razmjenom informacija o brodu, putnicima/posadi/teretu, među svim akterima uključenim u proces izvještavanja, poštuje se po automatizmu pravo pristupa informacijama ili tzv. *need-to-know* (eng.) princip;
- Smanjuju se vrijeme slanja izvještaja, sa reda sati na red minuta, čime se posada oslobođa dijela administrativnog posla i može bolje da se usresredi na poslove neposrednog vođenja broda, što povećava bezbjednost navigacije;
- Smanjuju se ukupni troškovi izvještavanja i eliminiše se potreba za angažovanjem posrednika;
- Smanjuje se IT kompleksnost. Korišćenjem tzv. *in-house solutions* (eng.) u domenu pomorskog transporta/saobraćaja, obezbjeđuje se potpuno izvještavanje, odnosno, praćenje brodova na lokalnom, regionalnom, (nad)nacionalnom nivou (ima);
- Obezbjeđuje se usaglašenost sa međunarodnim standardima, tipa: ISO 28005, WCO, EDIFACT, uključujući i specifične EU zahtjeve [22, p.14] i dr.

Izvor 2:

- Pomorske i logističke procedure će biti pojedostavljene;
- Brodarske usluge će biti poboljšane u poslovnom smislu, a smanjenje kašnjenja je pritom najvažniji elemenat;
- Novi sistem će smanjiti potrebu za *face-to-face* (eng.) kontaktima, čime će se ne samo smanjiti troškovi, već će se povećati i transparentnost;
- Povećaće se sigurnost transakcija;
- Transfer podataka će biti prilagođen svim (uključenim) poslovnim sistemima;
- *Papirne* transakcije će biti eliminisane;
- Novi sistem će biti univerzalna *jedinstvena tačka* (single point, eng.) za unos relevantnih podataka, čime će se izbjeći dupliranje unosa;
- Sistem će biti zaštićen od upada, *curenja informacija*, virusa i sl.;
- Sistem će, takođe, biti skalabilan sa pojednostavljenim postupcima za uključivanje novih korisničkih servisa [23, p.30] i dr.

[24] Više informacija o ovoj kompaniji, može se naći na web-u: www.intrasoft-intl.com (pristup: 01.08.2016)
[25] Ovdje treba, još jednom, poentirati i problem vezan za standardizaciju samog naziva sistema.

Za sada, još uvijek ostaju brojna otvorena pitanja po osnovu potpune implementacije ovog sistema u okviru EU jedinstvenog pomorskog tržišta, njegovog efikasnog funkcionisanja, fleksibilnosti i skalabilnosti. Ova pitanja bi trebalo da budu predmet daljih i podrobnijih istraživanja.

I.6. Izvori

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DIO II

P.1. Seaport positioning supported by the combination of some quantitative and qualitative approaches[1]

Pozicioniranje morskih luka podržano kombinacijom kvantitativnih i kvalitatitivnih pristupa

Abstract: The ports' management is facing the challenge of sustainable port development, considering several aspects: economic, technological, logistical, environmental, and community involvement. Although the numerous scientific concepts have been developed for explaining the trends of ports' involvement into the logistics chains, this research work presents an attempt to draw the attention to the marketing aspect of the port mission, being focused primarily on the customers' needs, whose preferences are the key factor in selecting specific port in competitive environment. Therefore, the Adriatic, Aegean, and Black Sea ports, sharing the unique marketing features and target market, have been analyzed with the aim to be mutually positioned. The considered ports have similar goals: to achieve the greater degree of competitiveness as well as to acquire the larger number of customers being attracted on the basis of superior port choice criteria. These circumstances have been explored through some distinctive quantitative and qualitative criteria by employing the appropriate, well known and structured PROMETHEE and AHP methods. The obtained results are presented by perception maps, and described on the basis of gained quantitative indicators and the qualitative explanations given by the authors, primarily, in the marketing manner.

Keywords: port choice criteria, marketing, positioning, multi criteria decision analysis.

Apstrakt: Upravljanje lukama je povezano sa izazovima održivog razvoja, uključujući nekoliko aspekata: ekonomskih, tehnoloških, logističkih, onih vezanih za očuvanje životne sredine i uključenost šire društvene zajednice. Iako su razvijeni brojni naučni koncepti koji se bave uključivanjem luka u lance snabdijevanja, ovaj istraživački rad predstavlja nastojanje da se skrene pažnja na marketinške aspekte misije luka, koji se odnose na potrebe korisnika, čije su preferencije ključni faktor za opredjeljenje za određenu luku u konkurentskom okruženju. Stoga su luke Jadranskog, Jonskog i Crnog mora, koje dijele zajednička marketinška svojstva i jedinstveno tržište, analizirane s ciljem međusobnog pozicioniranja. Predmetne luke imaju slične ciljeve: postizanje veće konkurentnosti, kao i privlačenje većeg broja korisnika na bazi superiornosti. Ove okolnosti su ispitane putem nekoliko kvantitativnih i kvalitativnih kriterijuma, tj. putem poznatih i dobro struktuiranih PROMETHEE i AHP metoda. Dobijeni rezultati su predstavljeni percepcionim mapa i opisani su na osnovu dobijenih kvantitativnih indikatora i kvalitativnih tumačenja autora, prvenstveno u marketinškom smislu.

Ključne riječi: izbor luke, marketing, pozicioniranje, višekriterijumska optimizacija.

1. Introduction

Expanding the spatial and functional scope of their activities, modern ports represent significant logistical and industrial centers, but they are dominantly related to maritime transport (Noteboom and Yap 2012). Also, ports are the elements of value - driven chain systems (Robinson 2002), i.e. seaports are the link without which, the two modules of transport - maritime and land could not be effectively connected. In a competitive environment, marketing as a concept and port business practice offers a wide range of solutions for achieving and maintaining competitive advantage, which could be expressed as financial (profit) and/or nonfinancial (port image, etc) parameters. The variety of methods have been applied, many ideas and activities carried out in order to achieve the ultimate goal - to be more competitive in the port services market and to be chosen by users (shippers, forwarders, shipping companies, terminal operators, port authorities, government agencies, and other clients).

For the purpose of developing an efficient marketing (re)positioning strategy for ports, we emphasize here the two basic themes attracting the attention of the scientific

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and professional community: a) seaport competition and competitiveness, and b) the port choice criteria. Many methods have been used in order to define the factors of seaport competitive performance, but benchmarking is standing out as a method of the marketing positioning of the ports based solely on the comparison and the research aiming to determine, which port is the leader in the market. Rugman and Verbeke (1993) applied the Porter's Diamond in the case of seaports, concluding that a seaport position in the market is based on six key "diamond" factors. Pando *et al.* (2005) showed that the benchmarking practice was appropriate and applicable in the case of seaports. Pardali and Michalopoulos (2008) applied the benchmarking method in the case of Mediterranean container ports. Evaluating the competitiveness of container ports in Korea and China, Yeo, Roe, Dinwoodie (2008) made the comprehensive literature review of the port competitiveness components, concluding that port competitiveness is determined by the port service, hinterland condition, availability, convenience, logistics cost, regional centre and connectivity. Efficiency, shipping frequency, adequate infrastructure, location, port charges, quick response to port users' needs, reputation regarding cargo damage, intermodal and value – added services, information system availability are some of the port selection criteria (Tongzon 1995, 2005, 2009; Murphy, Daley, Dalenberg 1992; Malchow and Kanafani 2004; Magala and Simmons 2008; Vickery, Jayaram, Dröge and Calantone 2003).

There are many quantitative methods that are used to measure the degree of port competitiveness. One of them is linear programming, where a considerable number of authors agree about the most important factors such as: domestic (captive) traffic, good hinterland connections, adequate feeder networks, good infrastructure and competitive port pricing, which determine the port position as the hub one (Aversa, Botter, Haralambides and Yoshizaki 2005). The use of MCDM (Multi Criteria Decision Making) has also been promoted in the analysis of container port competitiveness. Song and Yeo (2004) carried out the competitive analysis of Chinese container ports using AHP (Analytic Hierarchy Process), while Guy and Urli (2006) used multi-criteria analysis to examine port selection in case of Montreal - New York ports. The AHP method has found an application in transshipment port selection from a global perspective (Lirn *et al.* 2004). The quantitative simulation modeling of some intelligent port transport systems' functional characteristics have been done by Jolić *et al.* (2003, 2004). Also, some quantitative analyses of the relevant indicators of the traffic flows (including some ports' flows), as well as their structure and dynamics have been presented in the work of Poletan-Jugović *et al.* (2009). Data envelopment analysis (DEA) is the method usually applied (Tongzon 2001; Barros 2003; Barros and Athanasiou 2004; Cullinane *et al.* 2006), though some authors (Panayides *et al*. 2009) critically reviewed its application in seaport economic efficiency measurement. Container port competition has also been considered in the context of applying hierarchical fuzzy processes (Huang *et al.* 2003; Yeo and Song 2006). All variables that are taken into consideration in these works are mostly related to infrastructure and superstructure, financial and development parameters, productivity and efficiency. They are also measurable and comparable, and discussions based on these variables are essentially objective.

In the case of ports investigated in this article which are characterized by the unique attribute of pretending to share the same target market, in the most general sense, their marketing positioning is the activity of designing a port offer and its image in terms of taking a distinctively (recognizable) place in the mind of the target market (customers), aiming to increase potential benefits for the ports (Kotler and Keller 2006). Previous re-

searches have rarely, and mostly in the widest economic context and less in the marketing one, discussed the question of the seaport positioning strategy development. Not earlier than in the 90's of the previous century, the strategic positioning of seaports started to be discussed from the point of seaport economy, i.e. port position in terms of growth, market participation and diversification, at the same time including the aspects of added value (Haezendonck and Noteboom 2002). Although the subject of seaport positioning hasn't been sufficiently researched in terms of customers' preferences, some elements featuring the marketing differentiation strategy had already been determined by the 80's of the previous century (Slack 1985). These researches aimed to find factors that would make the seaport services different and recognizable, e.g. based on efficiency, quality, reliability, etc. There are, of course, many contemporary research works that descriptively present current trends in container ports and shipping business. Notteboom and Rodrigue (2005) introduce the term of the port regionalization. Slack (2007) describes the terminalization of seaports. Particularly relevant topics are shipping networks and port development (Comtois and Slack 2007; Heaver, Meersman, Moglia and Van de Voorde 2000). A very attractive area of research is the domain of maritime supply chains and the role of ports in them (Notteboom and Winkelmans 2001; Carbone and De Martino 2003; Bichou and Gray 2004; Carbone and Gouvernal 2007; Wang and Cullinane 2006; Panayides and Dong-Wook Song 2009).

All the mentioned methodologies confirm the extent and complexity of topics related to the container ports positioning strategy. What is the most important in this paper and what makes it original in a way, is that the particular attention has been paid to the marketing dimension of the issue. This means that all factors that are considered here, both quantitative and qualitative, are to be chosen by their importance regarding users' satisfaction, which is essential for ports marketing positioning.

2. Methodology

The applied methodology can be divided into two categories: a) firstly, the quantitative method that includes PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluations) multi-criteria decision making method and b) secondly, the multi-criteria procedure of the analytic hierarchy process (AHP). In order to account different criteria, we developed four survey campaigns aimed at the following groups: the port community members, port development and marketing managers, port customers and academic researchers. Additionally, in order to position the considered eight seaports: P1-Bar; P2-Durres; P3-Constantza; P4-Koper; P5-Piraeus; P6-Ploce; P7-Rijeka; P8-Thessaloniki, the two sets of criteria have been identified and analyzed: quantitative (A), and qualitative (B). These criteria are divided into the appropriate sub-criteria sets as it is given in Tables 1 and 6. Regarding the first set of the quantitative criteria exact numerical values (A), the PROMETHEE multi-criteria decision making method was employed and the appropriate ranks were obtained for each sub-criteria set. In the second set of the qualitative criteria (B), each criterion was qualified by the linguistic value (YES/NO), and subsequently translated into the appropriate binary value (0/1): one-YES, and zero-NO. Then, these (0/1) values were summed separately per each sub-criteria set previously identified within complete B set of criteria. These sums were finally pondered by the average weight coefficients being estimated on the basis of AHP method, and the total score was found as the average value of all previously calculated and pondered sums per each sub-criterion set in B.

3. Quantitative criteria analysis and obtained results

The PROMETHEE is one of the most efficient multi-criteria methods, based on the numerous research works, among which are those of Brans *et al.* (1984, 1985, 1986, 1989), Petrović *et al.* (1988), etc. Namely, the preference function and the weights given to each variable have to be chosen before it might be applied to any problem. This method has been applied in many research articles in the field of seaport management, because it is reliable, the outcomes are easy for interpreting economically, and in marketing manner (Castillo-Manzano *et al.* 2009). In this article, PROMETHEE is applied to the problem of ranking (positioning) a finite number of alternative ports. Since the relative importance of the considered criteria is usually not the same, it is necessary to estimate their importance by giving them weight coefficients. In order to reduce the subjectivity factor in estimating these coefficients and setting preference function types, we have conducted a survey among the focus group experts.

Table 1. Quantitative criteria

A. Quantitative criteria (fixed)	A1. Container terminal infrastructure features	C_A1.1	Number of container terminals (no.)
		C_A1.2	Number of berths (no.)
		C_A1.3	Total length of berths (m)
		C_A1.4	Maximum water depth (m)
		C_A1.5	Terminal storage capacity (TEU)
		C_A1.6	Number of reefer plugs (no.)
	A2. Cargo handling: vertical and horizontal mechanization	C_A2.1	Gantry crane (no.)
		C_A2.2	Transfer crane (no.)
		C_A2.3	Straddle carrier (no.)
		C_A2.4	Forklift (no.)
		C_A2.5	Reach stacker (no.)
		C_A2.6	Container trailer (no.)
	A3. Cargo handling and human capacities	C_A3.1	Total cargo handling turnover (tons)
		C_A3.2	Annual operations (days)
		C_A3.3	Daily operations (hours)
		C_A3.4	Number of employees (no.)

The quantitative set of criteria (A) is composed of the following sub-criteria sets: A1-container terminal infrastructure features, A2-cargo handling vertical and horizontal mechanization, and A3-cargo handling turnover and human capacities, along with the corresponding units given in Table 1. Each of the used criteria represents one of the aspects of the investigated seaports' competitiveness. When deciding about these criteria and sub-criteria choices, we used the studies criteria by Rugman and Verbeke (1993), Pardali and Michalopoulos (2008), Tongzon and Heng (2005), Yeo, Roe, and Dinwoodie (2008). After setting the general scheme of the quantitative criteria given in Table 1, the exact numerical data values were acquired by the authors' survey of the respective ports in cooperation with the ports managers. These numerical data are given in Table 2.

Table 2. Quantitative criteria (A): sub-criteria sets A1, A2, and A3

Criteria / Port	P1	P2	P3	P4	P5	P6	P7	P8
C_A1.1	1	1	3	1	2	1	1	1
C_A1.2	2	11	9	25	9	1	2	2
C_A1.3	330	2200	1968	3200	2774	280	450	550
C_A1.4	14	11.5	16.5	18	18	13.8	12	12
C_A1.5	1760	2000	35472	24400	30500	1400	6500	7390
C_A1.6	174	105	987	340	288	32	150	276
C_A2.1	1	1	8	8	7	1	3	4
C_A2.2	0	2	15	14	1	0	0	0
C_A2.3	0	0	0	0	10	0	1	17
C_A2.4	2	2	7	0	3	1	0	6
C_A2.5	0	4	4	45	1	3	9	5
C_A2.6	2	5	60	30	2	5	14	1
C_A3.1	2407.4	968.3	36975.6	15372.0	11706.2	4532.8	4611.7	2281.4
C_A3.2	361	365	364	365	362	365	365	365
C_A3.3	24	24	24	24	24	24	24	24
C_A3.4	65	92	546	130	1250	15	83	150

Upon the numerical data (Table 2), PROMETHEE multi - criteria decision making method has been employed and the obtained results for positive (Phi+) and negative (Phi-) flows, along with the net preference flow (Phi), are given in Tables 3-5. This has been done for each sub-criteria sets (A1, A2, and A3) composing quantitative criteria (A). The weight coefficients, as well as preference function type (linear), and the corresponding coefficients (here, q and p) were estimated through the consultations of the focus group experts (the port managers and experienced academic researchers).

Table 3. PROMETHE II complete rank of the ports for A1 sub-criteria set

Criteria	C_A1.1	C_A1.2	C_A1.3	C_A1.4	C_A1.5	C_A1.6	Phi^+	Phi^-	Phi	Rank
max/min	max	max	max	max	max	max				
Port/weight	0.15	0.10	0.15	0.15	0.35	0.10				
P1	1	2	330	14	1760	174	0.037	0.402	-0.365	7
P2	1	11	2200	11.5	2000	105	0.740	0.382	-0.300	6
P3	3	9	1968	16.5	35472	987	0.628	0.027	0.601	1
P4	1	25	3200	18	24400	340	0.689	0.117	0.472	2
P5	2	9	2774	18	30500	288	0.531	0.059	0.471	3
P6	1	1	280	13	1400	32	0.016	0.454	-0.439	8
P7	1	2	450	12	6500	150	0.102	0.368	-0.266	5
P8	1	2	550	12	7390	276	0.162	0.330	-0.168	4
Preference	linear	linear	linear	linear	linear	linear				
q	1	1	300	1	1500	30				
p	3	24	3000	5	7000	150				

Thus, the obtained results are as follows: a) The complete rank of the considered ports, obtained by the PROMETHEE II method (PROMCALC software), for the first sub-criteria set (A.1) is: 1. Constantza; 2. Koper; 3. Piraeus; 4. Thessaloniki; 5. Rijeka; 6. Durres; 7. Bar; and, 8. Ploce (Table 3); b) The complete rank of the considered ports, obtained by PROMETHEE II method (PROMCALC software) for the second sub-criteria set (A.2) is: 1. Constantza; 2. Koper; 3. Piraeus; 4. Thessaloniki; 5. Rijeka; 6. Durres; 7. Ploce; and, 8. Bar (Table 4), and, c) The complete rank of the considered ports, obtained by PROMETHEE II method (PROMCALC software), for the first sub-criteria set (A.3) is: 1. Constantza; 2. Koper; 3. Piraeus; 4. Rijeka; 5. Ploce; 6. Bar; 7. Thessaloniki; and, 8. Durres (Table 5). The numerical results of sea ports positioning by the PROMETHEE

MCDA method for three different sub-criteria sets (A1, A2, and A3) regarding the quantitative criteria overall set A are graphically shown below in Figures 1-3, as well.

Table 4. PROMETHE II complete rank of the ports for A2 sub-criteria set

Criteria	C_A2.1	C_A2.2	C_A2.3	C_A2.4	C_A2.5	C_A2.6	Phi^+	Phi^-	Phi	Rank
max/min	max	max	max	max	max	max				
Port/weight	0.40	0.20	0.10	0.10	0.10	0.10				
P1	1	0	0	2	0	2	0.007	0.438	-0.431	8
P2	1	2	0	2	4	5	0.045	0.385	-0.340	6
P3	8	15	0	7	4	60	0.643	0.052	0.591	1
P4	8	14	0	0	45	30	0.629	0.081	0.548	2
P5	7	1	10	3	1	2	0.315	0.182	0.139	3
P6	1	0	0	1	3	5	0.018	0.399	-0.381	7
P7	3	0	1	0	9	14	0.176	0.326	-0.150	5
P8	4	0	17	6	5	1	0.278	0.247	0.031	4
Preference	linear	linear	linear	linear	linear	linear				
q	1	1	1	1	1	1				
p	5	10	15	5	5	15				

Table 5. PROMETHE II complete rank of the ports for A3 sub-criteria set

Criteria	C_A3.1	C_A3.2	C_A3.3	C_A3.4	Phi^+	Phi^-	Phi	Rank
max/min	max	max	max	min				
Port/weight	0.50	0.20	0.20	0.10				
P1	2407.4	361	24	65	0.024	0.220	-0.196	6
P2	968.3	365	24	92	0.020	0.257	-0.238	8
P3	36975.6	364	24	546	0.510	0.034	-0.476	1
P4	15372.0	365	24	130	0.393	0.072	0.322	2
P5	11706.2	362	24	1250	0.277	0.186	0.091	3
P6	4532.8	365	24	15	0.059	0.186	-0.127	5
P7	4611.7	365	24	83	0.59	0.185	-0.126	4
P8	2281.4	365	24	150	0.022	0.223	-0.201	7
Preference	linear	linear	linear	linear				
q	900	360	16	100				
p	11000	365	24	1000				

According to the group of A1 sub-criteria (container terminal infrastructure features), Constantza is the leading port, which is realistic, due to the fact that this port has the largest number of container terminals, terminal storage capacity, and number of reefer plugs. Also, the remaining three of the A1 sub-criteria are very competitive to other ports' sub-criteria. Koper port occupies the second position, which can also be confirmed, since this port has the largest number of berths and consequently the greatest length of berths, which can be an extremely important parameter for shipping companies choosing this port, if it is compared to the rest of the competing ports.

Also, this port has the highest value of the maximum water depth that could be a crucial port choice criterion for modern mega-carriers. Piraeus port is in the third position that is particularly determined by a significant number of reefer plugs and very competitive surface of storage capacity. This port also has a significant potential in terms of the number of container terminals. Thessaloniki port occupies a position which is very close to an *imaginary* average port (see Fig. 1). The remaining ports, in terms of A1 sub-criteria set, show a smaller degree of competitiveness compared to the four above mentioned well positioned ports.

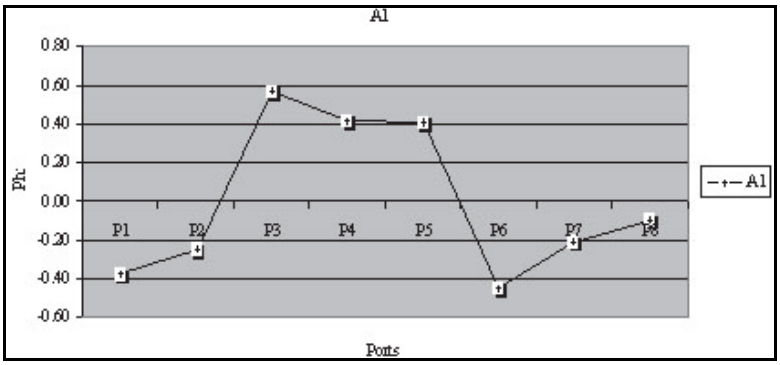

Fig. 1. The ports positions corresponding to the PROMETHEE net flows determined according to the A1 set sub-criteria values

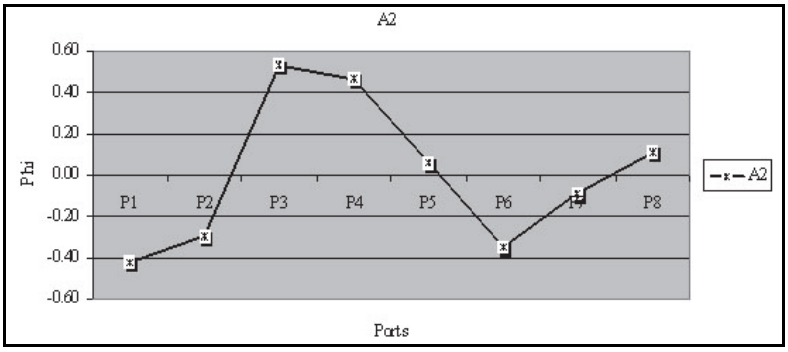

Fig. 2. The ports positions corresponding to the PROMETHEE net flows determined according to the A2 set sub-criteria values

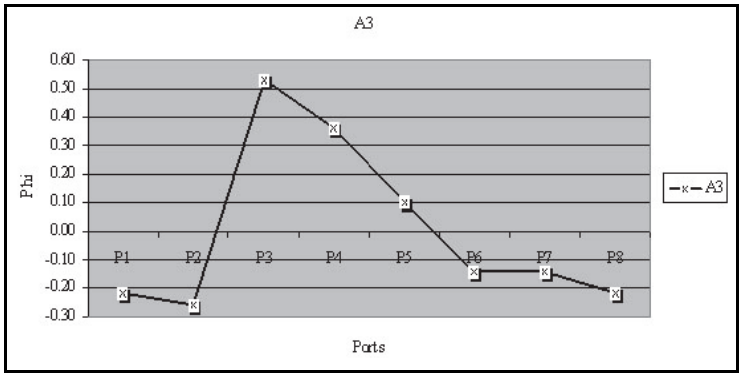

Fig. 3. The ports' positions corresponding to the PROMETHEE net flows determined according to the A3 set sub-criteria values

According to the group of A2 sub-criteria set (cargo handling: vertical and horizontal mechanization), Constantza port occupies the leadership position as in the previous case. This time, Koper port is very close to Constantza, while they share the same number of gantry cranes. Also, these two ports have small differences related to horizontal mechanization, however, slight advantage belongs to Constantza port. The remaining ports are of nearly similar ranking as they are ranked in the case of A1 sub-criteria set. Special em-

phasis is given to the Thessaloniki port, which now occupies the fourth place, and its position is very close to the third positioned Pireaus port. Bar port is in this case in the last position, which can be a very significant signal to this port's technical and development department to improve and modernize this segment of its operation.

According to the group A3 sub-criteria (cargo handling and human capacities), Constantza is highly advanced in comparison with all remaining ports, which confirms the highest total cargo throughput. This port has almost twice higher cargo handling turnover than the second ranked Koper port, and almost three times higher than the third positioned Piraeus port. According to this criterion, Durres port indicates smaller degree of competitiveness, which means that the marketing and development department of this port must intensify efforts in increasing the volume of traffic in this port, particularly container traffic. Concerning human capacity, Piraeus port has the largest number of employees, while each of the analyzed ports operate 24 hours a day, though this criterion in fact has no impact of the ports' positions. Concerning different values of the weight coefficients, different types of preference functions and their characteristic coefficients – ports' positions should be slightly, or even considerably different. Thus, in the next subsections, additional method based on both qualitative and quantitative estimations have been used in determining the ports' mutual positions as an additional aid for the ports' (eventual) (re)positioning.

4. Qualitative criteria analysis and obtained results

The container ports are likely to be more competitive if they are superior in terms of: proximity to key centers of production and consumption, and major trade lanes; maritime excellence and hinterland access; levels of productivity; efficiency of the capacity management; the ability to adapt to the new logistics business environment; potential to attract private capital at the level of terminal operations; possibility to become the key drivers of the local economies, and being supported by the stakeholders in the port area and the wider community (Noteboom and Yap 2012). Accordingly, the second qualitative set of criteria (B) is composed of the following sub-criteria sets: B1-infra and superstructure features, B2-connections with hinterland, B3-marketing features, B4-port management models, B5-vessels' and cargos' services, and B6-ICT applications. These criteria are listed in Table 6, along with the corresponding sub-criteria sets. Since the values of the qualitative criteria are expressed in terms of zero-one numerical values, these values are summarized per each sub-criteria sets in B, and then pondered by the average weight coefficients previously estimated by the AHP method, explained in more detail in the following sub-sections of the paper.

4.1. Ranking qualitative sub-criteria sets

The idea of qualitative sub-criteria sets' ranking is associated with AHP (Saaty 1977, 1980, 1990, 1994, 2003) approach applied to sub-criteria sets of B qualitative complete criteria set, with respect to the estimates of the respondents. Namely, ranking is a procedure, where the most significant sub-criteria set is given the highest rank, the last significant sub-criteria set is given the lowest rank, while the other sub-criteria sets are somewhere in between these two upper and down rank boundary values. Here, the respondents, i.e. three competitive persons (managers and/or administrative staff members), per each of the considered ports, are asked to compare each pair of the criteria sets (B1-B6)

according to the Saaty scale by using grades: 1-same importance; 3-weakly more importance, 5-moderately more importance, 7-strongly more importance, and 9-absolutely more importance of the first than the second considered criterion; or, by the corresponding reciprocity values depending on the mutual importance of the compared elements composing the certain pair(s). Although 24 competent persons were asked to create the Saaty matrixes, only ten Saaty matrixes have been taken into further consideration. Namely, the application of AHP requires highly developed logical thinking, though the estimate of only one highly qualified expert may be more important than the estimates made by a number of inexperienced persons (Sivilevičius and Maskeliunaite 2010). By the normalized eigenvector values calculus (Shikin and Chhartishvili 2000), the ranks of the considered criteria B1-B6 have been calculated (Table 7), along with the values of the largest eigenvalue λ_{max}, and the consistency index CI, while the random index RI is equal to 1.24 in all cases, since the number of criteria is constant and equal to six. It is obvious that all λ_{max} values, for each considered matrix, are less than 0.01, which is to be fulfilled in order to provide a satisfying degree of the Saaty matrix consistency (Table 8).

Table 6. Qualitative criteria

B. Qualitative criteria (fixed)	B1. Infra and superstructure features	C_B1.1	Container terminal (Y/N)
		C_B1.2	General cargo terminal (Y/N)
		C_B1.3	Bulk cargo terminal (Y/N)
		C_B1.4	Liquid cargo terminal (Y/N)
		C_B1.5	Ro-Ro terminal (Y/N)
		C_B1.6	Passenger terminal (Y/N)
	B2. Connections with hinterland	C_B2.1	Railway connections (Y/N)
		C_B2.2	Road connections (Y/N)
		C_B2.3	Pipelines connections (Y/N)
		C_B2.4	Barge service (Y/N)
		C_B2.5	Shuttle service (Y/N)
		C_B2.6	Bottleneck (Y/N)
	B3. Marketing features	C_B3.1	Free zone (Y/N)
		C_B3.2	Value-added logistics services (Y/N)
		C_B3.3	Distribution centers (Y/N)
		C_B3.4	Quality Management System (Y/N)
		C_B3.5	Integrated marketing communications (Y/N)
	B4. Port management models	C_B4.1	Service port model (Y/N)
		C_B4.2	Tool port model (Y/N)
		C_B4.3	Landlord port model (Y/N)
		C_B4.4	Private port model (Y/N)
	B5. Vessels' and cargos' services	C_B5.1	Vessel monitoring (Y/N)
		C_B5.2	Vessel repair (Y/N)
		C_B5.3	Vessel servicing (Y/N)
		C_B5.4	Container control (Y/N)
		C_B5.5	Non-containerized cargo control (Y/N)
		C_B5.6	Automatic scheduling and stacking of con-

			tainers (Y/N)
		C_B5.7	Automatic monitoring of cargo in stock (Y/N)
		C_B5.8	Container leasing (Y/N)
	B6. ICT applications	C_B6.1	The classic IT system (Y/N)
		C_B6.2	ERP (Enterprise Resource Planning) (Y/N)
		C_B6.3	EDI service (Y/N)
		C_B6.4	MIS (Management Information System) (Y/N)
		C_B6.5	VTS service (Y/N)

Though, the results of the sub-criteria sets weights ($w_i, i = \overline{1,6}$) in B, and corresponding ranks, per each of the ten considered Saaty's matrixes obtained by the algorithm presented in details in the article of Sivilevičius and Maskeliunaite (2010) are given in Table 7.

Table 7. The ranks of the sub-criteria sets in B assigned by ten competitive respondents

		Criteria											
		B1		B2		B3		B4		B5		B6	
		w_1	Rank	w_2	Rank	w_3	Rank	w_4	Rank	w_5	Rank	w_6	Rank
Respondents	R_1	0.3660	1	0.2650	2	0.0282	6	0.0704	5	0.1688	3	0.1016	4
	R_2	0.4493	1	0.2125	2	0.0615	5	0.0966	4	0.0283	6	0.1517	3
	R_3	0.3903	1	0.2559	2	0.0398	6	0.1496	3	0.1037	4	0.0607	5
	R_4	0.4076	1	0.2711	2	0.0280	6	0.1499	3	0.0875	4	0.0558	5
	R_5	0.2522	2	0.1677	3	0.0322	6	0.3910	1	0.0927	4	0.0643	5
	R_6	0.2565	2	0.1682	3	0.0346	6	0.3498	1	0.1166	4	0.0743	5
	R_7	0.3853	1	0.2790	2	0.0288	6	0.1542	3	0.0902	4	0.0625	5
	R_8	0.3831	1	0.2656	2	0.0339	6	0.1469	3	0.1109	4	0.0596	5
	R_9	0.4228	1	0.2371	2	0.0316	6	0.1428	3	0.1078	4	0.0579	5
	R_{10}	0.3584	1	0.2946	2	0.0280	6	0.1562	3	0.0995	4	0.0633	5

The values of the largest eigenvalue λ_{max}, and the consistency index CI are given in Table 8 per each respondent, as it is previously noted above. Used *Mathematica* codes are given in Table 9.

Table 8. The largest eigenvalue and consistency index per each AHP matrix given by the respondents

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
λ_{max}	6.5620	6.5274	6.4419	6.4441	6.5202	6.5758	6.5439	6.4711	6.5972	6.5278
CR	0.0906	0.0851	0.0713	0.0888	0.0839	0.0929	0.0877	0.0760	0.0963	0.0851

Table 9. Code 1: Calculating weight coefficients and testing Saaty's matrix consistency

Code 1: Off[General::spell1]
(*n=Input["Number of criteria is (n):"];*)
(*A=Table[0,{n},{n}]; For [i=1,i≤n,i++, For [j=1,j≤n,j++, A[[i,j]]=Input["Input Saaty matrix A ["<>ToString[i]<>
","<>ToString[i]<> "]:"]; If [A=[[i,j]]= =$ Canceled ∨ A[[i,j]]= =Null, Abort[]]]];*)
n=6; A={{1,5,9,3,5,5},{1/5,1,7,3,3,3},{1/9,1/7,1,1/5,1/5,1/3},
{1/3,1/3,5,1,3,3},{1/5,1/3,5,1/3,1,3},{1/5,1/3,3,1/3,1/3,1}};
wn=Table[0,{n}]; wp=Table[0,{n}]; For[i=1;ws=0,

i≤n,i++,wn[[i]]= $\prod_{j=1}^{n} A[[i,j]]$;wp[[i]]=wn[[i]]^(1/n);ws=ws+wp[[i]]]; w=Table[0,{n},{1}];

For[i=1;i≤n,i++,wn[[i,1]]=wp[[i]]/ws]

V=A·w; l=V/w; λ= $\frac{1}{n}\sum_{i=1}^{n} l[[i,1]]$; CI=(λ-n)/(n-1); RI={0,0,0.58,0.9,1.12,1.24,1.32,1.41,1.45}; CR=CI/RI[[n]];

Print ["Eigen value: λ= ",N[λ]]; Print ["Index of Saaty's scale consistency is: CI= ", N[CI]]; Print ["Random index of consistency is: RI= ", N[RI]]; Print ["Ratio of consistency indexes is: CR= ", N[CR]]; If CR≤0.1, Print ["Saaty's matrix is consistant"], Print ["Saaty's matrix is not consistant"]

The values obtained by this code are: $\lambda = 6.527$, CI=0.105, RI=1.24, CR=0.085. Since, $CR \le 0.1$ it means that the considered Saaty's matrix is a consistent one. On the basis of the ranks of B1-B6 sub-criteria sets in B, the average weights per each sub-criteria set have been calculated and used for pondering the sums of 0/1 values corresponding to each criteria in B1-B6 sub-criteria sets. The values 0/1 for all analyzed criteria B had been previously collected at the considered ports. The total score per each analyzed port was calculated by the formulae:

$$B_{SCR_i} = \sum_{j=1}^{6} v(i,j)\cdot \overline{w}_{1n} + \sum_{k=1}^{6} v(i,k)\cdot \overline{w}_{2n} + \sum_{l=1}^{5} v(i,l)\cdot \overline{w}_{3n} + \sum_{m=1}^{4} v(i,m)\cdot \overline{w}_{4n} + \sum_{n=1}^{8} v(i,n)\cdot \overline{w}_{5n} + \sum_{p=1}^{5} v(i,p)\cdot \overline{w}_{6n}\ , i = \overline{1,8}$$

Where,

- B_{SCR_i} - is total score for the i-th considered port, while $i = \overline{1,8}$ and corresponds to the analyzed ports;
- $v(i,j)$, $v(i,k)$, $v(i,l)$, $v(i,m)$, $v(i,n)$, $v(i,p)$ - are the variables' binary values 0, or 1 for i-th port, while $j = \overline{1,6}$, $k = \overline{1,6}$, $l = \overline{1,5}$, $m = \overline{1,4}$, $n = \overline{1,8}$, $p = \overline{1,5}$ are indexes of the criteria within each sub-criteria sets in B set; and,
- $\overline{w}_{1n,2n,3n,4n,5n,6n}$ - are the normalized average values of the weight coefficients for each B1-B6 subsets of criteria in B. The positions of the analyzed ports obtained by the calculations (1) are shown in Figure 4.

However, the method by which the normalized average weight coefficients per each sub-criterion set in B has been determined, needs to be explained, as well. The idea of evaluating these weight coefficients is associated with the sum of ranks of each criterion c_q, with respect to the estimates of respondents:

$$c_q = \sum_{r=1}^{10} c_{qr}\ ,\ q = \overline{1,6} \qquad (2)$$

Where,

- c_q - is the sum of ranks of each criterion set (B1-B6), while q is the number of sub-criterion sets in B (here 6), and r is number of experts, or respondents (here 10); and,

- c_{qr} - is rank of the q-th criterion estimated by the r-th respondent. Now, the average weight coefficient for each sub-criterion set in B can be calculated by the following formulae:

$$\overline{w}_q = \left[c_q / \sum_{q=1}^{6} c_q \right]^{-1}. \qquad (3)$$

Finally, the normalized average weight coefficients are to be calculated and used in (1) for pondering the sums of zero, or one values for each criterion, and per each of the considered ports ($n = \overline{1,8}$):

$$\overline{w}_{qn} = \overline{w}_q / \sum_{q=1}^{6} \overline{w}_{qn} \qquad (4)$$

The ranking of B set subsets of criteria (B1-B6) according to their significance, carried out by ten respondents is demonstrated in Table 10.

Also, the normalized average weight coefficients per each B criteria subsets (B1-B6) are given in the last column ($\overline{w}_{qn}$, $q = \overline{1,6}$). These weight coefficients have been calculated by the formulae (4), and on the basis of the previously realized calculus (2) and (3).

Table 10. Ranking of the B criteria sub-sets (B1-B6) in the respondent questionnaires

	Respondent No.										Sum of ranks	$\overline{w}_{qn}$, $q = \overline{1,6}$
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**		
B1	1	1	1	1	2	2	1	1	1	1	12	0.3689
B2	2	2	2	2	3	3	2	2	2	2	22	0.2012
B3	6	5	6	6	6	6	6	6	6	6	59	0.0750
B4	5	4	3	3	1	1	3	3	3	3	29	0.1527
B5	3	6	4	4	4	4	4	4	4	4	41	0.1079
B6	4	3	5	5	5	5	5	5	5	5	47	0.0942
Total	21	21	21	21	21	21	21	21	21	21	210	1.0000

Since the consistency of the respondents ranking is important in making conclusions regarding the ports final mutual positions, in following subsection of the article the concordance coefficient value has been calculated as the measure of reconciliation of the respondents' attitudes towards the considered issue.

4.2. The respondents' estimates consistency

In order to examine the level of consistency of the respondents' estimates (see Table 7), the concordance coefficient W is to be calculated as:

$$W = 12S / r^2 q\left(q^2 - 1\right) \qquad (5)$$

Where,

- $S = \sum_{q=1}^{6} \left(c_q - \sum_{q=1}^{6} c_q \right)^2$ - is analogue to the variance of the ranks;
- r – is the number of the respondents; and,
- q – is the number of the sub-criteria sets in B (B1-B6).

Now, the smallest value of W, i.e. W_{min} is to be calculated by the formulae:

$$W_{min} = \chi^2_{\alpha,v} / r\left(q - 1\right) \qquad (6)$$

Where, $\chi^2_{\alpha,v}$ - is critical chi-square statistics, found in the table (Montgomery 2008) by assuming the degree of freedom $v = 6 - 1$, and the significant level $\alpha = 0.010$. Here, it

is $\chi^2_{\alpha,v} = 15.09$. By taking into account the previous assumptions $W_{min} = 0.3018$, while $W = 0.8514$. Since the condition $W_{min} \le W$ has been satisfied, it implies that the estimates of the respondents are consistent. The pseudo-code in *Mathematica* program used in the realization of the previously explained calculus is given below, in Table 11.

Table 11. Code 2: Estimating the level of consistency of respondents' estimates

Code 2: Off[General::spell1]
n=Input["Number of criteria is(n):"]; m=Input["Number of respondents is (m):"]; Cm=Table[0,{n},{m}];
For [i=1,i≤n,i++, For [j=1,j≤n,j++, Cm[[i,j]]=Input["Input rank for the criterion "<>ToString[i]<> "and respondent"<>ToString[i]<>":"]; If [Cm=[[i,j]]= =$Canceled ∨ Cm[[i,j]]= =Null,Abort[]]];*)
c=Table[0,{n}]; For[i=1;cs=0, i≤n,i++,c[[i]]= $\sum_{j=1}^{m} Cm[[i,j]]$;cs=cs+c[[i]]]/n; $S=\sum_{i=1}^{n}(c[[i]]-cs)^2$; $W=\frac{12S}{m^2 n(n^2-1)}$;
$\chi^2 = Wm(n-1)$; $\chi^2_{\alpha,v}$=Input["Input the critical chi-square, from the statistical table: "]; $W_{\min}=\frac{\chi^2_{\alpha,v}}{m(n-1)}$;
Print["Variance of the ranks is: S= ",S]; Print["The concordance coefficient is: W= ",W]; Print["Random value χ^2 is: χ^2 = ", χ^2]; Print["The smallest value of W, W_{min} is: W_{min} = ", W_{min}]; If[W_{min} ≤W, Print["The estimates of the respondents are consistent."], Print["The estimates of the respondents are not consistent"]

4.3. The results presented by the ports perception map

On the basis of the previous calculus given in (4.1) and (4.2), the final positions of the considered ports, according to the qualitative B criterion set are obtained, and presented in Figure 4. The leading position in the case of the qualitative criteria analysis belongs to Constantza port. As opposed to the case when the quantitative criteria were considered, Rijeka port has significantly enhanced its position. Specifically, it is now ranked as the second port. The reasons for this *progress* lie in the fact that in the case of Rijeka port all B1 sub-criteria are present (i.e. each of them has value 1). Also, this port has appropriate connections with the hinterland. It is competitive in terms of ship and cargo services, while the lower degree of competitiveness exists related to the ICT applications.

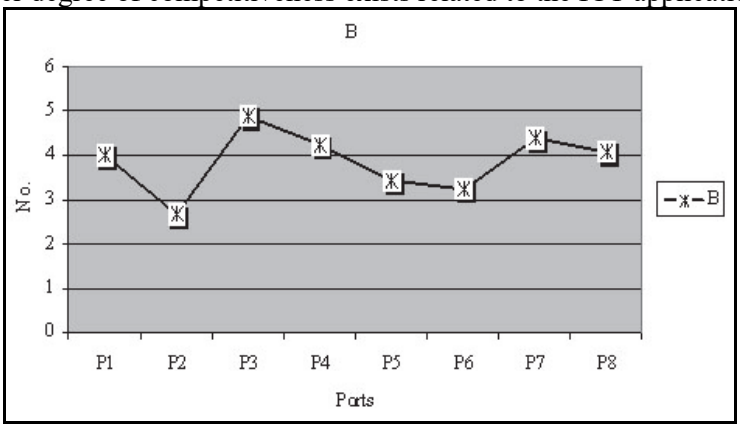

Fig. 4. Ports positions according to the qualitative criteria obtained by AHP approach

Koper is slightly lower positioned than Rijeka, however, it could be concluded that they share the second position. Koper differs from Rijeka in terms of PMM (Port Management Models) criteria. It is weaker in terms of ship and cargo services, but better than Rijeka in terms of ICT solutions. Thessaloniki and Bar are sharing the fourth position.

Port users perceived them as strong competitors in terms of B criteria. Users found that each of them has bottleneck regarding connections with the hinterland. Also, both ports share similar marketing, but different organizational models. Piraeus port takes lower position now, in comparison with the position previously established by the PROMETHEE method. Possible reasons are the absence of liquid cargo terminal, railway connections, and VAL (value-added logistics) services. Ploce and Durres are characterized by weaker positions in relation to other six ports. Compared with Durres, Ploce port has an advantage concerning marketing variables. Therefore, the Durres port management should intensify their efforts towards the affirmation of the free zone concept and other marketing issues, but also towards the strengthening of the links with the hinterland. Ploce and Durres are different in terms of organizational models, but competitiveness factors of these two ports are largely overlapping. The results obtained here were tested among the focus group experts in this field, who agreed that the positions of the investigated ports, determined using these quantitative methods, correspond to the real situation.

5. Conclusions

In this paper, the set of Adriatic, Aegean and Black Sea ports has been analyzed in order to gain an objective view of their business systems situations, having in mind that these ports have been facing great challenges of reorganization and integration into the global flows of international economics, foreign trade, maritime and inland transportation reforms, etc. With reference to both quantitative and qualitative criteria analysis, the following general observations can be given, which, to a certain extent, present the directions for marketing repositioning and development of the ports:

(I) According to the **quantitative** (sub)criteria (A)

- Constantza port is the leading port according to all three analyzed sub-sets of quantitative criteria (A1, A2, and A3), which is not surprising, considering that one of the leading terminal operators has overtaken the initiative over this port's container terminal; - Koper port is on the second position and its specific advantage is related to A2 group of criteria, thus this port should work on the enhancement of it's infrastructure; - Piraeus port is on the third position in the cases of A1 and A3 criteria sub-sets, while in the case of A2, it is in a worse position than in the previous two cases. The reasons can be found in the lack of horizontal mechanisation structures, which can be one of prospective directions for the enhancement of this port's capacity; - The positions of the other considered ports (Tessaloniki, Rijeka, Bar, Durres, and Ploce) are lower in comparison to the above mentioned ones, and they vary more or less, depending on the numerical values and nature (max/min) of the considered quantitative criteria. These ports must be headed towards the modernization of infrastructure, and especially horizontal and vertical mechanization assets, i.e. they need to improve the efficiency of the capacity management system, having in mind that it becomes an economically non-elastic feature in the short term. First of all, it would be especially favourable to turn towards developing a marketing concept related to the management of relationships with loyal customers in order to maintain or enhance their actual market share.

(II) According to the **qualitative** (sub)criteria (B)

- The positions of most of the ports are uniform, which confirms that they are very competitive-oriented toward each other; - The ports of Constantza, Koper and Rijeka are nearly the leaders and their development direction would be based on management and marketing variables, considering that the customers' selection greatly depends on these disci-

plines; - Solun and Bar share the fourth position and they will be highly competitive, especially for the target market of South East Europe, meaning that these ports' management must consider the modernization of their hinterland connections; - Piraeus port takes lower position in this case. The possible reasons are: absence of liquid cargo terminal, railway connections, and value-added and logistics services; - The other two ports (Ploce and Durres) are found at lower positions than the previously ranked ones, and they need to be managed in a way that would intensify their container transhipment, considering that they have a highly competitive geo-strategic position.

Ultimately, the aim of this research work was to, using the marketing logic, as well as applying quantitative tools, clearly define the positions of these ports in terms of their competitiveness, taking into account the perceptions of users about the quantitative and qualitative criteria of their business systems. Also, the goal was to *create a space* for acting in the direction of defining the port development strategy. In this sense, the paper could be dedicated primarily to the management of these ports, potential investors, port authorities, as well as the wider scientific and professional community. In this context, the PROMETHEE multi-criteria quantitative optimization method allowed us to set the positions of the analyzed ports as objectively and precisely as possible. The PROMETHEE method *reduces* large differences in numerical values of certain criteria in order to achieve more precise positioning of the considered ports at the market, although here they are all positively correlated to the objective function. While the PROMETHEE method included a set of purely quantitative (sub) criteria, in the paper applied AHP method *covered* a set of qualitative (sub) criteria of the observed ports operations. Using the AHP approach, the focus of the investigation has been expanded from the internal (established within each port, and unchangeable within a rather longer time interval) to the set that includes the external criteria, more visible to the users and more flexible in terms of adapting to their current preferences. Also, this method, in a sorely qualitative manner, provides the validation of the results obtained by the PROMETHEE method, since there are no crucial differences in the ports positions, especially the leading one.

The direction of future research work in this domain has a tendency to employ (or combine) additional quantitative, as well as qualitative methods, in order to verify the validity of the results presented by the ports perceptional maps in the paper. Also, there is a possibility to include some novel, additional, market-generated criteria for the purpose of more efficient (re) positioning of the analyzed ports.

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P.2. E-services and positioning of passenger ports in the context of cruise tourism promotion[2]

E-usluge i pozicioniranje putničkih luka u kontekstu promovisanja kruzing turizma

Abstract: The paper positions the passenger sea ports in the context of cruise tourism on the basis of e-services they offer. The e-services of eleven passenger ports are categorized and then quantitatively evaluated by binary and ranking approaches. In general, the port e-services might be categorized according to their functionality as navigational, ship and passenger-related ones, logistics, business, marketing, entertainment, security, safety, environmental, etc. These services can be bidirectional informational and/or transactional. In this paper, only those port e-services related directly to the passengers' needs, within the frame of cruise tourism, are taken into consideration and categorized as core, or as value-added ones, and as informational and/or transactional ones. Then, each of them is assigned an appropriate binary value (0/1), depending on whether the considered passenger port offers the related e-service or not. These values are employed in the evaluation of the analyzed passenger port e-services offered, and as a base for their positioning. The appropriate weights coefficients, obtained by ranking (Saaty method), were used in the process of the considered port final positioning on the cruise tourism e-market. Some additional analyses and recommendations in the direction of further positioning and promotion of the port of Kotor (Montenegro), as rising cruise tourism port (destination), are given as well.

Key words: cruise tourism, cruise port's positioning, e-services, Saaty method, service marketing.

Apstrakt: U ovom radu je izvršeno pozicioniranje putničkih luka, u okvirima kruzing turizma, na osnovu e-usluga koje one pružaju korisnicima. E-usluge jedanaest putničkih luka su kategorizovane, a potom kvantifikovane binarnim pristupom, uz korišćenje metoda rangiranja. U opštem slučaju, lučke e-usluge se mogu kategorizovati prema funkcionalnosti kao: navigacione, usluge vezane za brod i putnike, logističke, poslovne, one koje se odnose na zabavu, marketing, bezbjednost, sigurnost, zaštitu životne sredine i dr. Ove usluge mogu biti biderekcione, informacione i/ili transakcione. U radu su, jedino one lučke e-usluge koje su direktno vezane za potrebe putnika, uzete u razmatranje i kategorizovane kao osnovne i one sa dodatom vrijednošću, takođe, kao informacione i/ili transakcione. Potom je svakoj od njih dodijeljena odgovarajuća binarna vrijednost (0/1), zavisno od toga da li analizirana luka ima u svojoj ponudi određenu e-uslugu ili ne. Ove numeričke vrijednosti su korišćene pri procjeni e-ponuda analiziranih luka, pa su na osnovu njih luke kasnije pozicionirane. Odgovarajući ponderi, dobijeni na bazi rangiranja (Saaty-jevim metodom), primijenjeni su u procesu finalnog pozicioniranja luka na e-tržištu kruzing turizma. Takođe, u radu su date neke dodatne analize i preporuke u smislu boljeg pozicioniranja i promocije luke Kotor (Crna Gora), kao rastuće destinacije kruizing turizma.

Ključne riječi: kruzing turizam, pozicioniranje kruzing luka, e-usluge, Saaty-jev metod, marketing usluga.

1. Introduction

The trends on the global market induced ports to operate as enterprises, trying to reach maximum efficiency and competitiveness. Consequently, both freight and passenger ports need to transform the service (product) they offer by using modern information and communication technologies (ICT) [1, 2]. The innovative applications of ICT throughout the ports as enterprises, transform their functioning toward digital economy. The rapidly increased use of internet, intranets, extranets, e-business and e-commerce, social networks, and mobile computing has changed the way in which business is performed in almost all world ports being treated as enterprises. Also, the integration of port resource planning, customer relationship management and knowledge management with e-commerce is vitally important for the strengthening of their marketing approach. There is resurgence of intelligent systems and automated decision systems, both for facilitating

[2] Vitić-Ćetković A., Bauk S., E-services and Positioning Passenger Ports in the Context of Cruise Tourism Promotion, *PROMET-Traffic & Transportation*, Vol. 26, No. 1, January 2014, pp. 83-93.

security and increasing productivity and competitive advantage of a port. Besides managerial and artificial intelligence issues, ethical and legal issues are also of crucial importance within this context of growing ICT business and social implications everywhere, so as in the proper functioning of the contemporary passenger ports [3].

The web revolution is the most influential technological revolution in the modern era. The access and connectivity provided by the web keep transforming the way in which people work, shop, vote, invest, study, play, interact, and, of course, the way in which they decide when, where, and how to travel around the world and spend their leisure time. The e-services of passenger ports worldwide have changed the consumer behaviour enabling them to efficiently approach new distribution channels, combine different products and services, and ultimately improve the overall quality of lives. For example, a few years ago social networks were a novelty, but today approximately more than half a million people all around the globe participate in social networking as an instrument used in commerce, socialization, politics, healthcare, finance, entertainment, travel, and pleasure [3, 4]. Passenger ports might find these marketing tools not only to be generating faster and cheaper results than traditional focus groups, but also fostering ports feedback management. The passenger port feedback management should be interested not only in collected information, but also in interaction between customers and the port employees and/or management, and in properly distributing passengers' feedback throughout the port as an organization and destination.

Contemporary high sophisticated ICT solutions and tools have great impact on the entire economy and society, and consequently, on the ports as entrepreneur entities on the global market, and particularly on the passenger (cruise) ports as their special category. Regarding the passenger ports in the context of cruise tourism, along with the e-services which they offer they are under-researched; some rather recently written review and research papers represent efforts in acquiring more data/knowledge in this domain [5-8]. Also, within the following section of the paper the particular research attention is given to some actual *flows* in the nautical (cruise) tourism market, including the Port of Kotor (Montenegro) as its small, but growing segment in the Adriatic.

2. Cruise tourism trends and issues

Cruising (roundtrip) refers to tourist trip on a big boat for a period of several days, based on the itinerary or plan of roundtrip [9]. Cruise tourism has emerged relatively late in comparison to other forms of tourism. As product for the global tourism market, cruise tourism appeared in the 1960s.

From the aspect of tourism, a cruise ship plays the role of a floating hotel which may be considered as primary tourist destination, while the passing ports are considered as secondary ones. Cruise tourism provides tourists with vacation, fun and relaxation, docking at several ports and mainly returning to the port of departure. The size of the ship, equipment, and crew is adapted to the target group of tourists.

The broad concept of cruising includes port services of specialized loading and unloading of passengers on cruises that typically have special terminals for this purpose, then the shipyard focused on construction, equipment and repair of ships intended for cruising as well as the supply of ships [10-18].

The number of passengers on cruise travel in the world reached 20.6 million in 2012 (Figure 1), and it is estimated to reach 20.97 million passengers in 2013 [19].

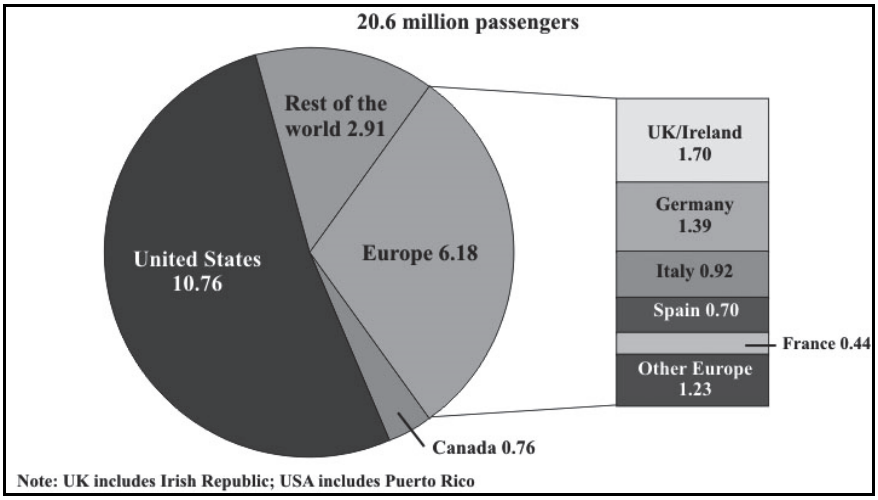

Fig. 1. Number of passengers on cruise travel in the world [19]

Demand for new destinations, increasing price competitiveness, branding cruise companies, shorter trips than in previous period, as well as changes in the profile of consumers in the global tourism market have strongly influenced the continuity of growth in the number of cruise tourism passengers. Accordingly, the marketing approach to cruise tourism has gained in importance, as well as the fact that consumers of cruise tourism services are becoming more critical to the ratio between the quality and price. A new generation of cruisers is designed to meet the needs in growing segmentation of the cruise tourism market. Thus, the cruise tourism is not only a growing market, but also a growing segmented market. Accordingly, we can notice the evolution of the cruise vacation experience since cruise tourism may be described by the concept of experience economy (memory itself becomes the product - the "experience"). The best experience/popularity belongs to the following cruise tourism regions [19]:

1. Caribbean/North America (including Pacific Northwest and Alaska currently);
2. Europe and Mediterranean (largest percent of increased bookings for 2012);
4. Baltic fjords (summer only);
5. Asia/Australia;
6. South America; and
7. Middle East – an emerging region.

There are some specific characteristics of the cruise tourism [16] that attract tourists:

- Passengers have the opportunity to visit different destinations in a short period of time;
- Cruisers have the required autonomy and represent the destination for themselves;
- Cruisers have a staff that is fully committed to a pleasant and enjoyable stay of passengers on board;
- Availability of high quality gastro–offer and entertainment, etc.

Modern development projects in the area of cruise tourism are related to the increase of investment in passenger terminals at cruise destinations in order to meet the needs of a new generation of mega-cruisers. From the European perspective it is important to say that cruising makes significant contribution to the European economy, sustaining jobs in shipyards, creating employment in European ports and supporting overall European tour-

ism development. However, there are also some significant obstacles to future cruising growth given in the economic crisis and rising fuel costs [19].

2.1 Port of Kotor as cruise tourism destination

In cruise tourism, seasonality is less emphasized, which gives the possibility of extended season, which is primarily the focus for Montenegrin tourism development in order to achieve sustainable development, as well as sustainable destination management. Due to constant demand for new destinations and few positioned Adriatic destinations, the Port of Kotor has a relevant potential for branding itself as a distinctive Mediterranean destination. In this field, the competition is growing, so the improvement of technological and organizational issues in the Port of Kotor, as well as the port services and standards are a necessity. This includes investments in infrastructure and superstructure in order to facilitate sustainable development and environmental protection, but also implementation of some measures, which include limitation of the number of tourists from the cruise ships, as well as giving priority to companies that organize cruising in low season. When it comes to cruising destinations such as Kotor, which is in the beginning stage of positioning itself on the global tourism market, there is a need to forestall the insufficiently controlled development of some distinctive cruising destinations (Figure 1). The travel experience in some cruise tourism destinations consists of a number of different value chains with many participants involved, from employees at ports, tourist guides, those employed in retail, security guards, etc. This is because tourists tend to have the perception of "tourism experience of great value" only if all participants in the value chain maintain adequate quality of service and if there is perception of an integrated tourism destination product (Figure 2).

Besides previously noted, the contemporary ICT components must be included into the port offer, in order to increase the overall quality of its service. How the Port of Kotor is in fact positioned nowadays among the group of several considered European ports due to e-services they offer is analyzed in more detail in the next sections of the paper.

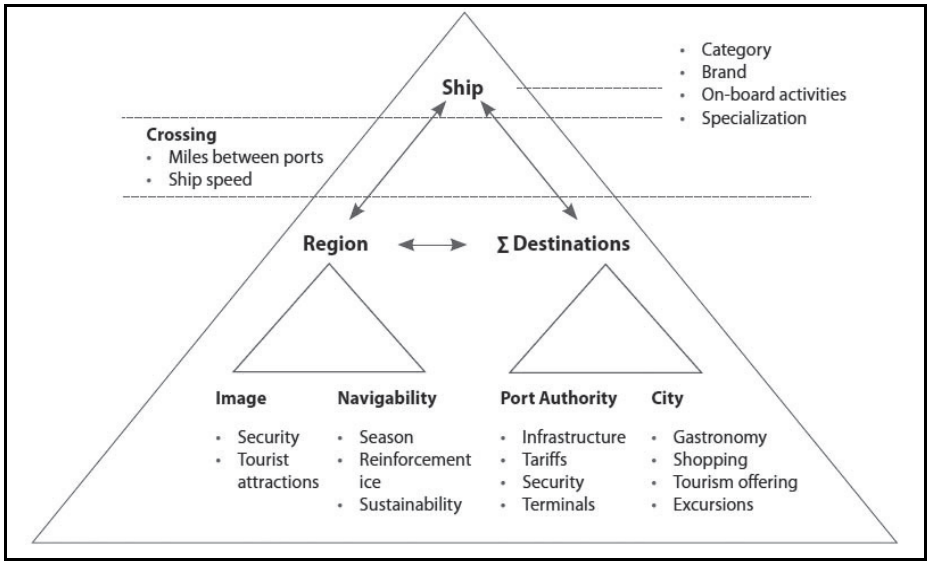

Fig. 2. Cruise tourism as a product from destination perspective [20]

3. ICT-based cruising port positioning

The purpose of the paper is two-fold: (a) to emphasize the growing demand in the sphere of cruising tourism in order to promote it, and (b) to identify, classify, and evaluate some crucial e-services of the passenger ports in this context. In the previous section some key points on the nautical (cruise) tourism phenomena with reference to the port of Kotor have been given, while in this section - ten most frequent EU passenger ports and the Port of Kotor have been analyzed [5, 6, 21-31] and mutually compared on the web-based ICT resources, i.e. according to the specific e-services they offer. At the end, the accent is given again to the port of Kotor [31], with the intention to position it properly, and to propose the potential solutions for its e-services and an enrichment of the general offer (in the wider sense) in the nearest future.

Within this context, prior to concrete analysis, the difference between ports of call (the geographical point where a cruise ship stops for a short time, especially on a journey [32]), and embarkation (home) ports (the geographic point in a routing scheme from which passengers and/or personnel depart [32]) should also be pointed out. The difference between these types of ports derives in fact from different needs they have to fulfil. There are also hybrid ports. Having this in mind, it must be highlighted that in this paper the considered ports:

- P1: Southampton (UK);
- P2: Limassol (CY);
- P3: Dover (UK);
- P4: Calais (FR);
- P5: Helsingborg (SE);
- P6: Barcelona (ES);
- P7: Palma de Mallorca (ES);
- P8: Venice (IT);
- P9: Genoa (IT);
- P10: Civitavecchia (IT); and,
- P11: Kotor (MN),

are all treated as ports of call. Then, by surveying the official web sites of the above listed cruise ports and previous research work in this field [5-8,21-31], more than seventy e-services have been recognized as relevant, and they are included in further analysis (web analyses have been done in July, 2012). The considered cruise ports e-services have been categorized in five different categories: c – core, v – value-added, i – informational, i/t – informational and/or transactional ones, and t – transactional. Then, for each of the considered ports it has been identified whether the port has (1) or has not (0) a certain e-service within its e-offer. The list of e-services and the corresponding binary values of each of the eleven examined passenger ports are given in Table 1.

Table 1. E-services of eleven considered passenger sea ports: categories and values (Research realized in July, 2012)

Some passenger's port e-services	c/v	i/t	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11
Tourist information center (virtual desk)	v	i	1	1	0	1	0	1	0	0	0	1	0
Accommodation	c	i/t	1	1	1	1	1	1	1	1	1	1	1
Booking possibilities	v	t	1	0	1	0	0	1	1	1	0	1	0
Transport	c	i/t	1	1	1	1	1	1	0	1	1	1	0
Car parking information	v	i/t	1	0	1	0	0	0	0	0	0	0	0
Information on parking charges	v	i/t	1	0	1	0	0	0	0	0	0	0	0
Map of the location of car parks	v	i/t	1	0	1	0	0	0	0	0	0	0	0
Spaces available (current state)	v	i/t	1	0	0	0	0	0	0	0	0	0	0
Bus information	c	i/t	1	0	1	1	1	1	0	0	0	1	0
Travel tickets	v	i/t	0	0	1	0	0	1	0	0	0	1	0
Discount card	v	i/t	0	0	0	0	0	1	0	0	0	0	0
Taxi	v	i/t	0	1	0	0	0	1	0	0	0	0	0
Renting vehicles	v	i/t	0	0	0	1	0	0	0	0	0	1	1
Renting vehicles on-line	v	i/t	0	0	0	1	0	0	0	0	0	1	0
Rail and coach information	c	i/t	1	0	1	1	1	1	0	0	0	1	0
Sea information	c	i/t	1	1	1	1	1	1	1	1	1	1	0
Airport	c	i/t	1	0	1	1	0	1	0	1	0	1	0
Airport guide: the latest news	v	i/t	1	0	1	0	0	0	0	0	0	1	1
Language	v	i	0	1	0	0	0	0	1	0	0	0	0
Currency	c	i	0	1	0	0	0	0	1	0	1	0	0
Calculator	v	i	0	0	0	0	0	0	0	0	1	0	0
Exchange offices	v	i	0	0	0	0	0	0	0	0	0	0	0
Bank services	v	i	0	0	0	0	0	0	0	0	0	0	0
Maps	c	i	1	1	1	1	1	1	1	1	1	1	1
Leaflets, brochures	v	i	0	1	0	0	0	1	1	1	0	1	0
Restaurants and bars	c	i	1	1	1	1	1	1	1	1	1	1	0
Shopping	c	i	1	1	1	1	1	1	1	1	1	1	0
Duty free shops	v	i	1	0	0	0	0	0	0	0	0	0	0
Malls, markets	v	i	0	0	0	0	0	1	0	1	0	0	0
Shopping on-line	v	i/t	0	1	0	0	0	1	0	0	0	0	0
Events	v	i	1	0	1	1	1	1	0	0	0	0	0
Special events tickets	v	i/t	1	0	0	0	0	1	0	0	0	0	1
Nightlife	v	i	1	0	0	0	0	1	0	0	0	0	0
Tickets on-line	v	i/t	1	0	0	0	0	0	0	0	0	0	0
Casinos	v	i	1	0	0	0	0	0	0	0	0	0	0
Casinos on-line	v	i/t	1	0	0	0	0	0	0	0	0	0	0

Excursions	v	i/t	0	1	1	1	1	1	0	1	0	1	0
Sightseeing	c	i	0	0	1	0	1	1	1	1	0	1	0
Gondola rides	v	i	0	0	0	0	0	0	0	1	0	0	0
Walking routes	v	i	1	0	0	0	1	1	0	0	0	1	0
Pedestrian routes	v	i	1	0	0	0	0	1	0	0	0	0	0
Biking zone	v	i	0	0	0	0	0	1	0	0	0	0	0
What to see and do?	c	i	1	0	1	0	1	1	1	1	0	1	0
Top free sights	c	i	0	0	0	0	1	1	0	1	0	0	1
Fisheye	v	i	0	0	0	0	0	0	0	1	0	0	1
Videos	v	i	0	0	0	0	0	0	0	1	0	0	1
Parks	v	i	1	0	0	0	0	1	0	0	0	0	0
Art Galleries	v	i/t	1	0	0	0	0	1	0	0	0	0	0
Museums	v	i/t	1	0	0	0	0	1	0	0	0	0	0
Theatres	v	i/t	1	0	0	0	0	0	0	0	0	0	1
Sports	v	i/t	1	0	0	0	0	0	0	0	0	0	0
Weather	c	i	0	1	1	1	1	1	1	1	0	0	0
Cruise passenger information	c	i	1	1	0	1	0	1	1	0	1	0	1
Cruise terminal(s) location (map)	c	i	1	0	0	1	0	1	0	0	0	0	1
Cruise terminal(s) facilities	c	i	1	1	0	1	0	1	0	0	0	0	0
Crew information	v	i	1	0	0	0	0	0	0	0	1	0	0
Crew members information	v	i	1	0	0	0	0	0	0	0	0	0	0
Seafarers center	v	i	1	0	0	0	0	0	0	0	0	0	0
Telecommunications	c	i	0	0	0	1	0	1	0	0	0	0	0
Telephone	c	i	0	0	0	0	0	1	0	0	0	0	1
Internet access	c	i	0	0	0	0	0	1	0	0	0	0	1
WiFi centers	c	i	0	0	0	1	0	1	0	0	0	0	0
Visitors with disabilities	v	i	1	0	0	0	0	0	0	0	0	0	0
Parking	v	i	1	0	0	0	0	0	0	0	0	0	0
Toilets	v	i	1	0	0	0	0	0	0	0	0	0	0
Shop mobility	v	i/t	1	0	0	0	0	0	0	0	0	0	0
Environmental protection	v	i	0	0	0	0	1	0	0	0	0	0	0
Links	c	i	1	1	1	1	1	1	1	1	1	1	0
Other	v	i	1	1	1	1	1	1	1	1	1	1	1

In the first step, for each of the ports, the overall scores (sums of values equal to one) for value-added e-services have been calculated in Excel by formula (1):

=SUM(IF(D2=1,IF($B2="v",1,0),0)) (1)

The obtained positions of the ports due to the value-added e-services they offer are shown in Figure 3. Similarly, in order to make the ports mutual positioning, according to

the number of transactional, or informational and/or transactional e-services that they make available to the passengers, the following formula has been applied (2):

=SUM(IF(D2=1,IF(OR($C2="t",$C2="i/t"),1,0),0)) (2)

The positions of the ports gained by the calculus based on formula (2), according to the number of transactional, or informational and/or transactional e-services which they offer, are shown in the form of the perception map in Figure 4.

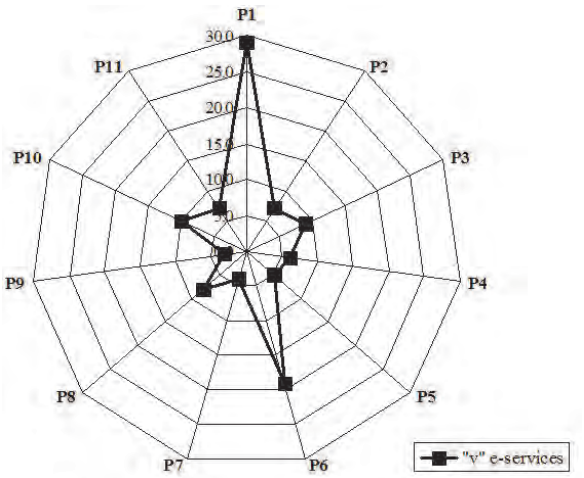

Fig. 3. Positions of passenger ports due to the value-added e-services

In the third analyzed case, the situation is a little bit more complex. Here, namely, there is an intention to position (rank) the considered passenger ports according to all the previously identified types of e-services they offer: c – core, v - value-added, i – informational, i/t – informational and/or transactional ones, and t – transactional. It is clear: if a certain port offers an e-service, that e-service will correspond to the numerical value 1, and otherwise, it will correspond to the numerical value 0. However, the main question is: how will the different types of e-services be pondered, or how will they impact the total scores? In order to answer this question, the authors interviewed ten respondents who are experienced in passenger port operations, sea ports marketing, and (cruise) tourism, and who have high level of logical thinking to rank the considered types of e-services according to their importance to the passengers and ports development. It is important to emphasize here that the estimation, or opinion, of only one highly qualified expert may be more important than the estimates made by a number of inexperienced persons [33]. However, for the purpose of this research, the highly qualified and experienced respondents have been asked to compare each pair of different types of passenger port e-services (c, v, i, i/t, and t) according to the Saaty [34] scale by using the grades: 1 - same importance; 3 - slightly more importance, 5 - moderately more importance, and 7 - strongly more or absolute importance of the first over the second considered criterion; or, by the corresponding reciprocity values depending on the mutual importance of the compared elements composing certain criteria pair(s). Although ten competent persons were asked to create the

Saaty matrices, only six matrices were taken into further consideration as the consistent ones. The selected matrices are given in Table 2.

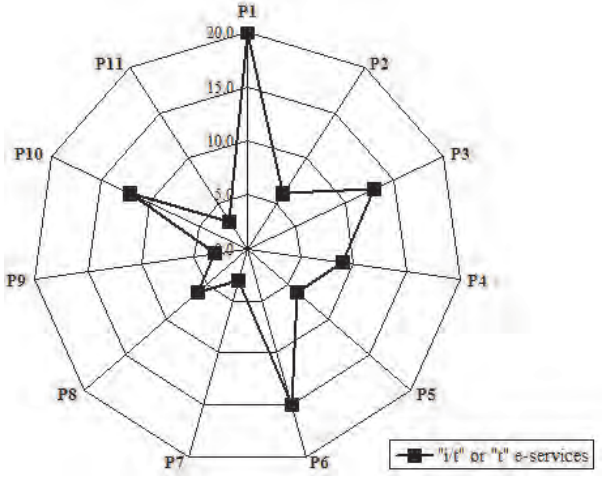

Fig. 4. Positions of passenger ports due to the transactional and information-al/transactional e-services

Table 2. Saaty matrices formed by respondents and consistency indices

Respondent 1						**Respondent 2**					
	c	v	i	i/t	t		c	v	i	i/t	t
c	1	1/5	1	1/5	1/7	c	1	1/3	1/3	1/5	1/7
v	5	1	3	1/3	1/5	v	3	1	3	1/3	1/5
i	1	1/3	1	1/5	1/7	i	3	1/3	1	1/5	1/7
i/t	5	3	5	1	1/3	i/t	5	3	5	1	1/3
t	7	5	7	3	1	t	7	5	7	3	1
$\lambda_{max} = 5.22473$; CI = 0.05618; CR = 0.05016						$\lambda_{max} = 5.28557$; CI = 0.07139; CR = 0.06374					
Respondent 3						**Respondent 4**					
	c	v	i	i/t	t		c	v	i	i/t	t
c	1	1/3	1	1/5	1/7	c	1	1/5	1	1/5	1/7
v	3	1	1/3	1/3	1/5	v	5	1	3	1/3	1/5
i	1	3	1	1/3	1/5	i	1	1/3	1	1/5	1/7
i/t	5	3	3	1	1/3	i/t	5	3	5	1	1/5
t	7	5	5	3	1	t	7	5	7	5	1
$\lambda_{max} = 5.40989$; CI = 0.10247; CR = 0.09149						$\lambda_{max} = 5.34840$; CI = 0.08710; CR = 0.07777					
Respondent 5						**Respondent 6**					
	c	v	i	i/t	t		c	v	i	i/t	t
c	1	1/3	1	1/5	1/7	c	1	1/3	1	1/5	1/7
v	3	1	1	1/3	1/5	v	3	1	3	1/3	1/5
i	1	1	1	1/5	1/7	i	1	1/3	1	1/5	1/7
i/t	5	3	5	1	1/5	i/t	5	3	5	1	1/5
t	7	5	7	5	1	t	7	5	7	5	1
$\lambda_{max} = 5.25864$; CI = 0.06466; CR = 0.05773						$\lambda_{max} = 5.28520$; CI = 0.07130; CR = 0.06366					

By the normalized eigenvector values calculus, the ranks of the considered types of e-services have been calculated, along with the values of the largest eigenvalue λ_{max}, and

the consistency index CI, while the random index RI is equal to 1.12 in all cases, since the number of criteria is constant and equal to five. It is obvious (Table 2) that all CR values, for each considered matrix, are less than 0.1, which is to be fulfilled in order to provide a satisfying degree of the Saaty matrix consistency [34].

The overall rank of the considered types of e-services which the analyzed ports offer is calculated by the standard statistical procedure and it is given in the last column of Table 3 [33,35]. It is based on subjectively estimated importance of the considered types of e-services by the interviewed experts. More explicitly, the idea of evaluating the final rank or normalized weight coefficients per each type of e-services is associated with the sum of ranks of each criterion c_q, with respect to the estimates of the respondents:

$$c_q = \sum_{r=1}^{6} c_{qr}\ ,\ q = \overline{1,5} \qquad (3)$$

where:

c_q is the sum of ranks of each e-service type, while q is the number of different types of e-services (here 5), and r is the number of experts, or respondents (here 6); and,

c_{qr} is the rank of the q-th criterion estimated by the r-th respondent.

Now, the average weight coefficient for each of the analyzed type of the e-services can be calculated by the following formula:

$$\overline{w}_q = \left[c_q \Big/ \sum_{q=1}^{5} c_q \right]^{-1} . \qquad (4)$$

Finally, the normalized average weight coefficients are to be calculated by formula (5):

$$\overline{w}_{qn} = \overline{w}_q \Big/ \sum_{q=1}^{5} \overline{w}_q . \qquad (5)$$

Table 3. Ranks of different types of passenger port e-services

E-service types	Respondents						$\overline{w}_q$	$\overline{w}_{qn}$	Rank
	R1	R2	R3	R4	R5	R6			
c	5	5	5	5	5	5	3.000000	0.087848	**5**
v	3	3	4	3	3	3	4.736842	0.138707	**3**
i	4	4	3	4	4	4	3.913043	0.114584	**4**
i/t	2	2	2	2	2	2	7.500000	0.219620	**2**
t	1	1	1	1	1	1	15.000000	0.439240	**1**

In order to examine the level of consistency of the respondents' estimates (Table 2), as the last step of the e-service different types ranking, the concordance coefficient W is to be calculated as well, through the following calculus (6):

$$W = 12S / r^2 q\left(q^2 - 1\right) \qquad (6)$$

where:

$S = \sum_{q=1}^{6}\left(c_q - \sum_{q=1}^{6} c_q\right)^2$ - is analogue to the variance of the ranks;

r is the number of the respondents (here 6); and,

q is the number of criteria, or the number of the e-service types (here 5).

Now, the smallest value of W, i.e. W_{min} is to be calculated by formula (7):

$$W_{min} = \chi^2_{\alpha,v} / r(q-1) \qquad (7)$$

where:

$\chi^2_{\alpha,v}$ is the critical chi-square statistics, found in the table [33, 35, 36] by assuming the degree of freedom $v = 5-1$, and the significant level $\alpha = 0.010$. Here, it is $\chi^2_{\alpha,v} = 13.28$. By taking into account the previous assumptions $W_{min} = 0.553$, while $W = 0.972$. Since the condition $W_{min} \le W$ has been satisfied, it implies that the estimates of the respondents are quite consistent.

Finally, on the basis of the final values of normalized weight coefficients per each type of e-services (Table 3, i.e. by means of $\overline{w}_{qn}$ values), it becomes possible to calculate the positions of the eleven examined passenger ports by the following formula created in Excel (8):

=SUM(IF(D2=1,IF($B2="v",0.14,0.09),0),IF(D2=1,IF($C2="t",0.44,IF($C2="i/t",0.22,0.11)),0)) (8)

This means, as in the previously explained cases, that if the observed passenger port offers a certain e-service it is assigned 1, and otherwise, if it does not offer such service, it is assigned 0. Furthermore, if the noticed e-service is a core one (c), it will be pondered by 0.09, but if it is a value-added one (v), it will be pondered by 0.14.

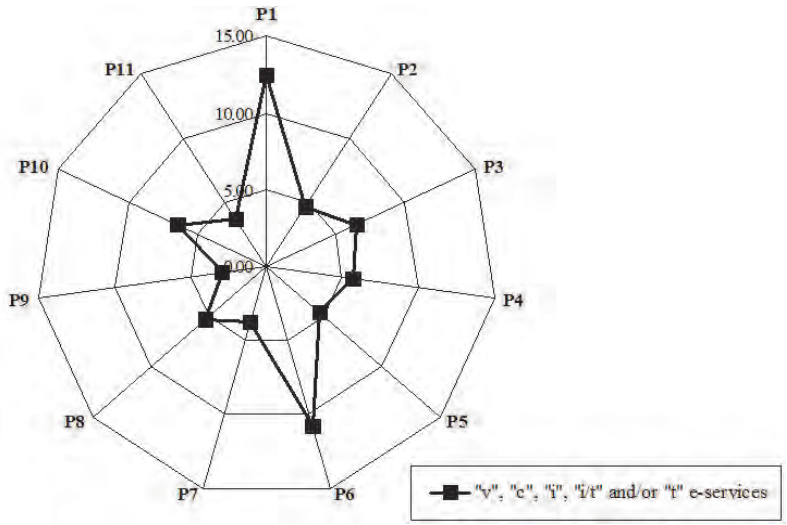

Fig. 5. Positions of cruise ports according to all considered e-services which they offer to the passengers

If a certain e-service is informational, it will be multiplied by 0.11, if it is informational and/or transactional (i/t), it will be pondered by 0.22, and finally, if it is transactional (t) one, it will be pondered by 0.44. The respective perception map of the positions of the analyzed ports from the aspect of e-services they offer and on the basis of the six experts' responds is shown in Figure 5. The obtained positions might be treated as relevant indicators of their competitiveness at the corresponding passenger (cruise) port e-market. The obtained *final* positions of the analyzed cruise ports according to e-services which they offer (on the basis of web surveys realized in July, 2012) are given in Table 4, as well.

Table 4. Positions of the analyzed ports according to available web-based e-services

Rank	**Port**	**Numerical values** (see Eqv. (8))
1	P1: Southampton (UK)	12.47
2	P6: Venice (IT)	10.82
3	P3: Dover (UK)	6.50
4	P10: Genoa (IT)	6.44
5	P4: Civitavecchia (IT)	5.69
6	P8: Helsingborg (SE)	5.28
7	P2: Barcelona (ES)	4.66
8	P5: Calais (FR)	4.51
9	P7: Limassol (CY)	3.75
10	P11: Kotor (MN)	3.70
11	P9: Palma de Mallorca (ES)	2.88

These positions (by this research obtained as *final* port rank) could not be treated as "absolutely" right ones, or as indeed "final" ones, but this survey should be used as an idea: how cruise ports (re)positioning might be done, or as the starting base for further more detailed and rigorous investigation in this domain. On the basis of these results, the port management, other responsible entities and/or stakeholders might get insight into what is to be done toward positive repositioning of the ports and through enriching their web-based e-service offer to the cruisers. It is to be mentioned as well, that there are some additional e-services that can be found on the web sites of some relevant passenger ports which are not included into this research. Ports of New York [37] and Rotterdam [38] e.g., supply the customers with some e-services that are not included into the list of different e-services used in this research work. Such e-services are: detailed information about passenger embarking/disembarking (embarking from buses, limousines, taxies, private vehicles, and disembarking upon returning from the cruise in opposite order), etc. Also, the mentioned ports (New York and Rotterdam) offer actual lists of cruiser calls, as well as relevant nautical information about the port and the cruise terminals. Port of Rotterdam e.g. offers ship repair capabilities within cruise facilities and services. Some ports offer possibilities of authorisation for some special (intranet or extranet) services, some ports offer possibilities of authorisation for different types of green cards, etc. So, all these should be also included into further research work in this field.

4. Research results and Port of Kotor (re) positioning

There are many quantitative methods that can be used to measure the degree of port competitiveness and allow their mutual comparison and positioning on the market. The detailed survey of their applications in sea port positioning is given in [36]. In this paper the combination of binary approach for the purpose of sublimation of a rather large num-

ber of employed criteria (i.e. cruise port e-services) and Saaty method for ranking particular categories of considered criteria, or e-services here (core, value-added, informational, informational/transactional, and transactional) have been used. On the basis of the numerical results obtained by conducting these quantitative approaches and the related quantitative analysis of the passenger (cruise) port e-services, primarily in the function of cruise tourism promotion, it becomes obvious that the Port of Kotor is averagely positioned among analyzed ports according to the value-added e-services it offers (see Figure 3), and that it is rather low positioned for other and all (together) treated e-services (see Figures 4 and 5). One of the aims of the paper is to offer possible directions toward improving this situation, i.e. toward repositioning of the Port of Kotor and making it thus more competitive on the respective cruise tourism market. However, the following recommendations might be offered:

- Concerning the value-added e-services offered by the eleven ports analysed in this paper, the Port of Kotor is on the seventh position, which is an average score. The Port of Kotor is on this position owing to the following value-added services it offers: renting vehicle possibilities, airport guide existence, offering the latest relevant (local) news, special events tickets offering, etc. As models or *ideal* ports toward which the Port of Kotor should be repositioned in a positive sense are ports of Southampton and Venice in the first place (see Table 1 for more detailed insight into their value-added e-service offers).
- In case of the cruise ports mutual comparison or positioning according to the informational and/or transactional, or exclusively transactional e-services, the Port of Kotor is at the lowest position. It says that it offers the smallest number of such e-services, i.e. only: those about taxi services and airport services in general, and some information concerning local museums. Additionally, the information are (only) informational, not transactional, which is undoubtedly another huge qualitative disadvantage of Kotor as a cruise port of call.
- According to all types of considered e-services (see Figure 5), the Port of Kotor is on the tenth position, which is a pretty *poor* score, and it speaks in favour of immediate need for its repositioning towards a "better score". As models for its repositioning in a positive sense the ports of Southampton and Venice should be considered again, and some of e-services they offer (see Table 1) should be included into the Port of Kotor offer as a growing Adriatic/Mediterranean cruise destination. For instance, a broad palette of new services should be included into the Port of Kotor e-offer, such as: accommodation booking possibilities; some relevant sea information; information on exchange offices; news about cultural events; information about galleries; Wi-Fi access availability information; special information for visitors with special needs (disabilities), environmental protection information – these, of course, imply physical existence of related opportunities.

Within the Conclusion, some general recommendations, along with a few very precise quoted ones, obtained on the basis of quantitative analysis, aiming cruise port ICT modernisation, which can be applied in a certain manner to the Port of Kotor as well, are pointed out, in order to *reach* the responsible bodies for providing its sustainable development as a rising cruising destination in the Mediterranean.

5. Conclusions

The digital revolution has changed the business and consumer trends in general [3-6]. Consequently, it has certain reflections to the passenger ports and to the passengers' expectations in the context of cruise tourism. With advent of ICT-enabled smart networking business models and the passenger port services are nowadays considered as "augmented" procedures, since their traditional physical nature is on the road to be overplayed by informational and electronic transactions components. However, it is not to be forgotten, that cruising is still a physical act and all passenger (cruise) ports still need passenger terminals and all required, following, real-physical capacities and features. Thus, the ICT capacities are the *tip of the iceberg*, requiring adequate passenger port infra and suprastructural capacities, adequate organizational, strategic development and numerous other structural, financial, organizational and environmental issues which in fact form the core base of ICT virtual superstructures. Furthermore, a new, unique taxonomy for systematic identification, assessment and selection of individual passenger port e-services is to be adopted and it is to be based on additional, more extensive research and evaluation efforts in this domain [5, 6]. In line with the previously noted, the comparative analysis of the availability of e-services and traffic intensity should be realized as part of next research steps in this domain. Besides these rather general conclusions, on the basis of research conducted in the paper, the following more precise conclusions might be derived as well:

- Some relevant e-services of eleven analyzed cruising ports in EU, including the Montenegrin Port of Kotor as cruising one, have been identified and categorized;
- The relatively large number of identified e-services have been sublimed per each category by simple binary approach, as a way of data pre-processing for the following quantitative and qualitative analysis;
- Multi-expert choice expressed in the form of Saaty matrix and the corresponding mathematical analyses [33-36] have been used for ranking the considered e-service categories;
- The *final* rank of the analyzed cruise ports is determined by combining binary and Saaty approaches (see Table 4 for final numerical results);
- On the basis of conducted calculus for each (all) type(s) of considered e-services, it becomes clear that ports: Southampton and Venice should be treated as models or *ideal* cruise ports for positive repositioning of all the other ports considered in this paper on the (global) cruise port market (see Table 1 for some more details on e-services they offer); and,
- The Port of Kotor should be repositioned according to all explored categories of e-services especially regarding the transactional ones.

These observations should be used as a particular base for further more detailed and rigorous investigation in this challenging sphere, concerning cruise ports development and their proper (re)positioning at the (global) permanently and rapidly developing cruise port market.

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P.3. Employing wireless networks in enhancing occupational safety at the developing seaport – Two proposals[3]

Korišćenje bežičnih mreža u poboljšanju bezbjednosti na radu u luci u razvoju – dva prijedloga

Abstract: The paper proposes two Wireless Body Area Network Sensors (WBANSs) scenarios at the logical and simulation levels for improving occupational safety and health conditions at the developing seaport environment. The Port of Bar (Montenegro) is taken as an exemplar. The logical model is based on the actual position of the Port of Bar at the seaport market, its needs and capacities for the information systems innovation through technology transfer and diffusion. The simulation model analyses the channel between the body central unit (BCU) of the worker's on port wireless body sub-network and the port access point. The quality of the signal transmission at the physical layer has been tested through a source code generated in the Matlab. The code includes the BCU composite signal modulation, transmission, and demodulation, along with a noise and fading effects analysis. The results of the simulation experiments for the different transmission frequencies and distances between transmitter (worker's BCU) and receiver (port's access point) by using binary phase-shift keying (BPSK) and quadratic phase-shift keying (QPSK) modulation schemes are presented. Some directions for further investigations in this field are given, as well.

Key words: occupational safety, developing seaport, Wireless Body Area Network Sensors (WBANSs), channel simulations, physical layer.

Apstrakt: U radu su predložena dva scenarija bežične mreže senzora u opsegu ljudskog tijela (WBANSs - Wireless Body Area Network Sensors, eng.), na logičkom i simulacionom nivou, s ciljem poboljšanja bezbjednosti na radu i zdravlja radnika, u luci u razvoju. Luka Bar (u Crnoj Gori) je uzeta kao primjer. Logički model je baziran na aktuelnoj poziciji Luke Bar na pomorskom tržištu, njenim potrebama i kapacitetima u pogledu inovacija informacionih sistema, putem transfera i difuzije novih tehnologija. Simulacioni model analizira kanal između centralne komunikaciono-kontrolne jedinice radnika (BCU – Body Central Unit, eng.) i pristupne tačke u luci. Testiran je kvalitet transmisije signala na fizičkom nivou, putem izvornog koda kreiranog u Matlabu. Kod uključuje modulaciju BCU kompozitnog signala, prenos, demodulaciju, kao i analize šuma i fedinga. Dati su rezultati simulacija za različite frekvencije i udaljenosti između predajnika (BCU) i prijemnika (najbliže pristupne tačke u luci) za dvije modulacijske šeme BPSK (binary phase-shift keying, eng.) i QPSK (quadratic phase-shift keying, eng.). Takođe, date su neke smjernice za dalja istraživanja u ovoj oblasti.

Ključne riječi: bezbjednost na radu, luka u razvoju, mreža bežičnih senzora u opsegu ljudskog tijela (WBANS), simuliranje kanala, fizički nivo.

1. Introduction

With the advancement of Information and Communication Technology (ICT) which enables *smart* networking business models, cargo and passenger ports services are nowadays considered like high technological processes enriched by informational and electronic transactions components. However, it is not to be forgotten, transportation and traffic are still physical acts and all ports therefore need terminals including all corresponding capacities and features. The sea ports need primarily the adequate infra and suprastructural capacities, adequate organization, sustainability development planning and numerous other structural, financial, and environmental issues which form the foundation for the ICT superstructures [1,2]. This holds true for huge developed sea ports like Shanghai, Singapore, Hong-Kong, Busan, Rotterdam, Kaohsiung, Hamburg, Antwerp, Felixstowe, etc. On the other side, this is not the case for ports of developing countries in

[3] Bauk S., Schmeink A., Colomer J., Employing wireless networks in enhancing occupational safety at a developing seaport – Two proposals, *Polish Maritime Research*, accepted in November 2016, to appear.

the South Adriatic region, e.g., Bar, Durres, Kotor, Ploce. Accordingly, in the focus of the paper shall be the last mentioned ones, primarily the Port of Bar.

Previous research in this field indicates that underdeveloped sea ports at the South Adriatic region suffer from the lack of the appropriate ICT solutions [1,3,4]. Some of the analyzed sea ports in this basin, e.g., Bar, Durres and Ploce, do not provide all, or some of the following *smart* operation processes: vessel monitoring, automatic containers control, scheduling and stacking containers, monitoring of cargo in stock, etc. These ports have mainly partial, fragmented ICT solutions for supporting some administrative and operational procedures, but they commonly do not have Enterprise Resource Planning (ERP), Customer Relationship Management (CRM) software solutions, Electronic Data Interchange (EDI) service, Vessel Traffic Management Information Systems (VTMIS), National Maritime Single Windows (NMSWs), Electronic Logistics Marketplace (ELM) access, etc. In addition, according to the previous research work [5-7], the passenger sea Port of Kotor is not digitally present at the appropriate scale on the web, in comparison to some developed EU ports of the same kind, what makes negative implications in terms of its position on the customers' perception maps.

The lack of ICT applications in some cargo and passenger ports within the South Adriatic region might be explained by a relatively small turn over of these ports. Consequently, they are lacking the justification for adopting the above mentioned rather costly ICT solutions which would provide greater automation and complete logistic integration of the ports' administrative and operational processes. From another side, insufficient digital presence of the Port of Kotor, e.g., in comparison to some recognized EU passenger ports can be explained by the lack of some value-added and e-transactional services that this port should provide to the customers.

The question here is: Which kind of ICT solutions are urgently needed and at the same time feasible in developing seaports with focus on the South Adriatic and the Port of Bar in the first instance? – Regardless of the turn over of the ports in this region and the economical and political milieu in which they operate, providing the appropriate employees (primarily on port workers) safety and health management, must be placed in the forefront. Therefore, our idea is to propose two wireless network models convenient for improving working conditions and workers' occupational health and safety. The proposed models should be at the same time cost-effective and relatively easy to be implemented and run. The proposed models can be adapted to satisfy the individual needs and capacities, especially if we bare in mind certain organizational and human capacity limitations that are present in the considered Port of Bar, especially when it comes to installing new ICT solutions, along with their continuous maintenance, providing their flexibility and scalability in the future.

2. Port of Bar: In brief

The Port of Bar[4] has a favorable geographical position. With the railway line Belgrade-Bar and the road network in its hinterland, along with the intermodal transportation and traffic links with Italian ports Bari and Taranto, it could provide good connections within its rather wide gravitational area. Thanks to its advantageous geographical position it might be developed into the distribution center for the whole region. More about the

[4] URL: http://www.lukabar.me/eng/Port_of_Bar.htm; last access, September 2016

Port of Bar can be found on its web site and in the documentation of numerous regional and EU projects in which realization the Port of Bar has been involved.

In the period from 2007 to 2013, the Port has participated in implementation of several EU projects which concerned [8]:

- strengthening intermodal transport;
- short-sea shipping possibilities;
- integrated logistics chains and attracting innovative investments;
- improving environmental impacts at ten South East European (SEE) ports (TEN ECOPORT);
- establishing a sustainable transport system at the Adriatic coast and in the hinterland;
- improving environmental protection (marine/river pollution);
- detecting dangerous materials under the sea water in the ports' area;
- developing sustainable integral sea-land transport/traffic network;
- concerning integration of maritime and river transport in the logistics chain;
- pollution prevention in the SEE ports (ECOPORT 8), etc.

Partners from the EU were at most of these projects leading ones, so that the Port of Bar was not mainly in a position to independently decide on the allocation of the available funds. During the projects implementation everything remains on the level of consideration of previous appropriate practices, data collection, analysis, modeling, but when it comes to the implementation of innovative solutions, it seems that the results are quite weak, almost minor. Attracting foreign investments is not realized in the planned volume due to the high administrative barriers, inconsistencies in law enforcement and economic uncertainty within the region. It seems that this geographical area, including Port of Bar as its strategically important sea-land transportation node, remains in the *vacuum of inadequate solutions* [8,9]. It is necessary to make a clear strategy including the competitive and agile administrative and personnel structures that will devotedly work on achieving development in the sphere of freight multimodal, intermodal, co-modal and/or synchromodal [10] transportation modes in the future.

2.1. Safety and health management in the Port of Bar

Within the projects TEN ECOPORT [11] and ECOPORT 8 [12], some recommendations for further actions towards improvement of working conditions and occupational safety in the Port of Bar are provided. The most harmful environmental and workers' health and safety impacts are identified. The working processes in the Port are also analyzed in detail and the points with the highest level of risk to the workers employed directly on port operations are specified. Most of the safety and health issues in the Port of Bar are described in detail in the Port safety management official acts and within the previously mentioned projects' documentation. On the basis of a previous detailed analysis in these fields, here will be given an envisaged approach to the problem, in terms of proposing two WBANSs scenarios which are in accordance with the Port of Bar needs and contemporary ICT based safety management recommendations in this domain.

For the purposes of the project TEN ECOPORT realization, several in-dept interviews with the managers in the Port of Bar were performed [13], and the highlights in terms of the most common risks to which the workers directly on port are exposed are identified. These risks are: working outdoors at various (unfavorable) weather conditions (extremely high or low temperatures, rain, wind, etc.), exposure to the dust during the

transshipment of bulk cargos (grains, all types of ores and concentrates, alumina, etc.), maneuvering with obsolete transshipment equipment and transportation devices, manipulating with damaged cargo (bags, pallets, packages, containers, etc.), exposure to the risk of fire (especially during the summer months), etc. In addition, workers on port are realizing mostly monotonous and repetitive operations what results in fatigue which increases the risk of accidents.

Above listed risks correspond to those identified and in detail explained, e.g., by the UK Health and Safety Executive (HSE) and Irish Health and Safety Agency (HSA) in seaports, as credible institutions, including the advices for risks preventing and straightforward reacting in the cases when the accidents unfortunately occurred [14-16]. The HSE also gives the extensive list of references in terms of operational and law regulations in these fields, including the relevant statistics. It is worth to mention here that the UK Port Employment and Accident Rates (2009/2010) statistical report stands: "The estimated annual accident rate for all direct on-port employees was 1.1%, or 1,100 per 100,000 employees. …An employee of a direct on port company is more than fifty times more likely to have an accident (across all severities) in comparison to an employee based in office." These data support the hypothesis that working directly on a port is really dangerous occupation.

Since the Port of Bar has a low turnover, its workers are *spared* to the considerable extent of some risks to which are exposed the dock workers in the world's leading ports. Therefore the relatively low level of turnover in the Port of Bar, with the aspect of the risks, might be treated as an advantage. Regardless of this fact, in the following parts of the paper two scenarios are proposed for improving safety and health conditions of workers on docks in the Port of Bar.

The first one is based on WBANSs being attached to the workers' personal protective equipment (hard helmets, protective jackets, or safety vests, and ptotective shoes) including a BCU (Body Central Unit), while the second one deals with wearable WBANSs for scanning and transmitting in regular time intervals vital body (electrophysiological) signals: skin temperature, heart activity, respiratory rate, acceleration, oxygen blood saturation, and level of glucose. Although the additional body signals relevant in assessing and improving overall human body (workers') health conditions today might be used trough: artificial cochlea, artificial retina, camera pill, carbon dioxide sensor, visual sensor, bio-impedance spectroscopy, chipped sweatbands, etc. [17-20], for the purpose of this study, the attention will be put to the firstly listed ones.

3. Scenario 1: WBANSs as parts of Personnel Protective Equipment (PEE)

The workers in the Port of Bar are working mainly at open space (docks, open stacking and warehousing areas, gangways, etc.) under various weather conditions with obsolete manipulative equipment and transportation devices, so they are exposed to the variety of non negligible risks. In order to reduce them, the workers should wear personal protective equipment which at least includes: hard helmet, jacket (safety vest) and protective shoes. Over each piece of these garments are to be attached Radio Frequency IDentification (RFID) tags/chips which provide at least an ID for each of the personal protective equipment parts and the data on its functionality. The RFID tags/chips play here the role of the WBANSs. Besides IDs and tags/chips functionality data, the RFID-sensor device attached to the workers' helmets should also provide the information about

the temperature and light inside the helmet, while the RFID-sensor devices on the protective shoes should provide the data on workers' plantar pressure. By measuring temperature and light, it is possible to capture the information about working environment conditions, and by measuring plantar pressure distribution it is possible to get the information about the workers' performed actions (Figure 1).

These WBANSs are wirelessly connected through the access point to the advanced back-end info-communication system which sends warning to the worker in cases if a part of personal protective equipment is missing, or if it is not functional. In such case the worker has to come to the central and change that piece of the protective equipment. Also, the worker will be warned in cases when ambient temperature and light are not appropriate.

Similar scenario has been already employed at the Cagliari International Container Terminal, and analyzed in [21-23]. In these references Sole, et al., deal with radio networks for public safety; avoiding possible false alarms generated by the WBANSs; the system of video cameras for feature recognition; the specific absorption rate (SAR) level analysis, etc. We are focus here on simulating network segment on the physical layer between Body Central Unit (BCU), or handheld RFID-sensors' reader, and the access point or sink node of the port local area network by employing several wireless propagation schemes and two modulation (BPSK and QPSK) types.

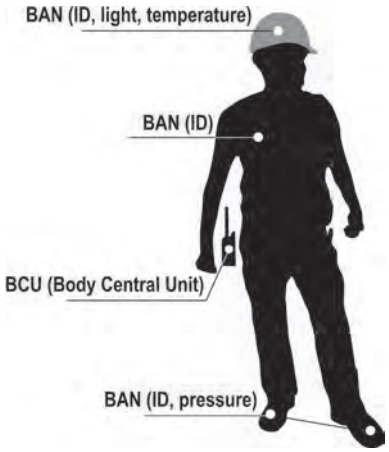

Fig. 1. The WBANSs on worker's personal protective equipment RFID-sensors and BCU (*Source:* Adapted from [21])

The physical layer addresses the lower-level operations of the radio interface for a transmission and reception of packages in a harsh environment like the seaport one. These operations include the frequency selection, transmission power, modulation, signal coding and detection [24].

In the simulation section (Section 6), the communication between RFID tags/sensors and handheld reader is abstracted at this beginning phase of our research work. The content of that information is not clear at the moment and it may vary depending on the port's (i.e., workers, managers and stakeholders) real needs and preferences [25]. The attention is paid to the transmission of the composite signal, generated by previous fusion

of personal protective equipment pieces IDs, temperature and light data according to the proposed scenario over the link BCU – the nearest port access point.

4. Scenario 2: WBANSs as scanners of workers' vital signs

The second proposed scenario is based on the concept of wearable sensors for measuring in real time workers' electrophysiological data. Since in Montenegro there is no reliable data on professional diseases, the choice of several types of common vital signal sensors which form worker's WBANSs is based mainly on our empirical assessments and intuition. The data published in [26] are incomplete, since they consider only the number of patients who have asked for the help in public health institutions in the recent period. But, there are a lot of people who consciously avoid asking for the health in the public health institutions in Montenegro, even if they have health problems, because the services provided there principally are unfortunately poor. Additionally, most of ill people do not have assets to ask for the help in growing number of specialized private health ambulates. This works for the on port workers, as well. Due to the best of our knowledge, the majority of ill people/workers do not "report" their illness and consequently the official statistics are trustless. Therefore the proposed model at the level of a black box, at the initial stage of our research work, might be of interest to the managers in the Port of Bar and for the health institutions in Montenegro in terms of starting with screening and collecting reliable real-time data on workers' health conditions in a harsh environment.

Figure 2 gives a schematic view of worker's on port WBANSs set, which is composed of several non-intrusive biomedical, vital data sensors for monitoring: (1) heart rate, electrocardiography (ECG), respiratory rate, skin temperature; (2) acceleration; (3) oxygen blood saturation; and (4) glucose level, including optionally insulin pumps, only for those workers who still have some diabetes problems and who are willing to use these sensors-actuators (4).

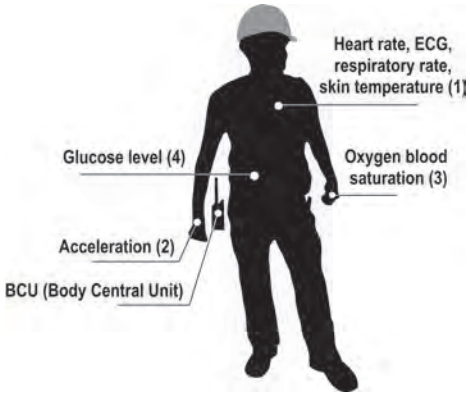

Fig. 2. WBANSs for scanning worker's vital signs sensors and BCU
(*Source:* Adapted from [25])

These wearable sensors (Figure 2) are briefly described as follows [25]:

Sensor module (1): It is a compact physiological monitoring module that enables capturing and transmission of comprehensive physiological data on the worker. It is

proposed here for measuring: worker's heart rate, electrocardiography (ECG), respiratory rate and skin temperature.

Sensor (2): It is used for measuring the acceleration of a body in an inertial three-dimensional coordinate system, and it plays a key role in human energy expenditure detection and behavioral recognition. Since modern life style demands balanced physical work, the worker's on port physical activity in working-intensive and harsh seaport environment needs permanent recording on daily basis.

Sensor (3): It is commonly used for measuring oxygen blood saturation. It allows monitoring chronic diseases like obstructive pulmonary ones, congestive heart failures or asthma. Since on port workers are exposed to the dust and variety of air pollutants [11,12], we proposed this sensor as an element of the worker's WBANSs set.

Sensor module (4): This sensor module provides the information about the glucose level and it gives the insights into the body's glycemic profile. In addition, it may include the insulin pump therapy that implies the use of multiple daily injections or continuous subcutaneous insulin infusion therapy. It should provide an optional health care measure to the workers' on port who still have diabetes problems, strictly under the condition that they are willing to use this type of body sensor-actuator loop.

By all means, there is a plenty of options [27,28] in the considered case in terms which kind of sensors to use, who among the employees will use them or not, depending on their previous health assessment, on their personal will and on managers' decisions. The overlap in sensors' data collecting and processing is to be avoid, as well. It is important to mention that all these sensors should communicate, like in the previously proposed scenario, to the port access point via worker's handheld BCU device. The content of the information which BCU acquire from above proposed and briefly described sensors is still not clear and may vary depending on the port's needs and preferences, along with the workers readiness to become a part of such network. Therefore, it is abstracted here as a payload that is to be transmitted between worker's BCU and the nearest access point at the port perimeter. Similarly to the first proposed scenario the WBANSs are connected through the access points to the appropriate advanced back-end info-communication system which sends warnings to the worker in cases if some of his/her biomedical parameters are outside the prescribed boundaries. In such cases the worker has to leave working place and ask for the medical advice and/or help.

3. Comparison of Scenarios 1 and 2

It is clear that both presented scenarios are purposeful and it is difficult to determine which one is more effective. We tried to analyze them through three qualitative parameters: medical independence (MI), technological independence (TI) and non-invasiveness (NI). The parameter *medical independence* means that sensors can realize its purpose without (continuous) medical supervision; *technological independence* means that sensors can operate independently of other technological systems (i.e., only in coordination with BCU), and *non-invasiveness* means that the sensors are wearable or non-invasive. The values of these parameters are given in Table 1. If (RFID)sensor is independent in medical and technological terms, and/or if it is non-invasive, mark "x" is used; if it is dependent than "o" mark is used, and if it is periodically dependent on the considered parameter(s), mark "x/o" is used. Numerical values assigned to the (x; x/o; o) are respectively (1.0; 0.5; 0.0). These parameters are heterogeneous, but with positive

correlation, what means: it is favorable in all cases that sensors are medically and technologically independent and non-invasive. Therefore, by simple additive method, a rather rough approximation in terms which scenario is more desirable can be made.

Table 1. Qualitative-quantitative comparison (*Source:* own)

Scenario	Sensor	MI	TI	NI
Scenario 2	Heart rate, ECG, respiratory rate, skin temperature	x/o	x	x
	Acceleration	x/o	x	x
	Oxygen blood saturation	x/o	x	x
	Glucose level (insulin pump – optionally)	o	x	o
	Score:	1.5	4.0	3.0
Scenario 1	RFID $_{Helmet}$ (ID, light; temperature)	x/o	o	x
	RFID $_{Jacket}$ (ID)	x	o	x
	RFID $_{Shoe\ 1}$ (ID, pressure)	x/o	o	x
	RFID $_{Shoe\ 2}$ (ID, pressure)	x/o	o	x
	Score:	2.5	0.0	4.0

For instance the sensor for measuring worker's heart rate, ECG, respiratory rate and skin temperature functions independently, but after a certain time it needs to be read by the physician. Similar situation is with accelerometer and oxygen blood saturation meter; while glycol meter and insulin pump requires more frequent physician scrutiny. The RFID chips with light, temperature and pressure sensors require also periodically medical survey. When it comes to the technologically independent, then the sensors which belong to the scenario 2 can function independently.

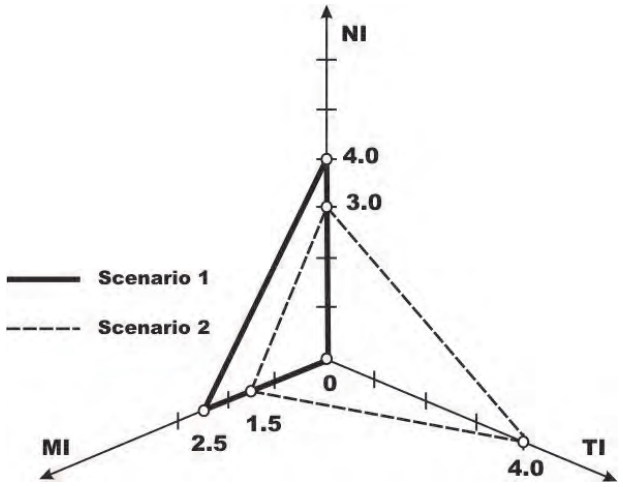

Fig. 3. Results of quantitative comparison (*Source:* own)

On the contrary, greater precision can be achieved if the sensors within the scenario 1 work in combination with system of video cameras and RFID readers fixed at strategically points in the port [22, 24, 25], besides those imbedded in workers' handheld sets (BCUs). Further, three of four sensors associate to the scenario 2 are non-invasive, except glucose pump, which can be use optionally; while all RFID-sensors in scenario 1 are non-invasive. These observations, expressed numerically, are shown in Figure 3.

The second scenario is obviously in a considerable advantage to the first one in accordance to the second parameter – *technologically independence* (TI). Meanwhile, if the port management decides to use the first proposed scenario without supplementing system of video cameras and fixed readers installed on port, it will be preferable, etc. At any rate, this comparative analysis is quite rough, and it can be used only for orientation, it terms how to perform later more detailed one. For this purpose it would be necessary to specify which of the commercial sensors will be used, in which intervals medical supervision will be carried out for each scenario, shall be used additional supporting systems in the case of scenario 1 or not, etc. However, these decisions are up to the port's managers and stakeholders, workers and ICT and medical experts who will be eventually engaged in designing and implementing such scenario(s).

4. Simulation model and some analysis

Since here are proposed two different conceptual models for monitoring occupational safety, in Figure 4 is given a wider network scheme that can envelop them. The worker's on port BCU performs RFID-sensors and biomedical sensors data access control and fusion, and transmits them through the access point to the outside world. This means data transmission via broadband modem (fixed, wireless, or mobile one), which provide high-speed connection via Internet, which is here symbolically presented as a cloud, to the advanced backend RFID-sensors' and biomedical sensors' central servers. The high-speed broadband connection can be established as: (i) Wireless Local Area Network (WLAN) by means of Bluetooth, Wi-Fi, ZigBee, UWB, or White-Fi; (ii) Wireless Metropolitan Area Network (WMAN) by means of WiMax USB modems and the towers; and/or (iii) Wireless Wide Area Network (WWAN) by means of cellular or satellite communication systems [29,30], etc. (Figure 4).

If some among the screened on port workers need 24 hours long surveillance (Scenario 2), then they have to wear sensor(s) not only at work, but also at home. In such case, the corresponding connection to the network must exist from the home environment, i.e., the access points at worker's home place should be provided, as well.

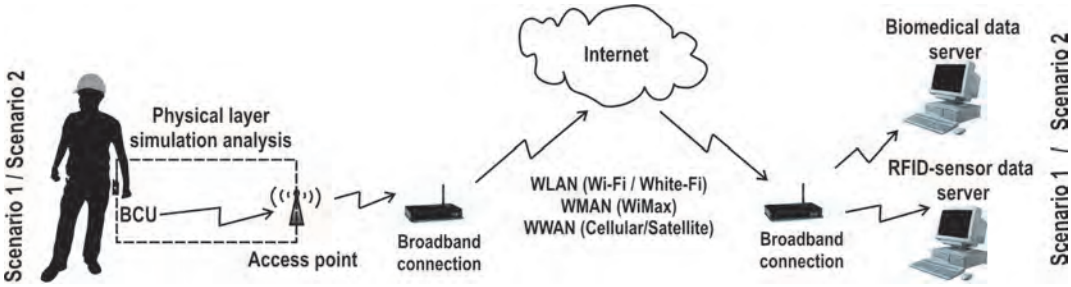

Fig. 4. A conceptual scheme of the worker's WBANSs connection to the backend servers (*Source:* own)

Whereas the proposed network structural model is a complex one, in this initial phase of our research work the simulations are limited to a small segment of the network, i.e., on the wireless link between the worker's BCU and the port's access point. Although this looks as a notably simplified simulation procedure, it is significant. Namely, this segment

of the network requires at the same time low energy consumption, large scale of nodes mobility in a harsh working environment and high reliability in real-time. Hence, it is surely among the most vulnerable and challenging segments of the network in terms of further research endeavors.

The simulation model is realized in the Matlab (ver. 7.12.1), by an Inter(R) Core™ i5 processor on 2.4 GHz (4GB RAM). The key steps in creating simulation model of the channel between the worker's BCU and the port's access point are given in Table 2.

Table 2. Simulation steps in modeling the channel between BCU and access point at the physical layer (*Source:* own)

Step 1:	Definition of the simulation parameters: carrier frequency, distance between transmitter and receiver, a sequence of input bits, number of iterations, and Signal-to-Noise-Ration (SNR) range
Step 2:	Calculating Free Space Path Loss (FSPL) by (Eq.1): $\mathrm{FSPL} = \left(\frac{4\pi df}{c}\right)^2$ (Eq.1), where d – is the distance between the transmitter and the receiver [m]; f – is the frequency of the carrier [Hz]; and c – is the speed of light in vacuum, i.e. $\approx 3 \cdot 10^8$ [m/s]
Step 3:	Applying binary phase-shift keying (BPSK) and quadratic phase-shift keying (QPSK) modulation schemes on real and complex signal components respectively
Step 4:	Generating Gaussian noise and computing the standard deviation for each SNR value by (Eq.2): $P_{noise} = \sqrt{\frac{P_{signal}}{SNR \cdot FSPL}}$ (Eq.2), where P_{noise} - is the power of noise [W]; P_{signal} - is the power of transmitting signal [W]; and SNR – is the signal-noise-ratio
Step 5:	Simulating Additive White Gaussian Noise (AWGN)
Step 6:	Generating recovering (source) signal by Wiener filter which minimizes the mean square error between the estimated random process and the desired one
Step 7:	Compute the number of Bit Error Rate (BER) after the slicer, i.e., part of the code that compares the original signal with the recovered one, point by point, specifying if it is well recovered or not
Step 8:	Plotting graphics: BER vs. SNR

6.1. Simulation analysis

On the basis of the Matlab code briefly described above and summarized in Table 2, the relations between the transmitted signal, between worker's BCU and port's access point, BER and SNR are presented. In the first case the considered relation is examined for characteristic carrier frequencies in different wireless technologies [24], e.g., 915 [MHz], 2.4 [GHz] and 3.1 [GHz]. The simulation results are presented in Figure 5, and it is obvious that in all cases the BER decreases as SNR increases. The simulations are run through several thousand loops. It is clear that higher frequency causes higher BER and inversely.

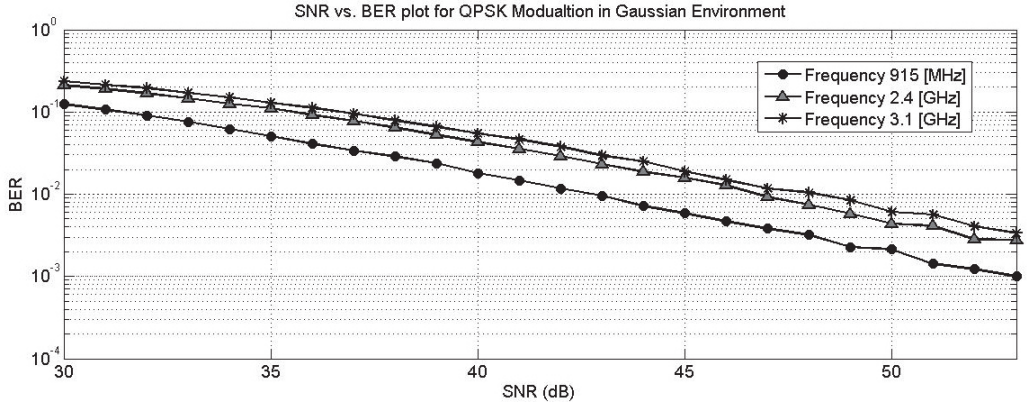

Fig. 5. SNR vs. BER for three characteristic wireless networks frequencies (*Source:* own)

Similar simulations are realized for different distances between the transmitter (worker's BCU) and the receiver (port's access point). The characteristic distances between end nodes of the simulated network segment of 10, 20, and 30 [m] are considered (Figure 6). It is clear that the BER decreases by rising SNR in all considered cases, in a manner that greater distance corresponds to a higher BER and conversely. The simulations are run like in the previous case trough several thousand loops.

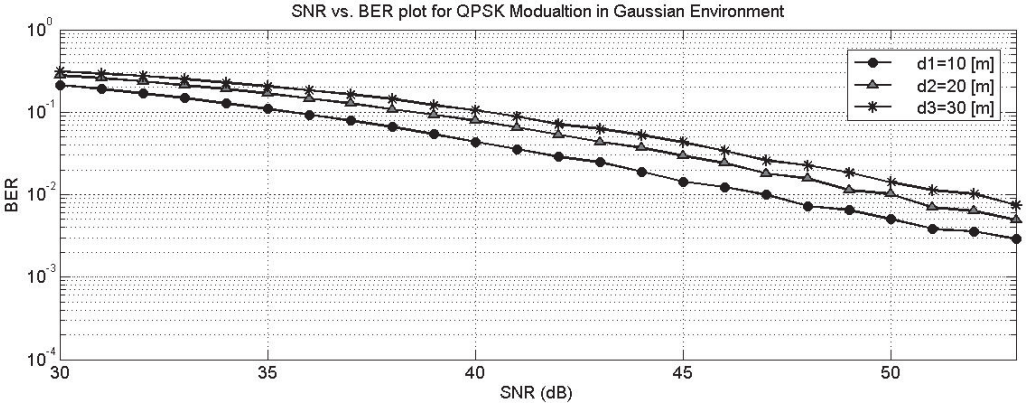

Fig. 6. SNR vs. BER for various distances between end-nodes (BCU and access point) (*Source:* own)

In addition to the simulations for typical wireless frequencies and covered distances, some simulations for White-Fi are performed. It is to be pointed out that by using White-Fi signal absorption can be avoid easily, while some additional, otherwise unused TV frequencies, might be used. In order to achieve this, the new technologies and rules are developing, like cognitive radio, geographic sensing, etc. [31]. Hereto, due to the best of our knowledge, there are no obstacles for implementing White-Fi in the considered port environment.

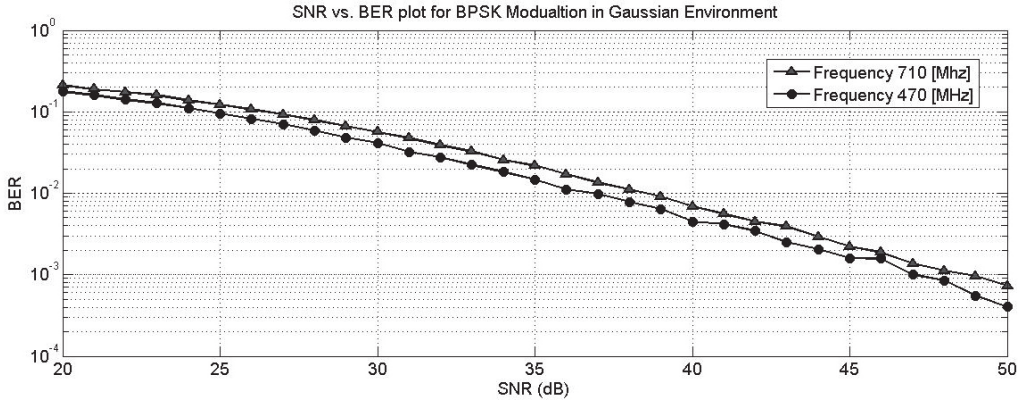

Fig. 7. SNR vs. BER for two characteristic White-Fi frequencies (*Source:* own)

In Figure 7 are shown the transmission simulation results for two typical White-Fi frequencies: 470 [MHz] and 710 [MHz]. The simulations are realized by using the BPSK modulation scheme, and it is obvious that the BER decreases to E-03 as SNR reaches about 50 [dB]. The obtained simulation results in all considered cases (see Figure 5, 6 and 7) speak in favor of the applied modulation scheme, path loss and noise models, so they can be employed as a sound basis for further, more extensive, analysis in this domain. The trade-off between BPSK and QPSK modulation schemes is simulated, as well, and it is observed that the BER is slightly lower in the case of BPSK, but it is negligible in terms of the transmitted data amount which is doubled by using QPSK [24, 32-35].

With the aim to add a dynamic dimension to the simulation analysis, we have analyzed the scenario with, e.g., four workers and four access points at 2.4 [GHz] over the port area of 1000 [m^2]. The change interval is 1 [sec] with 0.1 [sec] of standard deviation. This means that over 1 [sec] each node will make a move at a specified speed. The speed was set to emulate the movement of a worker, approximately 3 [m/sec]. The transmission power was set to [-30 dB]. Figure 8 shows the relation of the reception power of the fixed access points and the delay. The distance and delay are linked by the speed of transmission of the signal. It is easy to notice that the received power is less as the distance and the delay decreases.

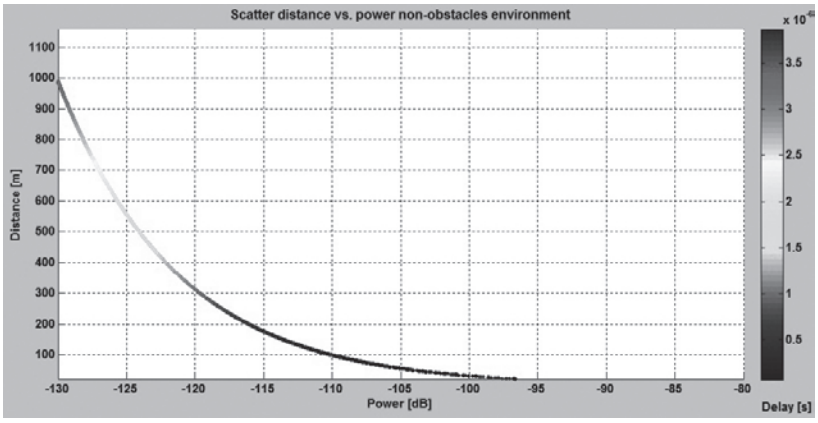

Fig. 8. The distance/delay vs. received power for a non-obstacle scenario over the port layout (*Source:* own)

If we introduce the obstacles, the scatter function will be changed (Figure 9). As the simulation experiment has been done over the layout of the Port of Bar container and general cargo terminal, the obstacles were imaginary containers blocks. Therefore, the obstacles' approximate measures were 200x100x4 [m]. The containers (obstacles) have a specific relative permittivity and permeability, which also affects the channel. When the distance and the delay were biger, the received power became lower and vice versa.

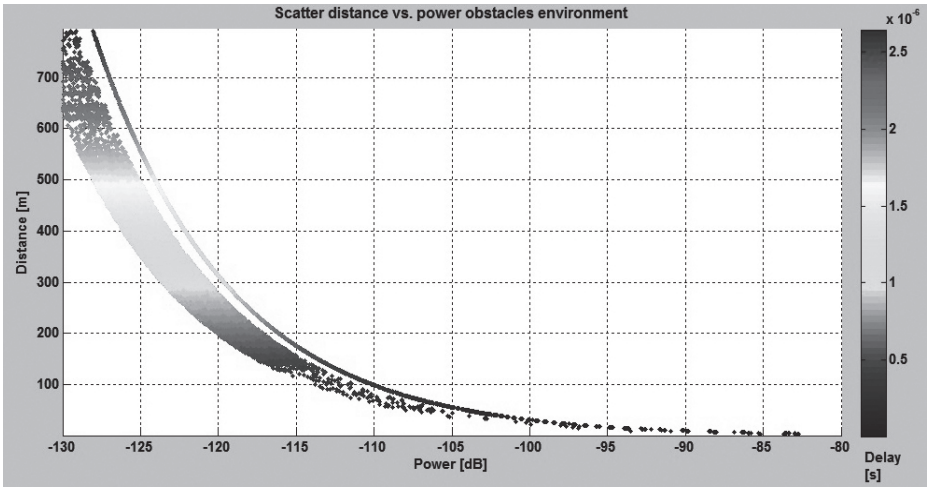

Fig. 9. The distance/delay vs. received power for a scenario with obstacle over the port layout (*Source:* own)

The scatter diagram in the scenario with obstacles has two significant shapes. The thin one represents the line of the sight signal, while the thicker one represents the reflections or the signals that pass through the obstacle. The difference between the received power of the line of a sight signal and the received power of a reflected one, or those that passes through the obstacle is approximately 1-5 [dB]. Consequently, the scenario with obstacles needs a higher value of SNR in order to achieve the same level of BER like in the case of non-obstacle environment.

7. Conclusions

In the paper are proposed conceptually two WBANSs scenarios for monitoring workers' occupational safety and health conditions at the developing seaport environment. The Port of Bar (Montenegro) is taken as an example. A short overview of its current position at the seaport market is given. Also, some projects recently realized in the Port in the environmental and occupational safety domains are briefly presented and used as a base for the proposed occupational safety models.

The first proposed scenario has direct impact on improving workers' safety through strengthening their awareness about the necessity of the protective equipment proper use. By employing this scenario, managers can locate workers, get insight in their behavior and undertake the appropriate safety measures. On the other side, scanning and collecting data on workers' health conditions, within the context of the second scenario, might be useful in protecting workers' health and for collecting the data that can be used later for

establishing cross-correlations between workers' health and their eventual (occupational) diseases.

One of the most vulnerable and at the same time challenging segments of the proposed scenarios, i.e., those between moving worker's BCU and fixed port's access point, is analyzed through the simulation experiments, and the following is drawn out:

- By analysing different characteristic frequencies for wireless communications and distances between the transmitter (BCU) and receiver (access point), a satisfying level of BER is achieved by using both binary phase-shift keying (BPSK) and quadratic phase-shift keying (QPSK) modulation schemes;
- In addition to standard frequencies for wireless communications (915 [MHz], 2.4 [GHz], and 3.1 [GHz]) between the transceivers, two characteristic frequencies from White-Fi spectra (470 [MHz], and 710 [MHz]) have been examined, while the satisfying level of BER has been achieved, too;
- The scatter functions, in the simulation environment without and with obstacles, both contain the line of sight signals, and their values are the same in both cases;
- In the scenario which includes the obstacles, the attenuation of the signal of 1-5 [dB] has been noticed (shadowed area below line of sight signal in Figure 9), etc.

The managers in the Port of Bar can use the proposed WBANSs scenarios, along with the simulations results, as the landmarks in the course of adopting these or similar models and in the negotiation processes with the ICT experts responsible for the (eventual) implementation in the future. It should be noted that both concepts simultaneous adaptation can make a burden for workers and port management.

Our work is not without shortages and below are noted some of them. Albeit the considered topic is a *hotspot* of contemporary research in several scientific disciplines, numerous and complex problems still remain. There are a lot of challenges when it comes to the on- and in-body sensors' technology, data fusion and network communication technology. The networks of such kind also need evolving standards for co-existence and data transfer with other networks and Internet. In this paper, simulations are realized rather at the level of black box over one small and simplified segment of the network. Therefore, the further experiments should be oriented toward considering larger network segment, or the entire network, in terms of data processing algorithms, communication protocols, power consumption, network flexibility and robustness. Bearing these in mind, our further investigations will be focused on the simulations of the network with larger number of moving BCUs and fixed port's access points. These simulations will be done by means of Matlab, LabView, Opnet and/or Omnet++ tools.

In addition to the above mentioned limitations in the technological realm, there are several organizational and ethical issues which deserve to be examined. The level of the Port's mangers and stakeholders readiness for providing funds and employing such safety and health solutions should be evaluated. The possibilities of engaging medical institutions and experts, besides ICT ones, are to be examined, as well. And finally, the willingness of the on port workers to become constituents of the proposed network(s) is to be assessed. The achieved results of these planned examinations might cause considerable modifications of the proposed WBANSs models.

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P.4. An RFID model for improving workers' safety at the seaport in transitional environment[5]

Jedan RFID model za poboljšanje bezbjednosti radnika u luci u tranzicionom okruženju

Abstract: The paper proposes an RFID (Radio Frequency IDentification) model for enhancing port workers' safety with reference to the Port of Bar (Montenegro) as a developing seaport operating in a transitional environment. The paper also highlights the lack of appropriate ICT (Information and Communication Technology) solutions in some developing seaports, including safety-related ones. It emphasizes the importance of safety measures through the prism of reducing the number of accidents, and gives a review of some RFID safety solutions in the harsh environments. The main part of the paper deals with the RFID worker's safety model proposed according to the Port of Bar's individual needs. The model has been presented at a logic level, while some of the physical and link layers performances between the set of an active and several passive RFID devices embedded to the port workers' PPE (Personal Protective Equipment) and the UHF (Ultra High Frequency) RFID readers located at the port perimeter, are simulated in Matlab and OMNeT++. The obtained results followed by discussions can be used as landmarks to the ports' management in adopting this or a similar model for enhancing safety measures in the port and its promoting as a safety one at the maritime market.

Key words: seaport, workers' safety, RFID, PPE, model.

Apstrakt: U radu je predložen jedan RFID (Radio Frequency Identification, eng.) model za poboljšanje bezbjednosti radnika, sa osvrtom na Luku Bar (Crna Gora), kao luku u razvoju, koja funkcioniše u tranzicionom okruženju. U radu je takođe dat osvrt na nedostatak odgovarajućih ICT (Information and Communication Technology, eng.) rješenja u nekim lukama u razvoju, uključujući i ona koja se vezuju za poboljšanje bezbijednosti. Akcenat je stavljen na bezbjedonosne mjere kroz prizmu smanjenja broja akcidenata i pregled nekih RFID bezbjedonosnih rješenja u invazivnim okruženjima. Centralni dio rada se bavi RFID modelom za povećanje bezbjednosti radnika u skladu sa individualnim potrebama Luke Bar. Model je predstavljen na logičkom nivou, dok su analize nekih performansi fizičkog i nivoa veze između skupa koji čine jedan aktivni i nekoliko pasivnih RFID uređaja ugrađenih u zaštitnu opremu (PPE-Personal Protective Equipment, eng.) radnika i UHF (Ultra High Frequency, eng.) RFID čitača postavljenih na perimetru luke, realizovane u Matlab i OMNeT++ simulacionom okruženju. Dobijeni rezultati i prateća diskusija, mogu poslužiti menadžerima u luci kao orjentir u usvajanju predloženog modela, s ciljem poboljšanja bezbjedonosnih mjera u luci i njene promocije kao bezbjedne na pomorskom pržištu.

Ključne riječi: morska luka, bezbjednost radnika, RFID, PPE, model.

1. Introduction

Seaports are logistic and industrial centres of maritime nature that play an active role in the global transport system. They are characterized by spatial and functional clustering of activities that are directly and indirectly involved in seamless transportation and info-communication processes in production chains (Notteboom, 2001). Harbours combine the major operations of large-scale shipment, storage, and transportation. The fact that about 90% of the world trade (by volume) and 60% (by value) is performed by the sea, whereas the sea transportation is still the most cost-effective way to move row materials and goods *en masse* around the world (IMO, 2015; UNEP 2012), speaks in favour of the seaports as critical nodes of the global economy.

On the other side, ICT functions support contemporary multimodal, intermodal, comodal, and/or synchromodal transportation chains and bring multiple benefits to all involved parties, inevitably including seaports, by providing real-time visibility, efficient data exchange, and better flexibility in the context of unexpected changes during a ship-

[5] Bauk S., Schmeink A., Colomer J., An RFID model for improving workers' safety at the seaport in transitional environment, *Transport*, accepted in February 2016, to appear.

ment (Harris, et al., 2015; Moxa Inc., 2008). There has been a debate about ICT being the major technological facilitator of economic globalization by creating a *death of distance* (Cairncross, 1997) or a *flat world* (Fredman, 2005). However, it is not possible to exclude the role of innovation in transport, most notably in containerization (Levinson, 2006). It is the combination of both - containerization and ICT that has allowed the reduction of shipping costs and the rise in importance of logistics and supply chain management (Jacobs, 2011). Both sea ports and ICT play important roles in the world trade. Nevertheless, they are still insufficiently present among research trends of some transitional economies.

In an extensive survey of papers on ICT-related topics within transitional economies (including countries of former Eastern-Soviet Block, former Yugoslavia, and Albania) published between 1993 and 2012 (Roztocki and Weistroffer, 2014) there are several papers which are explicitly concerned with ICT in the domain of transportation. These papers are the results of projects' work, or they deal only with organizational, either national level. The lack of research outcomes and especially ICT applications in developing countries is a result of their unstable economies and still rigid administrations, which additionally increases digital divide and put them at risk of being further marginalized (Parliamentary Office of Science and Technology, 2006).

We would like to mention several papers published in the context of transitional economies, though from their titles it might not be obvious that they are considerably concerned with ICT. In addition, some of these papers have been published after 2012. For instance, the presence of contemporary ICT solutions at eight seaports of developing countries (Bar, Durrës, Constanza, Koper, Piraeus, Ploče, Rijeka, and Thessaloniki) was explored in (Bauk et al., 2013). The results, unfortunately, were not encouraging. All the ports, except one (Durrës), had EDI (Electronic Data Interchange) service, while five ports, except Bar, Durrës, and Ploče, had VTS (Vessel Traffic Service) system. However, neither of the considered ports had (at the time of the survey) contemporary ICT solutions such as: ERP (Enterprise Resource Planning), CRM (Customer Relationship Management), VTMIS (Vessel Traffic Management Information System), PCS (Port Community System), nor access to ELM (Electronic Logistics Marketplace). Also, they did not use cloud computing services, neither Internet of Things (*Internet of everything*) concept (Cisco, 2015), etc. Furthermore, Vitic and Bauk (2014) concluded that the Port of Kotor, as an emerging cruising destination of the South Adriatic Sea, suffers the lack of transactional and added-value e-services, which are on the contrary, notably present at the official web sites of some recognized EU cruising ports (e.g., Southampton, Venice, Dover, Genoa, Civitavecchia, Helsingborg, etc.). Ivanovic and Bauk (2014) offered a novel model of logistics (based on real data collected *in loco* over several years), developed for the coastal tourist destinations in Montenegro (Bar, Budva, Kotor, Tivat, and Herceg Novi). This model, of course, includes the ICT dimension. In addition to these research works, which are more or less concerned with seaports, sea-land transportation, passenger traffic, and corresponding ICT solutions, research works in the domain of PCS and ICT integration in the Croatian seaports (Tijan 2012; Tijan et al., 2012; Bezic et al., 2012) are also worth mentioning. It might be of interest to point out, that Tijan et al. (2012), among other points, concluded: "Croatian seaports are currently in the phase of transition from isolated seaports to communicated seaports". It is also important to mention, that Beskovnik and Twrdy (2014) gave an original seven-pillar regional model of ports' development within a single port system of the Balkans. The uniform IT (Information Technology) platform at the port and logistics level was proposed as one of the pillars. The authors

suggested a regional approach to develop standardized IT tools and platforms. They also pointed out: "Anyhow, the main issue remains on how to motivate all transport and logistics entities to accede to this important project. Certainly, a top down model is needed, where governments and transport ministries should achieve wider agreements for the region."

2. ICT in improving safety at seaports

Seaports can be dangerous places for port workers and pedestrians in terms of operational risks connected to (un)loading operations, port traffic management and transportation, handling manipulative equipment, warehousing, etc. Additionally, seaports usually operate 24 hours a day, in all conditions, with a variety of employees and contractors performing different activities (Roberts and Gray, 2013). It is the employer's duty to preserve the health and safety of workers and to improve occupational safe systems. Unfortunately, accidents in seaports are not rare (Darbra and Casal, 2004). The reason for the growing number of accidents is the increase in the seaports' turnover over the past decade. On the other side, the relatively low turnover at developing seaports should be in favour of the workers' safety, even though, as to our knowledge, there is no official statistical data concerning this issue in the aforementioned transitional countries. Regardless, improving safety measures is a must.

The world-class seaports use the latest technology based on advanced ICT solutions to help reducing the risk of accidents. These technologies include end-to-end flexible seaport surveillance solutions (Milestone, 2014), i.e., sophisticated camera systems based on CCTV (Closed Circuit Television) comprising a cutting-edge graphical interface and video analytics features, then radar systems connected with port transportation devices and vehicles, variety of infrared/laser, ultrasonic and/or RFID sensors for safety purposes (Russell, 2015) monitoring of cargo handling operations and allied activities (Vizag Seaport Pvt. Ltd., 2010), different pathway anti-collision systems (Roberts and Gray, 2013; SICK, 2014), etc.

The simple transfer and diffusion of these and similar systems sometimes might not be fully effective for the developing countries (Avgerou, 2011). In other words, setting up over-ambitious goals for employing ICT in a developing environment could end up with little hope of being effectively put into practice. Bearing this in mind, we are here looking for a feasible and cost-effective RFID system for monitoring port workers' safety at the developing Port of Bar (Montenegro).

3. The needs of the Port of Bar

The Port of Bar has a favourable geographical position. With the railway line Belgrade-Bar and the road network in its hinterland, along with the intermodal transportation and traffic links with Italian ports Bari and Taranto, it could provide good connections within its rather wide gravitational area. Thanks to its advantageous geographical position, it can be developed into the distribution centre of the area. More about the Port of Bar can be found on its official web site[6] and in the documentation of numerous regional and EU projects. In the period from 2007 to 2013, the port participated in the implementation of several projects (Bauk, 2015) concerned with:

- strengthening of intermodal transport;

[6] Port of Bar, URL: http://www.lukabar.me/eng/Port_of_Bar.htm (last access on the 20th May 2015)

- short-sea shipping possibilities;
- integrated logistics chains and attracting innovative investments;
- improving environmental impacts at ten South East European (SEE) ports (TenEcoport);
- establishment of a sustainable transport system at the Adriatic coast and in the hinterland;
- enhancing environmental protection (marine/river pollution);
- detection of dangerous materials under the sea water in the ports' area;
- development of a sustainable integral sea-land transport/traffic network;
- integration of maritime and river transport in the logistics chain;
- prevention of pollution in the SEE ports (Ecoport 8), etc.

The projects TenEcoport (TenEcoport, 2014) and Ecoport 8 (Ecoport 8, 2013) are of particular importance in the context of environment protection and enhancing workers' safety. During their implementation and in the final reports, some recommendations for further actions towards improving environmental and safety management were provided. The working processes in the port were analysed in detail and the points with the highest level of risk to the workers directly employed in port operations were specified. Several in-depth interviews with the managers in the Port of Bar were performed (Bauk, 2014), and the highlights in terms of the most common risks to which the dock workers were exposed were identified. These risks are: working outdoors in various (unfavourable) weather conditions (extremely high or low temperatures, rain, wind, etc.), exposure to dust during the transhipment of bulk cargos (grains, all types of ores and concentrates, alumina, etc.), manoeuvring with obsolete transhipment equipment and transportation devices, handling damaged cargo (bags, pallets, packages, containers, etc.), exposure to the risk of fire (especially during the summer months), etc.

In addition, port workers perform monotonous and repetitive operations, which results in fatigue increasing the risk of accidents. It is not easy to overcome all these risks, but it is feasible to upraise the safety by identifying and (periodically) locating personnel and their safety equipment.

In the next section we are giving an overview of RFID-based solutions for enhancing working safety in harsh environments, since it could be useful in conceiving a satisfying, individually tailored solution in the case of the Port of Bar.

4. On some RFID working safety solutions

There is a significant number of academic survey papers in the field of RFID technology and its applications (Ngai et al., 2008; Ferrer, Dew and Apte, 2010). Far fewer papers deal with the implementation of RFID technology in the field of seaports' safety management, particularly in the sub-field of identifying and locating workers and their PPE (Personal Protective Equipment). Therefore, we shall firstly mention some seaports RFID safety applications in general, and then in the next sub-section (4.1), we shall give a review of three applications in the domain of PPE.

The paper on RFID model for intelligent seaports (Siror et al., 2011) is, e.g., an envisaged approach to the intelligent safety measures in the seaport made at the exemplar of Mombasa Port (Kenya). On the basis of the performed simulations, the model is promising and it might be used as a framework for planning future safety solutions for seaports. It is also important to mention the RFID application of the *smartPORT* traffic light, implemented for the first time in the Port of Hamburg (Kathrein Corp., 2015). Seaport

workers, pedestrians and vehicles are equipped with RFID chips which communicate among themselves and with the smart traffic light via Wi-Fi network. A rather theoretical approach to similar solution, based on drafting the algorithm for establishing efficient communication between traffic density, vehicle priority, RFID controllers, and traffic lights is given in (Sigh et al., 2012). Also we have to mention several papers which consider the adaptation of RFID safety solutions in the port of Cagliari (Italy). They deal with several aspects of the complex centralized control system of the seaport audio communications, video surveillance, and Web GIS (Geographical Information System) applications combined with workers' wearable RFID sensor networks (Sole, 2014; Musu, 2015).

In the following parts of the paper, we are focusing on the Port of Bar individual needs and challenges of working safety monitoring, concerning in the fist instance identifying and examining functionality of port workers' PPE pieces equipped with RFID devices. Our aim is giving support to the Port's managers to become able to select the right RFID workers' safety system and provide the correct justification to the senior management and stakeholders to secure its buy-in (Ferrer, Dew and Apte, 2010).

Table 1. Supply/supporting/research RFID industry: some providers

No.	Name	Web
1.	**Avonwood Development Ltd.**	http://www.avonwood.co.uk/ (last access: 22nd July, 2015)
2.	**ChainLink Research**	http://www.chainlinkresearch.com/rfid/index.cfm (last access: 13th July, 2015)
3.	**CiscoSystems**	http://www.cisco.com/web/strategy/docs/trans/Seaport_Overview.pdf (last access: 28th July, 2015)
4.	**DominateRFID**	http://www.dominaterfid.com/ (last access: 9th November, 2015)
5.	**Identec Solutions**	http://www.identecsolutions.com/ (last access: 13th July, 2015)
6.	**IdentyTag**	http://www.identytag.de/rfid-labels-tags/smart tag/?gclid=CIuai_nTg8kCFda4Gwoduabbq (last access: 9th November, 2015)
7.	**Kathrein**	https://www.kathrein.com/de/ (last access: 22nd July, 2015)
8.	**Nedap**	http://www.nedapidentification.com/ (last access: 28th July, 2015)
9.	**Pema**	http://www.pema.org/ (last access: 13th July, 2015)
10.	**Phase IV Engineering Inc.**	http://www.phaseivengr.com/product/pressure-temperature-rfid-uhf-wireless-sensor/ (last access: 9th November, 2015)
11.	**Savi**	http://www.savi.com/ (last access: 13th July, 2015)
12.	**Skyetek**	http://www.skyetek.com/solutions/rfid/personnel-tracking (last access: 2nd November, 2015)
13.	**Synometrix**	http://www.synometrix.com/all-products/rfid/ (last access: 28th July, 2015)
14.	**Syrma Technology**	http://www.syrmatech.de/index.php?content=unternehmen (last access: 9th November, 2015)
15.	**WhereNet**	https://www.zebra.com/us/en/products/location-solutions/wherenet.html (last access: 13th July, 2015)

In this regard, firstly, below is given the list of some providers of RFID solutions, equipment and/or services (Table 1) that can be consulted by the Port of Bar managers in a case that they decide to upgrade safety measures.

It is important to mention that there are several key factors to consider when selecting an RFID solution, like: cost, reliability, security, compliancy, read/write range, read/write speed, multi-tag capacities, environment, etc. The cost is often one of the most important, and one the most difficult to evaluate at the same time (Sattlegger and Denk, 2014). At this initial stage of our research, it is really hard to give reliable costs evaluation. Therefore, we will be focusing on the conceptual solution and some simulation analysis.

4.1. Considering some RFID and PPE solutions

We proposed an RFID port workers' safety model on the basis of the secondary literature resources and three previously developed systems for monitoring working safety in harsh environments. They identify, localize, and/or check operability of RFID devices embedded into the workers' PPE.

The first system has been commercialized and applied in the construction industry (Kelm et al., 2013) but there are no obstacles for its implementation in seaports. The second one is applied in seaports (Sole, 2013a, 2013b, 2014). However, these two scenarios do not provide permanent real-time monitoring of the workers' PPE (safety helmets, reflective safety vests, and steel-toed safety shoes) at working place. The third one is developed at the level of prototype and it has not yet been commercialized. It is designed with the intention to provide a permanent PPE traceability, i.e., its real-time monitoring. The main shortcomings of the last mentioned system are: (a) it is not utterly unobtrusive, and (b) it is not easy to establish a proper communication between RFID tags and readers over the end points, here workers' BANS (Body Area Network Sensors), in terms of determining the position of PPE items, what was one of the main goals of this experimental project (Barro-Torres et al., 2012). Let us consider now the three models in some more detail.

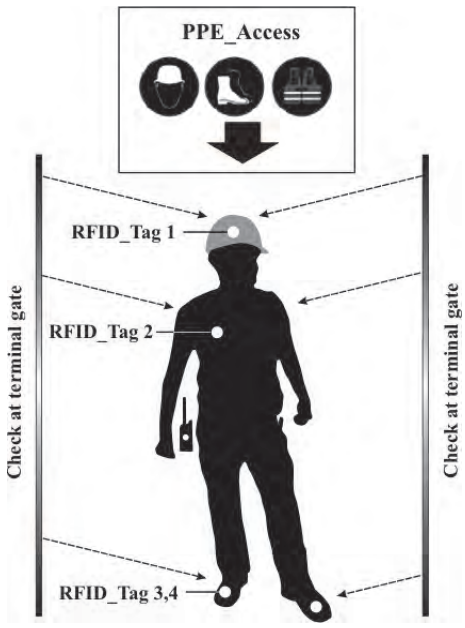

Fig. 1. Inspection of worker's PPE at entrance gate
[Adapted from (Kelm et al., 2013)]

***Case 1**:* In this case, before entering the working place, a worker has to pass through the control gate. He/she should not pass through too quickly, since the standard UHF signal update is 1 [Hz]. The worker and his/her PPE must be uniquely identifiable. The intelligent system and user interface provides real-time feedback to the worker. The system is able to recognize multiple tags simultaneously, thus the worker is immediately notified if the ID is not proper and/or which PPE component(s) is(are) missing. Once the worker has been properly identified and proved to be wearing the required equipment, the turnstile at the terminal entrance opens, otherwise entry will be denied. The scheme of this scenario is given in Figure 1. The main shortcoming of this solution is the impossibility of locating and monitoring workers and their PPE pieces after passing through the gate, unless the whole working area is covered by the sufficient number of the long range RFID readers.

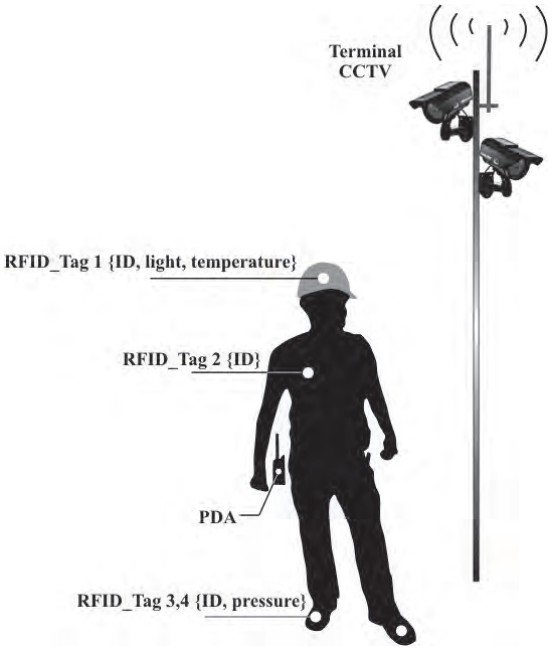

Fig. 2. Checking the proper usage of the worker's PPE at the terminal by means of CCTV [Adapted from (Sole, 2013a)]

***Case 2**:* In this case, assuming that the worker has passed the identification and PPE control at the entrance gate, the CCTV system installed at the terminal provides continuous monitoring with the intention to discover if the worker properly wears the PPE at the working place. In the case of non-use, or improper use of PPE, the technician responsible for the video surveillance will warn the worker by sound or text message alarm via the port wireless network (Wi-Fi) and PDA (Personal Digital Assistant) device attached to the worker's belt (Sole, 2014). Wearable sensor network in this case consists of passive RFID and WISP (Wireless Identification and Sensing Platform) devices which provide the ID and ambient light and temperature (helmet), and worker's plantar pressure (shoes) data. Figure 2 gives a scheme of this scenario. It is presented as an example of a possible port workplace safety solution, but it hasn't been recommended for application in the case of the Port of Bar. The centralized monitoring system of the CCTV connecting with the port Web GIS maps, RFID/WISP sensors and readers, might be too complicated for im-

plementation at the present stage of the Port of Bar development. This model has been recently re-engineered towards the Internet of Things concept (Musu et al., 2014; Musu, 2015). In this regard, among other things, it excludes workers' PDA devices and provides direct communication between worker's clothing with embedded RFID tags and readers placed at the strategic port's locations. A smart software system is used for locating workers, their PPE functionality, and helmet position, thanks to the accelerometer installed in it. The segment of this safety solution that provides direct (periodical) communication between tags and readers through the intelligent software back-end system might be partially implemented in the Port of Bar, in the manner presented in the next section.

Case 3*:* This system can be treated as a novel one in comparison to the previous two systems. It is composed of BAN (Body Area Network) that collects information from the RFID tags by the readers located throughout the workers' clothing. The CUM (Central Unit Microcontroller) processes the data and transmits them by radio module to the external mesh network composed of the set of end nodes (workers' BANs), routers, and the coordinator. The coordinator collects and stores the data coming from the end nodes, configures nodes and performs synchronization. End nodes are the critical part of the system. They are composed of central unit microcontroller, radio module and RFID readers. The readers are located at strategic points in the clothing, since the technology used allows them to be read at close range. The detection rate clearly increases when the antennas of the reader and the tag are in parallel, while it decreases dramatically when the antennas are oriented orthogonally. To avoid the null spots, different alternatives have to be weighted up in order to modify the antenna radiation pattern. The scheme of this scenario is given in Figure 3. We do not recommend this model to be implemented at the Port of Bar, since it is complex, intrusive, and the central microcontroller is currently at the level of a prototype.

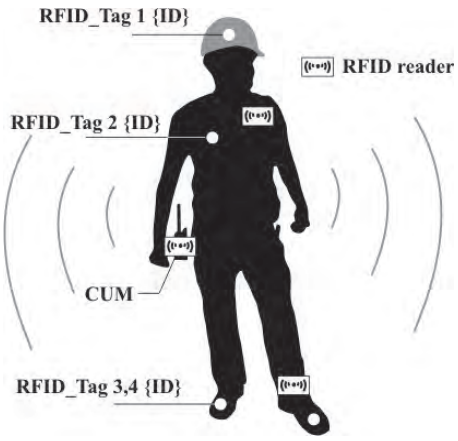

Fig. 3. Self-checking system of the worker's PPE proper usage
[Adapted from (Barro-Torres et al., 2012)]

By merging *Case 1* and *Case 2* scenarios and some modifications, an acceptable model for the Port of Bar can be conceived. Instead of scanning and alerting workers at the port gate, we proposed collecting data from an active and several passive RFID tags attached to/embedded into the workers PPE pieces by UHF RFID readers (Musu, 2015) located at strategic points within the port perimeter. These readers can be connected by

Wi-Fi or Ethernet to the port backend info-communication system through which the status of the tags and the information returned can be read and stored in the database.

5. Proposed model and some simulation analysis

Although the range of negative working and environmental impacts in the Port of Bar is quite large, prospective application of PPE equipped with RFID tags will strengthen port workers' safety and increase the level of their corporate safety culture. Previously described systems *Case 1* and *Case 2* can be adapted by the Port of Bar with some conceptual and technological modifications. Namely, an active UHF RFID-enabled worker's badge can transmit the ID number at preset intervals to the port's fixed readers. These ID badge can be worn around the neck, attached to clothing or placed in the pocket and it can be read up to 500 [m] (Swedberg, 2011). It allows the smart software system and RFID hardware to track the number-identities of the port worker at any time, as well as, in some cases, pinpointing the worker's location. The system memorizes the "last seen location data" for each worker. On the other side, each time the worker is in the range of the reader(s), approximately in the range of 10 [m], the control system will have the information on the status of passive RFID tags attached to the PPE, i.e., if they: work correctly, don't work correctly, or don't work at all. Figure 4 shows an example of the worker who does not have a helmet on site, and whose shoe is damaged. In such a situation, the worker must be alerted to go to the central for wearing/changing PPE.

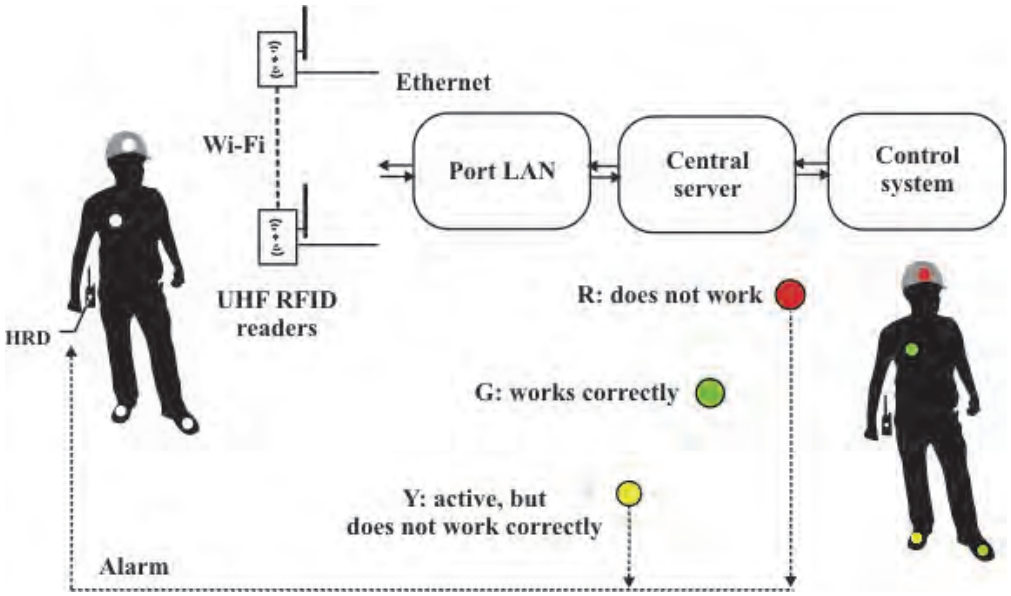

Fig. 4. An RFID model for port workers' safety monitoring [Adapted from (Musu, 2015)]

Hence, a worker's PPE is composed of a helmet, safety vest and shoes with passive UHF RFID tags attached/embedded. These tags must unambiguously identify a particular safety garment and communicate via reader(s) to the port's safety control centre which provides alarm to the worker's HRD (Handheld Radio Device) in a case a certain tag(s) does(do) not work (at all/properly). It is important to mention that the RFID inlay pro-

vides data on radio frequency functionality of any tag (RFIDinsider, 2015). The tagged PPE should be designed, produced, and tested in accordance with the port's needs by specialized companies such as: Extronics, Identytag, Omni-ID, ScanLink, Syrmatech, etc. All readers are connected via Wi-Fi or through the port's Ethernet through which the status and the information returned can be read and stored in the beck-end server connected to the central control system. If a worker is not wearing the mandatory and functional PPE clothes, or if he/she is in an extremely dangerous zone, a signal alarm alerts of a dangerous situation.

The system should be used as an emergency preparedness one, as well (Vermesan et al., 2010). In the event of an emergency, the workers should be alarmed to leave the zone of potential danger and come immediately to the appointed place. At the appointed place, the workers' current position can be determined and all PPE tags identified and checked.

In the following sub-sections we shall analyse the channel between workers' wearable sensor sub-network composed of an active UHF RFID ID badge and four passive UHF RFID tags (attached to the helmet, vest, and shoes), and the UHF readers located at the port perimeter. The readers should work at EU standardized carrier frequency range of 865~869 [MHz] and offer a flexible platform to evaluate the identification and status of the RFID transponders by supporting EPC (Class 1) Gen2 standard.

The layout of the Port of Bar container terminal is used as a base for some simulation analysis of the proposed workers' wireless safety model (Figure 5).

Since our goal is not to offer the *final* solution, but to provide an insight to the managers in the Port of Bar into the existing solutions of the kind and a framework for an individually-tailored solution, we considered it important to analyse some of the key parameters of wireless networks. Regardless of the model which will be adapted, wireless networks will be in any case essential segments of the whole project: whether it is a BAN that connects PPE RFID active and passive devices, or WLAN (Wireless Local Area Network) that connects UHF RFID readers with PCs, routers and other components of the port network infrastructure. Therefore, in the first set of simulations, we gave some analysis of the channel between the transmitter and receiver at the physical and the link layers. This might be helpful for the managers in understanding the principles of wireless networks and later on making the decision on adapting certain workplace safety systems. The simulation experiments have been done in Matlab. In the second set of simulation experiments, the channel between the moving nodes (the sub-networks of port workers' RFID devices) and several fixed nodes (RFID readers) located over the Port of Bar container terminal operational area, was analysed. These simulation experiments were realized in an OMNeT++ environment. The obtained results are discussed in the following sub-sections.

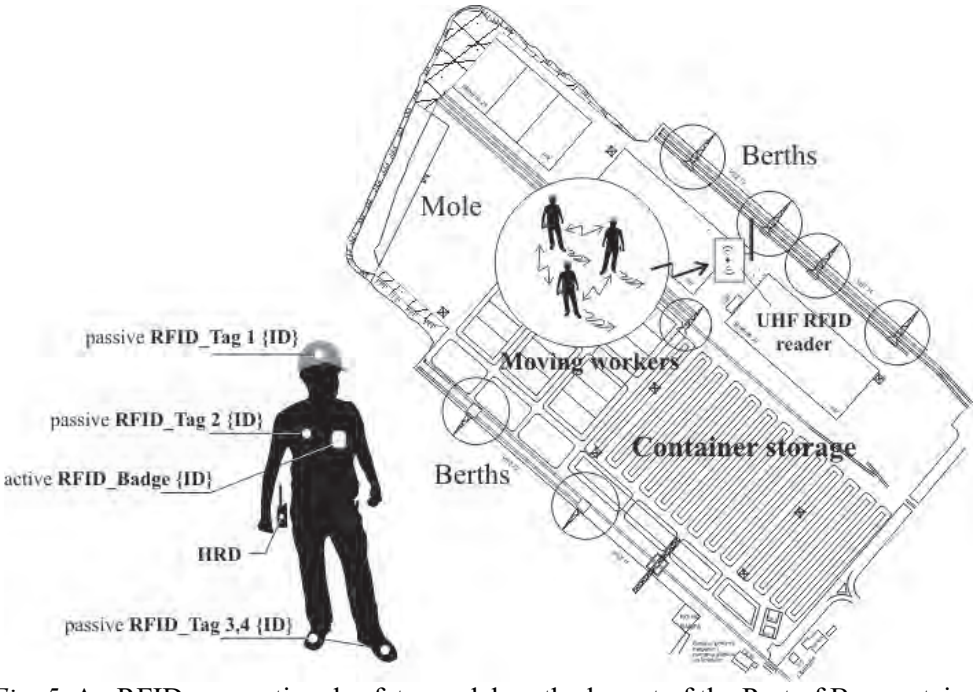

Fig. 5. An RFID occupational safety model on the layout of the Port of Bar container terminal

5.1. Simulation model 1: Wireless networks' performances

The first set of simulation experiments was performed in Matlab (ver. 7.12.1), by an Intel(R) Core™ i5 processor on 2.4 GHz (4GB RAM). The key steps within these Matlab simulations are as follows:

(a) Definition of the simulation parameters: carrier frequency, distance between transmitter and receiver, a sequence of input bits, number of iterations, and SNR (Signal-to-Noise-Ratio) range;
(b) Calculation of FSPL (Free Space Path Loss):

$$\mathrm{FSPL} = \left(\frac{4\pi \mathrm{df}}{\mathrm{c}}\right)^2 \qquad (1)$$

Where:
d – is the distance between the transmitter and the receiver [m];
f – is the frequency of the carrier [Hz]; and,
c – is the speed of light in vacuum;
(c) Application of the binary phase-shift keying (BPSK) and quadratic phase-shift keying (QPSK) modulation schemes on real and complex signal components respectively;
(d) Generation of the Gaussian noise and computation of the standard deviation for each SNR value:

$$\mathrm{P}_{\mathrm{noise}} = \sqrt{\frac{\mathrm{P}_{\mathrm{signal}}}{\mathrm{SNR} \cdot \mathrm{FSPL}}} \qquad (2)$$

Where:

P_{noise} - is the power of noise [W];

P_{signal} - is the power of transmitting signal [W]; and

SNR – is the signal-noise-ratio;

(e) Simulation of AWGN (Additive White Gaussian Noise);

(f) Generation of the recovering (source) signal by the Wiener filter which minimizes the mean square error between the estimated random process and the desired one;

(g) Computation of the number of BER (Bit Error Rate) after the slicer, i.e., part of the code that compares the original signal with the recovered one, point by point, specifying if it is well recovered or not; and,

(h) Plotting graphics: BER vs. SNR (see Figures 5 and 6).

On the basis of the source code in Matlab, the relation between the transmitted signal BER and SNR have been analysed. In the first case, the considered relation has been examined for characteristic carrier frequencies in different wireless technologies (Mahalik, 2007): 915 [MHz] (ZigBee), 2.4 [GHz] (Bluetooth), and 3.1 [GHz] (Ultra Wide Band). In addition to the simulation experiments for these typical WLAN carriers' frequencies, the simulations for White-Fi have been performed, as well. Two characteristic frequencies in the White-Fi domain have been analysed: 470 [MHz] and 710 [MHz]. By using the White-Fi signal, the absorption can be easily avoided and otherwise unused TV frequencies might be exploited. In order to achieve this, the new technologies and rules are currently developing (IEEE, 2015), such as cognitive radio, geographic sensing, etc. It is clear that in all cases the BER decreases with the increase of SNR (Figure 6). In addition, it is clear that the higher frequency causes higher BER and inversely. The simulations have been made for the distance between the transmitter and receiver of 10 [m], and they have been performed through several thousand runs in order to achieve smoother curves.

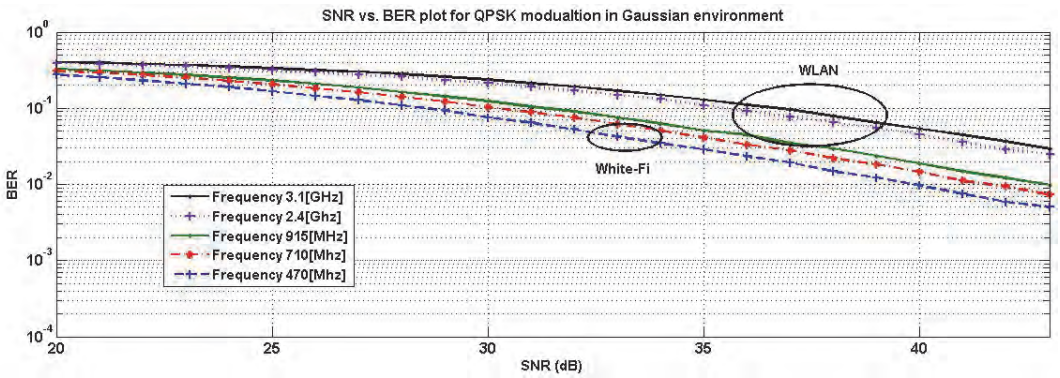

Fig. 6. BER vs. SNR for three characteristic WLANs and two White-Fi carriers' frequencies

Similar simulations have been done for different distances between the transmitter and receiver (Figure 7), i.e., for 10, 20, and 30 [m]. The BER decreases with rising SNR in all the considered cases, in a manner that a greater distance corresponds to a higher BER and conversely. The simulations have been run like in the previous cases trough

several thousand trials. They have been realized by using the BPSK modulation scheme, and it is clear that the BER decreases to E-02 as SNR reaches ca. 45 [dB].

The obtained simulation results in the considered cases (Figures 6 and 7) speak in favour of the applied modulation schemes, path loss and noise models. The trade-off between BPSK and QPSK modulation schemes has been simulated, too, and it shows that the BER is slightly lower in the case of BPSK, but it is negligible in terms of the transmitted data amount which is doubled by using QPSK.

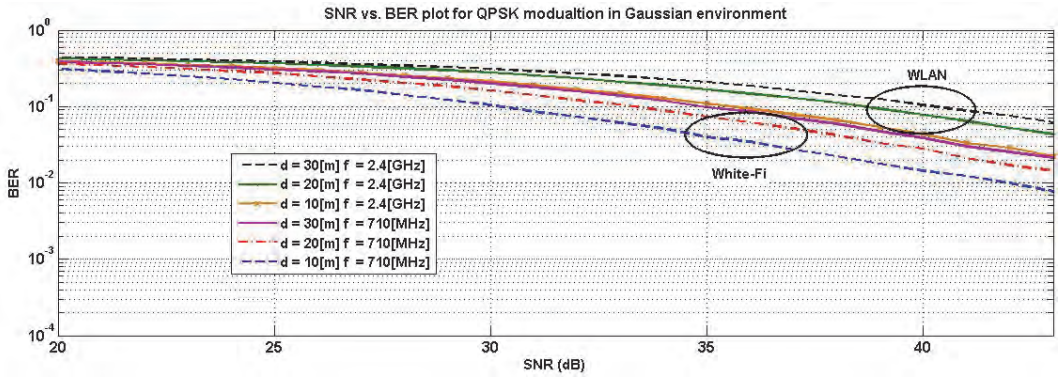

Fig. 7. BER vs. SNR for three different distances at two characteristic WLAN and White-Fi carriers' frequencies

5.2. Simulation model 2: Moving-fix nodes channel analysis

The second set of simulation experiments has been performed in OMNeT++ (ver. 4.6) environment, by an Intel(R) Core™ i5 processor on 2.4 GHz (4GB RAM). The average time per simulation was approximately 15 [min]. OMNET++ is a relatively new simulation tool. It is a modular, extensible, component-based C++ simulation library and framework. The main use of this tool is to simulate, model, and build all kinds of networks: wired and wireless, on-chip, queuing ones, etc. This tool provides component architecture for models. Components are programmed in C++ and then assembled into larger schemes using a high-level network description language (OMNeT++ Community, 2015).

The 2D simulation area is limited within 1000 [m] in both directions. It includes four randomly moving port workers' sub-networks and four fixed port's nodes (readers). The change interval is 1 [sec] with 0.1 [sec] of standard deviation. This means that over 1 [sec] each node will make a move at a specified speed. The speed was settled to emulate the movement of a human person, i.e., 3 [m/sec]. The type of selected channel was the Rician fading channel. The transmission power was set to 1 [mW] or [-30 dB]. Figure 8 shows the relation of the reception power of the fixed nodes and the delay. The distance and delay are linked by the speed of transmission of the signal. It is easy to notice that the received power is less as the distance (or the delay) decreases.

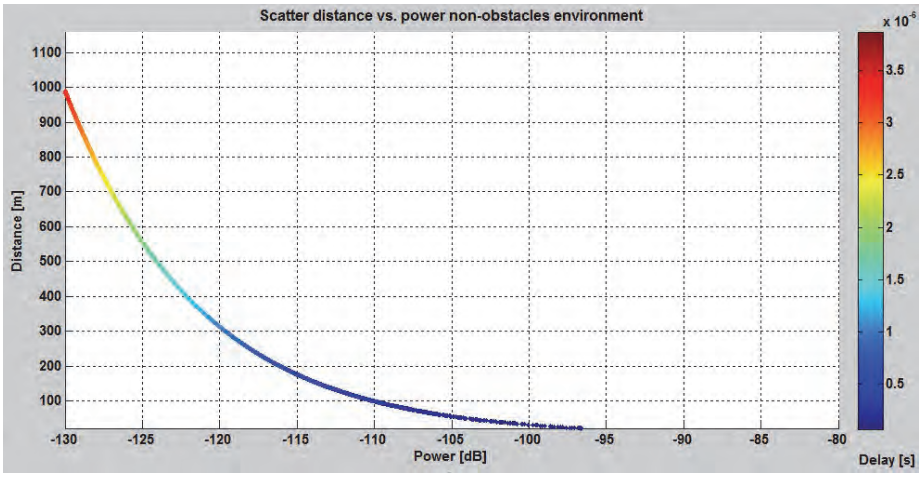

Fig. 8. Scatter function of the distance vs. received power for a non-obstacle scenario

If we introduce the obstacles, the scatter function will be changed (Figure 9). As the simulation experiment has been done over the layout of the Port of Bar container terminal, the obstacles were imaginary containers blocks (12 of them). The obstacles' approximate measures were 200x100x4 [m]. They were metallic with a specific relative permittivity and permeability, which also affects the channel. When the distance/delay was big, the received power was very low and vice versa. The scatter diagram in the scenario with obstacles has two significant shapes. The thin one represents the line of the sight signal, while the thicker one represents the reflection or the signals that pass through the obstacle. The difference between the received power of the line of a sight signal and the received power of a reflected or a signal that pass through an obstacle is approximately 1-5 [dB]. This is completely meaningful as long as the signal through an obstacle or a reflected signal is received with less power.

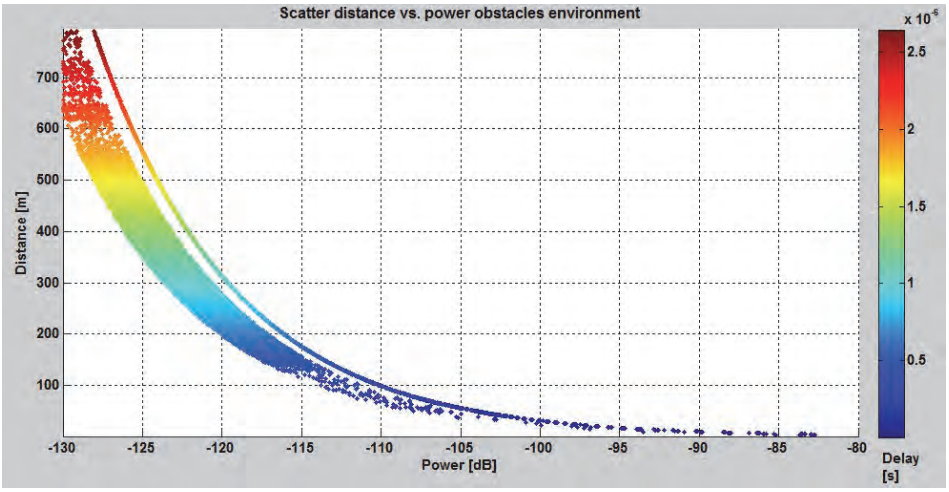

Fig. 9. Scatter function of the distance vs. received power for a scenario with obstacle

Over the simulation scenario with the obstacles, different modulation types: BPSK, QPSK, 16QAM, 64QAM, were used. It is easy to notice that BER decreases if SNR increases in for each modulation scheme (Figure 10). The curves are not smooth, resulting from the random nature of the simulation environment, and the presence of the obstacles. Depending on the modulation type, BER is different. Namely, BPSK modulation works with only one bit per symbol, and it is therefore the simplest one. On the other hand, if the simulation used QPSK, the number of bits per symbol was two, if it used 16QAM, the number of bits per symbol was four, and finally, for 64QAM modulation type, the number of bits per symbol was six. This causes the proportional trade-off between BER and the number of bits transmitted.

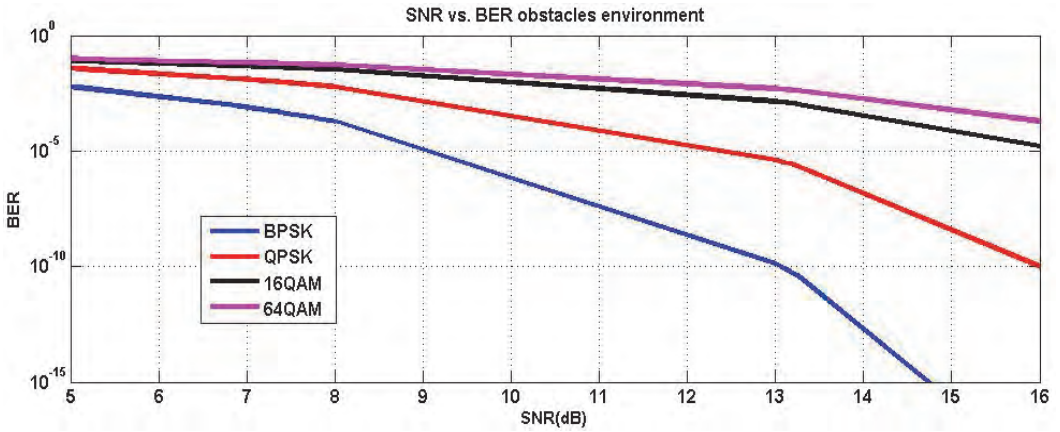

Fig. 10. Scenario with obstacles: SNR vs. BER for BPSK, QPSK, 16QAM, 64QAM

The simulations outcomes can be summarized as follows: (i) Both scatter functions (for the scenario without and with obstacles) contain the lines of sight signal components and their values are the same. (ii) The attenuation of the signal caused by the block of containers' obstacle cannot be neglected (it's approximately 1-5 [dB]); and (iii) The scenario with obstacles needs a higher value of SNR in order to achieve the same level of BER as in the case of non-obstacle environment.

6. Conclusions

The paper describes the current situation in the developing seaports regarding the implementation of innovative ICT solutions, with emphasize on the Port of Bar (Montenegro). It has been observed that some seaports in transitional economies do not have contemporary info-communication business and safety solutions. Our intention was to identify where the implementation of new ICT tools is necessary, but also feasible. Consequently, we came up with the idea that enhancing port workers' safety by introducing RFID technology might be useful and cost-effective solution in the initial phase of adapting modern ICT safety models.

Throughout the simulation experiments in Matlab and OMNeT++, the performances of the channel between the transmitters and receivers placed at appropriate locations within the seaport perimeter have been tested over the Port of Bar's layout. The simulations in Matlab have been performed for the simplified one-to-one (transmitter-receiver) communication channel, while the simulations in OMNeT++ have been realized for the

case of several constantly moving workers' wearable sub-networks and several fixed port's nodes. The obtained results are presented in the sub-sections 5.1 and 5.2, while the following can be summarized:

- For different carrier frequencies and distances between the transmitter and receiver, a satisfying level of BER is achieved by using binary phase-shift keying (BPSK) and quadratic phase-shift keying (QPSK) modulation schemes above real and complex signal components, respectively, while Wiener filter was successfully used for recovering source signal in the Gaussian environment;
- In addition to standard frequencies for wireless communications (915 [MHz], 2.4 [GHz], and 3.1 [GHz]) between the transceivers, two characteristic frequencies from White-Fi spectra (470 [MHz], and 710 [MHz]) have been examined, while the satisfying level of BER has been achieved, as well;
- In the seaport environment without and with the obstacles (container blocks) in OMNeT++ environment: the scatter functions of the distances vs. received powers have been generated, and SNR vs. BER for BPSK, QPSK, 16QAM, and 64QAM modulations schemes compared;
- It has been concluded that both scatter functions, in the simulation environment with and without obstacles, contain the line of sight signals, and that their values are the same in both cases;
- In the scenario in OMNeT++ that includes the obstacle, the attenuation of the signal of 1-5 [dB] was noticed; and,
- By comparing plots for SNR vs. BER in the cases of different modulation schemes: BPSK, QPSK, 16QAM, and 64QAM, it is clear that the scenario with obstacles needs a higher SNR value in order to achieve the same BER value characteristic for the same environment without the obstacles.

The presented findings might be of importance to the managers in the considered developing seaport, since they can be used as *landmarks* in negotiations with senior managers and stakeholders in the port in order to provide funds, as well as in negotiations with ICT companies being in charge of implementing the proposed workers' safety model.

Active RFID workers' badges and passive RFID tags for identification and periodical locating, together with the PPE pieces (helmets, vests, and shoes) should have both direct and indirect positive effects. The PPE protects the workers from injuries, and this is direct positive effect of the proposed safety solution. Indirectly, by regular usage of the PPE garments equipped with RFID devices, including alarm capabilities, raises the port workers' and supervisors' awareness of the occupational risks, as well as the level of the corporate culture.

However, the proposed model for enhancing port workers' safety has certain shortcomings. They are primarily related to the RFID technology and backend network infrastructure limitations. The proposed technology has several significant beneficial aspects, such as: batch readability, resistance to some harsh environment conditions, large information storage and processing capability, etc. On the other hand, it has also several substantial disadvantages (Kapoor et al., 2009), such as: reading error, privacy/security concerns, computing bottleneck, cost-benefit issues (vagueness of investments returns and difficulties in estimating opportunity costs), risk of obsolescence, inter-operability (global) standards issues, etc. In addition to these rather general shortcomings of the RFID technology, there is one more, specifically related to the issue in matter, i.e., inability of

monitoring workers in real time and checking whether the workers wear their PPE correctly. Barro-Torres et al. (2012) have done the efforts for resolving this problem, but the proposed solution has some limitations and it has not yet been commercialized. Therefore, the real-time locating and tracking of port workers and their PPE garments by employing Internet of Things concept, might be considered as next step in developing this model, although it is more expensive.

There is an additional problem which is not technical in its nature, but it should not be ignored, either. Namely, there are several organizational and ethical issues which deserve to be examined in this context. The level of the seaport's both senior managers' and stakeholders' readiness for providing funds and employing the proposed occupational safety solution should be assessed. Also the willingness of the workers to become the active constituents of the proposed network is to be assessed. The achieved results of planned *soft* examinations might cause some modifications in the proposed RFID port workers' safety scenario.

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P.5. Simulation analysis of a ZigBee/RFID system for enhancing occupational safety at the seaport[7]

Simulacione analize ZigBee/RFID sistema za poboljšanje bezbjednosti na radu u morskoj luci

Abstract: The paper examines three potential safety solutions for protecting on port workers which are based on a junction of Radio Frequency IDentification (RFID) as an automatic identification, data collecting and positioning system from one side, and ZigBee as a low energy consumption communication technology from another side. The considered solutions are placed in the context of the individual needs and capacities of the developing Port of Bar in Montenegro (South East Europe), which operates since two decades in the transitional environment. These transitional circumstances prevent the port in adopting advanced occupational and environmental safety measures. Therefore we propose models for improving workers' safety, which are at the same time cost-effective, reliable and flexible. More precisely, on port workers' body area sub networks formed by RFID active/passive devices are treated in the paper as end nodes of a ZigBee network. On the other hand, forklifts' RFID warning systems are treated as moving routers of a ZigBee network. Some simulation experiments in an OPNET environment with such RFID/ZigBee hybrid system are realized over the Port of Bar container and general cargo terminal layout, while corresponding conclusions are derived, along with the directions for further research work in the field.

Key words: seaport, workers' safety, ZigBee/RFID.

Apstrakt: U radu se razmatraju tri potencijalna rješenja za zaštitu lučkih radnika, bazirana na kombinaciji RFID tehnologije za automatsku identifikaciju, prikupljanje podataka i lociranje, sa jedne strane, i ZigBee telekomunikacione tehnologije s malom potrošnjom energije, s druge strane. Razmatrana rješenja su smještena u kontekst individualnih potreba i kapaciteta Luke Bar u Crnoj Gori (Jugo-istočna Evropa), koja fukcioniše već decinijama u tranzicionom okruženju. Ove tranzicione okolnosti sprječavaju Luku u uvođenju naprednih bezbjedonosnih mjera kada su u pitanju zaštita na radu i očuvanje životne sredine. Stoga smo ovdje predložili modele za poboljšanje bezbjednosti radnika, koji su u isto vrijeme troškovno-efikasni, pouzdani i fleksibilni. Preciznije, mreže aktivnih/pasivnih RFID uređaja na tijelu radnika su tretirane kao krajnji čvorovi ZigBee mreže. S druge strane, RFID sistemi alarma na viljuškarima su tretirani kao ruteri ZigBee mreže. Neki simulacioni eksperimenti u OPNET okruženju sa ovakvim RFID/ZigBee hibridnim sistemom su realizovani nad terminalom za kontejnere i generalni teret u Luci Bar, dati su odgovarajući zaključci, kao i smjernice za dalja istraživanja na ovom polju.

Ključne riječi: luka, bezbjednost radnika, ZigBee/RFID.

1. Introduction

The seaports (hereafter ports) are traditionally viewed as an economic springboard for the country development, since their services and manufacturing activities create economic benefits and socio-economic wealth via labor income, business earnings, taxes, etc. (Park and Seo, 2016). Ports also have catalytic economic and social impacts on their corresponding hinterlands. Over the past years, advances in Information and Communication Technologies (ICT) have played a key role in transforming the way in which they function. The successful transfer and implementation of actual ICT applications is a prerequisite for their greater business achievements. However, ports' innovations cannot be restricted to the adoption of new technologies, which are mostly ICT driven in the recent years. So-called soft innovation is currently used to refer to non-technological dimensions like: people and organization, markets and relationships, knowledge and integration, meanings and experiences (Martino et al., 2013), etc. It seems that both technological and soft innovations can ensure to the port a sustainable advantage. The afore remarked holds true for highly developed leading class ports, but unfortunately not to the developing

[7] Bauk S., Garcia-Gonzalez D., Schmeink A., Simulation analysis of a ZigBee/RFID system for enhancing occupational safety at the seaport, submitted to *Journal of Marine Science and Technology*, in April 2016.

ones, e.g., the Port of Bar in Montenegro. It functions for decades in the transitional environment and combats with the lack of investments and rigid administration structures, which permanently reproduce crises and prevent its economic development. Through several projects and research papers we tried at least to lighten and merely alleviate these problems (Bauk, 2014; Bauk, 2015; Bauk et al., 2015; Bauk at al., 2016). We focused on conceiving and developing ICT models for enhancing on port workers' security and uprising the level of their occupational safety culture. This paper provides a continuation in this regard, and it is organized in the following manner: (i) it gives a short overview in terms of how working on port can be dangerous; (ii) it considers three available RFID solutions for reducing workers' safety risks; (iii) it presents some channel analysis in OPNET environment, while workers' body central units (BCUs) and active RFID identification (ID) badges are treated as moving end nodes of the ZigBee network; (iv) it also analyses the channel between workers' and/or pedestrians RFID active ID badges (tags) as end nodes, and forklift trucks' (hereafter forklifts') RFID warning systems as moving routers of the ZigBee network. Finally, the paper gives some concluding remarks according to the simulation experiments' results, as well as, directions for further examinations in the field.

2. On port working risks

Work at ports takes place through the day and night (24/7) in all weather conditions (HSE, 2011; HSE, 2013). It involves a number of different employers and contractors carrying out different activities: harbor authorities, stevedoring firms, haulers, ship's masters, crews, etc. This requires synchronized co-operation and communication between all involved parties. There are usually pressures to load or unload ship's cargo quickly to catch a tide or to free up a wharf for another ship; or, visiting drivers want to pick up or drop off their cargo as quickly as possible and get back on the road. Ports also tend to be associated with emerging environmental problems (Darbra and Casal, 2004): water and air pollution, soil contamination, problems related to dust and noise, generation of waste, dredging operations, warehouse storage of hazardous substances, etc. Therefore, they are dangerous places especially for on port workers and/or pedestrians in terms of operational risks connected to un-loading operations, managing on port traffic and transportation, handling manipulative equipment, warehousing dangerous cargoes (Roberts and Gray, 2013), etc. All these make the work at port challenging, but also of high risk.

Under the regulations, both employers and employees in ports must ensure the health and safety of themselves and others. In developed ports, employers have duties concerning the provision and use of the Personal Protective Equipment (PPE) to their employees who are exposed to the risks. This is still not the case in the Port of Bar, but it should become obligatory. In this regard, within the following section we shall refer to several PPE intelligent solutions which are proposed and/or employed in highly developed harsh working environments. PPE can include items such as safety helmets, gloves, eye protection, high-visibility clothing, safety footwear, safety harnesses etc., but it is commonly limited to the 3 Point PPE, i.e., helmet, safety vest, and protective shoes. Garments equipped with passive or active RFID devices can help identifying each protective piece, examining its functionality and proper using. By the corresponding alarm system workers are alerted if some PPE garment is missing or not properly worn, or if some of RFID tags embedded-attached to the PPE do not function properly. Furthermore, using active RFID ID badges allows smart back-end software system monitoring workers' presence at the

port, their access to the dangerous zones, and in the case of emergency workers can be alerted to come to the appointment place which is well covered with the anchor readers. Thanks to the numerous interrogators installed at strategic points of the appointment zone, workers can be automatically identified, located, and the inspection of using and correctness of their PPE garments can be carried out. Additionally, RFID locating system for both workers equipped with ID cards (i.e., active RFID tags) and forklifts equipped with RFID light/audio alerting system to oncoming vehicle ahead of time, giving the workers and/or pedestrians on port enough time to get themselves to safety, can be used. These safety solutions will be described in some more detail within the next section.

3. Concerning some PPE-RFID safety solutions

In order to give support to the managers of the developing Port of Bar to provide justification to the senior management and stakeholders to secure buy-in and implementation of smart safety solution(s) for preventing and reducing occupational risks, we described within this section some of the previously mentioned smart PPE-RFID systems. The first one which is briefly presented is described at large in (Barro-Torres et al., 2012). However, it is still at the level of prototype, with the intention to be implemented at construction sites. The second system, which is presented here, is implemented in the North Sea oil and gas industry (Vermesan, 2010), and the third one can be implemented at a port or at any other industrial and transportation environment of high density. In any case, there are no severe restrictions for implementing these solutions at a port environment, as a rough and work and commercial intensive one. Introducing a ZigBee network for establishing communication between workers', pedestrians', and forklifts' RFID enabled devices and warning systems, at the port perimeter, including port's backend info-communication system, might be considered as a novelty of this paper in comparison to the previous research works in this domain (Musu, 2014; Musu, 2015; Sole, 2014; Sole and Musu, 2013a; Sole and Musu, 2013b; Bauk et al., 2016).

3.1. The RFID equipped PPE functionality and correct wearing inspection

This system is composed of a body area network (BAN) that collects information from the readers located throughout the workers' clothing (Barro-Torres et al., 2012). The short range RFID readers are located at strategic points in the clothing, with the aim to provide checking correctness of wearing 3 Point PPE. The detection rate clearly increases when the antennas of the reader and the tag attached to each 3 Point PPE garment are in parallel, while it decreases dramatically when the antennas are oriented orthogonally. To avoid the null spots, different alternatives have to be weighted up in order to modify the antenna radiation pattern. The central unit microcontroller (CUM) processes the data from readers and transmits them by radio module to the ZigBee mesh network composed of the set of end nodes (workers' BANs), routers, and the coordinator. The CUM contains the XBee module for ZigBee communications. This module has a transmitting power of 2 [mW] and works at 2.4 [GHz], while its range varies greatly depending on environment (temperature, humidity, size and material of obstacles). The coordinator collects and stores the data coming from the end nodes, configures nodes and performs synchronization. The end nodes are the critical part of the system. The scheme of this scenario is given in Figure 1. We do not recommend it to be implemented at the Port of Bar at the present moment, since it is complex, intrusive, and the central microcontroller is currently in the developing phase. In any case, we believe it is worth to present it to the managers in

the Port of Bar as a kind of potential working place and environmental safety solution which can be adopted in the future.

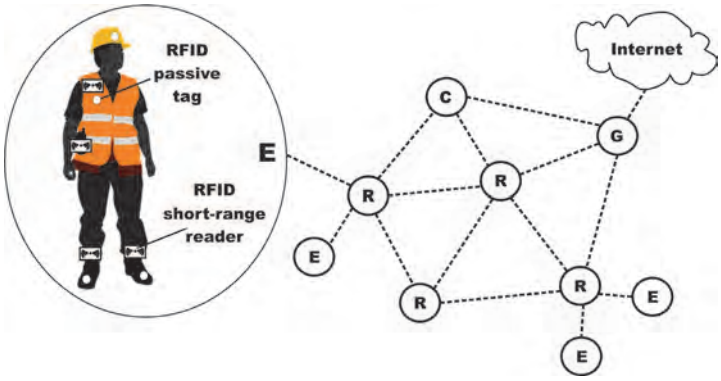

Fig. 1. ZigBee/RFID scenario 1: Worker's BAN as an end node
(Legend: E-end node; R-router; C-coordinator; G-gateway/coordinator)

3.2. The PPE and active RFID tags in reducing risks

A cost effective RFID technology solution for locating and tracking personnel in case of emergency situations was deployed at oil and gas rigs in the North Sea in the beginning of 2000's. This system is conceived as an offshore emergency preparedness system, rather than personnel surveillance one. Its two key components are RFID readers and tags. In the event of an emergency, the system determines the current and past locations, and the identities of all personnel wearing an active RFID tag (ID badge, or card) for the purpose of tracking. Of course, in addition to this emergency safety system, using PPE at oil and gas rigs is obligatory. Extended version of the personnel tracking system may also include usage of the environmental sensors, e.g., temperature, humidity, gas detection, etc. In some cases, the active ultra high frequency (UHF) Gen2 tags are installed onto the hard helmet of each worker. By installing RFID readers at each entry gate of the floating ship or another enclosed space, the system can track how many people are inside. In this way the fire and security officials have real-time information on head count and are able to size the number of means of escape (Hild, 2007).

Platforms operating in an offshore environment typically employ hundreds of people. Some of them are connected via bridges which create a center that can hold up to thousands persons. Each person on the rig has an RFID active ID badge which can be worn around the neck, attached to the clothing or placed in the pocket. The badge has a battery powered UHF tag which works at 868 [MHz] (EU standard) and transmits ID number at preset intervals. The tags can be read from up to 500 [m] away. Back-end software stores each worker's name, shift, job, education, etc., which is linked to the unique ID number on the badge. When a reader captures a tag's ID number, it forwards that information via a wireless connection to a computer, which could then pass on that data, either to the company's back-end server or to a server on-site via Wi-Fi or Internet connection (Swedberg, 2011). We propose here employing ZigBee mesh network as a *connector* to the smart back-end control system, while the end nodes are workers' active RFID tags. Simplified, worker has the RFID active tag, while the router reads the tag and sends the information to the ZigBee network. At the end, the data arrive to the coordinator which is connected with a geographic information system (GIS) map (Grupo Autolog, 2010).

Basic scheme of this workers' RFID safety scenario is given in Figure 2. If there are several readers on the site, the system can determine each employee's location, while the accuracy of position being determined depends on the number of readers used. The system typically tracks which zone an employee is in, rather than the worker's specific location. The system also provides an alerting function, in the case that certain personnel are not allowed to enter specific zone. Using active ultra-wideband RFID tags (3.1-10.6 [GHz]) should allow determination of worker's position with precision of a few inches (Roberti, 2013). However, such tags can be fairly expensive, especially if we bear in mind specific economic and administrative conditions in which functions the Port of Bar. Therefore we suggest using UHF active RFID ID badges for workers' identification and their locating within a certain zone or read field within about 5-10 [m].

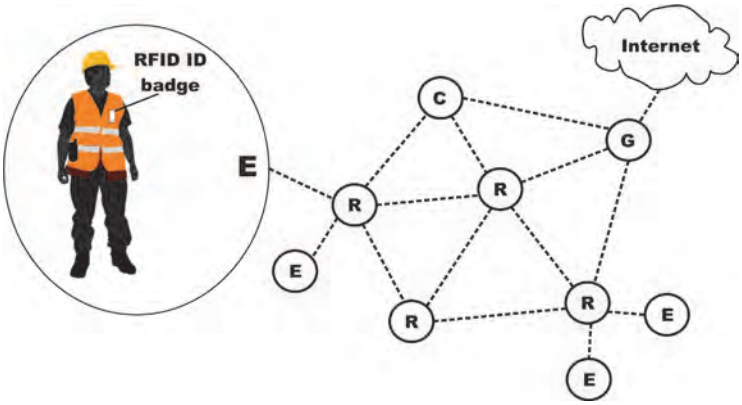

Fig. 2. ZigBee/RFID scenario 2: Worker's RFID active ID badge as an end node (Legend: E-end node; R-router; C-coordinator; G-gateway/coordinator)

3.3. The RFID supported forklift warning system

Workplace accidents involving moving vehicles (e.g., forklifts) cost ports a huge amount of money in terms of expensive downtime, investigations and increased insurance premises (Orbitcoms, 2016). Above all are fatal injuries and loss of human lives. In 2014, e.g., their number was 734 in the USA, in the transportation sector, according to the Bureau of Labor Statistics (Grayson, 2015). Fortunately, the fatal accidents are not recently recorded in the Port of Bar, but this should not be excluded as a potential danger and anyway it should be prevented.

There are several ready made, commercial solutions for reducing the risk of collision between moving vehicles and pedestrians/workers at the workplace, like: Forklift Safety RFID Solutions (SPT, 2016), BodyGuard (Orbit, 2016), Pedestrian Alert System (IcnitaSafety, 2016), EGOpro Safety Move Proximity Warning Systems (AME, 2016), etc. They all improve safety through a proximity alert system for forklifts and workers/pedestrians. Main operating characteristics of these systems are (IcnitaSafety, 2016): detection of workers/pedestrians in frontal (0.5-6.5 [m]), back (0.5-6.5 [m]), and side area (up to 4 [m]) of operation of forklift and warning forklift's driver (while maximum detection range can be adjusted smaller); alerting at the same time worker/pedestrian by visual and/or audible alarm; and, automatic reducing speed or stopping forklift (maximum speed is of 10 [km/h]). The system helps to overcome typical risk caused by factors such as driver inattention, poor visibility (e.g., blind entry/exit, warehouse aisles, etc.), worker

non-compliance with exclusion areas around vehicles, collision between worker and moving vehicle at the common working area, etc. Also workers/pedestrians can be alerted through steady audio of light alarm. In the following simulations (Section 5) we shall consider the case that a (moving) forklift contains a RFID long-range reader and an alerting system and it is considered as a moving router of the ZigBee network at the port area (Figure 3).

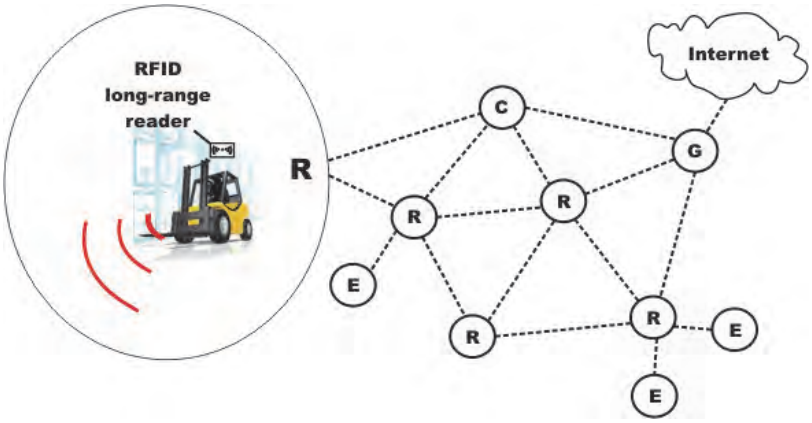

Fig. 3. ZigBee/RFID scenario 3: Forklift's RFID reader as a moving router
(Legend: E-end node; R-router; C-coordinator; G-gateway/coordinator)

All three previously shortly presented occupational safety scenarios include the combination of RFID and ZigBee technologies, which can be applied at the port working environment. Therefore, ZigBee/RFID hybrid technology will be described in the next section. Also, some simulation experiments over ZigBee communication channels in an OPNET environment shall be performed.

4. Blending ZigBee and RFID technologies

ZigBee networks can collaborate with RFID devices to enhance lower battery power consumption, robustness, extension of ranges, communication with applications and other network devices, etc. In other words, an integrated ZigBee/RFID system architecture performs the needs of multiple applications with more capability than stand-alone RFID products. It can deliver extended range through multi hops and considerable savings in power consumption when all the network components are well coordinated. In the ZigBee/RFID system, ZigBee end device like worker's BAN, an active on port worker's ID badge, or forklift RFID warning system have capabilities of returning a unique identifier to a nearby scanning reader. ZigBee transceivers automatically form a mesh network with any ZigBee transceiver in the range of the same network ID and frequency range (Abdula and Widad, 2011; Rubio, 2010). An XBee product (Digi, 2016) is radio frequency transmission module programmed for use as a ZigBee end device with transparent operation as an active RFID tag and receiving and transmitting capabilities in a wireless transmission physical layer. In the following simulation experiments we assumed that workers' BANs composed of active/passive RFID devices (scenarios 1 and 2) are end nodes of the ZigBee network which features we analyzed. Also we considered forklifts' RFID sub network composed of reader, warning devices, and driver's ID badge as a mov-

ing router of analyzed ZigBee mesh network on the port parameter (scenario 3). Some of the results of performed experiments in OPNET (Hammoodi et al., 2015; Sahraei, 2009; Kaur, 2014) are presented and discussed in the following section. Besides improving on port workers' and pedestrians' safety, ZigBee/RFID systems can be also used for enhancing building security (Infanta, 2013), traffic flow management (Chao and Chen, 2014), intelligent traffic control and patient monitoring for efficient ambulance services (Suneesh, 2015), etc.

5. Simulation results

Simulation experiments with a ZigBee network which end nodes are workers' RFID sub networks, and moving routers are forklifts' RFID warning systems sub network, are realized in OPNET Modeler (Riverbed Modeler v.17.5.A) on PC (Intel-Core™ i7, 2.50 GHz, 8GB RAM) over the layout of the Port of Bar container and general cargo terminal which covers area of about 650 x 350 [m^2] (Figure 4).

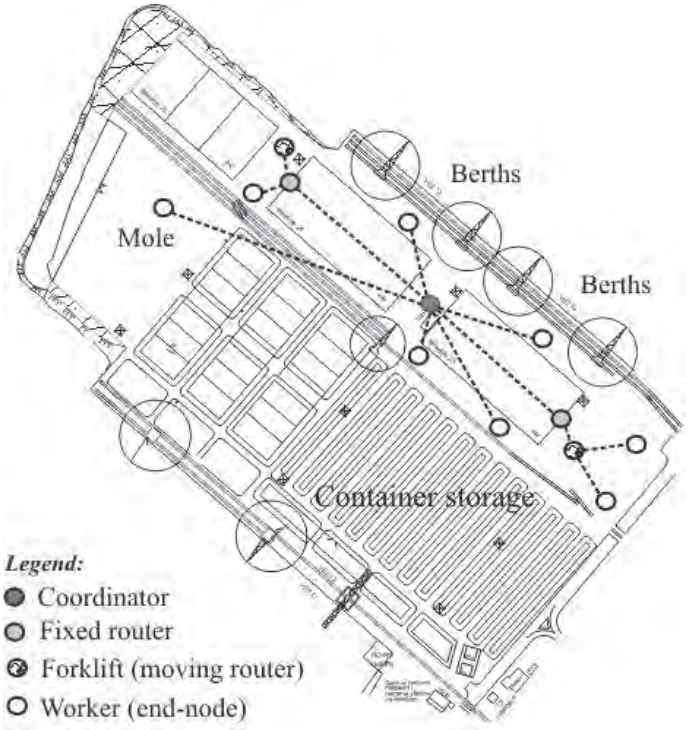

Fig. 4. Layout of the Port of Bar container terminal over which some ZibBee/RFID network performances are analyzed

For the needs of simulation experiments, the fixed routers and the coordinator of the ZigBee network are mounted at the top of the main warehouse buildings at the terminal, which height is approximately 10 [m], and which is greater than the height of usual container blocks height on the container yard. We used mesh topology since it has mainly superior performances in comparison to star and tree topologies (Vancin and Erdem, 2015; Mihajlov and Bogdanovski, 2011; Vats et al., 2012). Workers and forklifts are moving over the operational area between wharfs and storage (warehousing) area. We

suppose that a worker's speed is 2 [km/h], and a forklift's one 10 [km/h]. The paths of workers and forklifts are randomly chosen.

Since the Port of Bar has 100 on port workers who are scheduled at seven terminals depending on the workload: (1) container and general cargo terminal; (2) wood terminal; (3) terminal for grains; (4) bulk cargo terminal; (5) container and general cargo terminal; (6) liquid cargo terminal, and (7) passenger terminal, we supposed (according to the ususl turnover) that mostly 18 workers might be engaged daily at the container and general cargo terminal. Also, according to some previously made consultations with port managers, we assumed that 2 forklifts are usually in operation daily on the terminal. In order to get better insight into the simulation experiments' results, we tested the network for various combinations of workers and forklifts, e.g., for: (a) 4 workers and 1 forklift; (b) 9 workers and 1 forklift; (c) 13 workers and 2 forklifts, and (d) 18 workers and 2 forklifts. The main settings of the network are as follows for the end nodes:

- Packet Interval Time: constant (1);
- Packet Size: constant (32);
- Start time: constant (30);
- Stop time: infinity; and,
- Transmition power: 5 [mW].

The forklifts, which are treated as moving routers has the same application traffic parameters, but the transmission power is greater, i.e., it is 50 [mW]. Routers do not generate application traffic. The coordinator is responsible for configuration of the network parameters. It sets the topology of the network (tree, star, or mesh; here mesh), the number of children that each node can have, the number of routers, the depth on the network tree, it defines the PAN, etc. The coordinator also does not generate any application traffic, but will be the final destination for all the application traffic generated in the end nodes.

Figure 5 presents the traffic received by the coordinator in cases (c) and (d) at the frequencies 868 [MHz] and 2.45 [GHz] respectively. It is obvious that the received traffic is about 12-18 packages per second for 2.45 [GHz], and that it is considerably lower, i.e., it is between about 6-9 packages per second for 868 [MHz]. This is due to the increased performances that we have in the 2.45 [GHz] band, compared to the 868 [MHz], such as the data rate, the number of channels, or even the use of more efficient modulation protocols. We may remark also, that each end node sends application traffic each second, but for our application we can assume some packets losses, as long as all the data traffic from one worker is not completelly lost.

Figures 6 and 7 present end-to-end delays for (a), (b), (c), and (d) scenarious, for 868 [MHz] and 2.45 [GHz] carrier frequencies. It is clear that the delay is consideralby lower for 2.45 [GHz] than for 868 [MHz]. More precisely, in the better case (at 2.45 [GHz]) it is about 0.07-0.16 seconds, while in the worse one (at 868 [MHz]), it is about 0.12-0.44 seconds. This happens since the data rate increases at 2.45 [GHz], and because more efficient modulation scheme QPSK (in comparison to BPSK one) has been used.

Fig. 5. Traffic received by coordinator for different on port scenarios

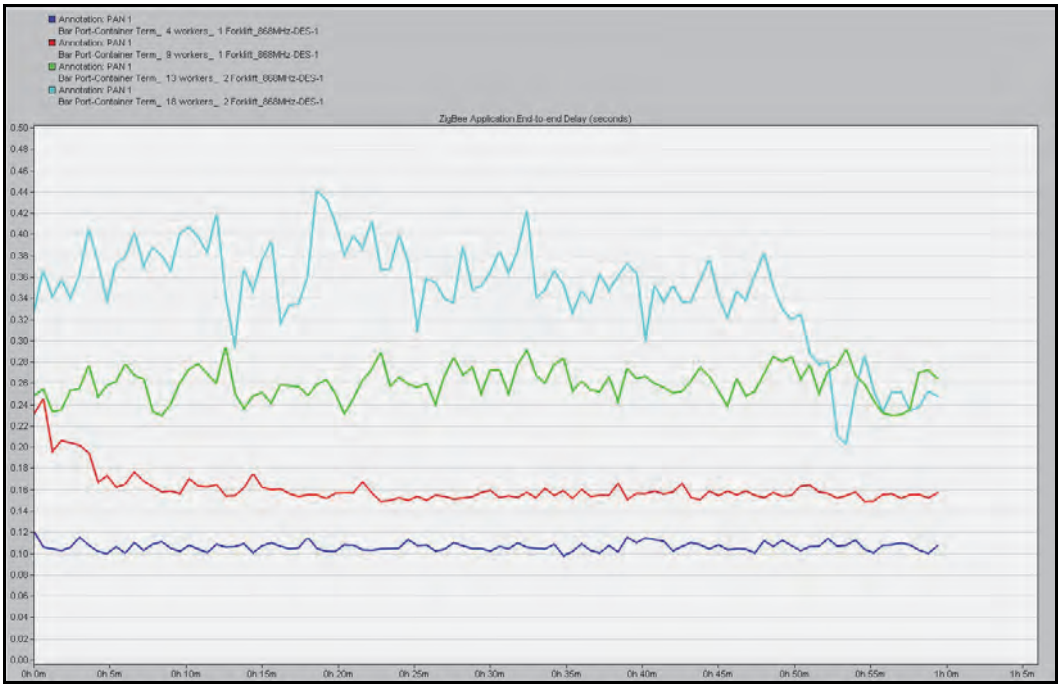

Fig. 6. End-to-end delay for 868 [MHz] carrier's frequency

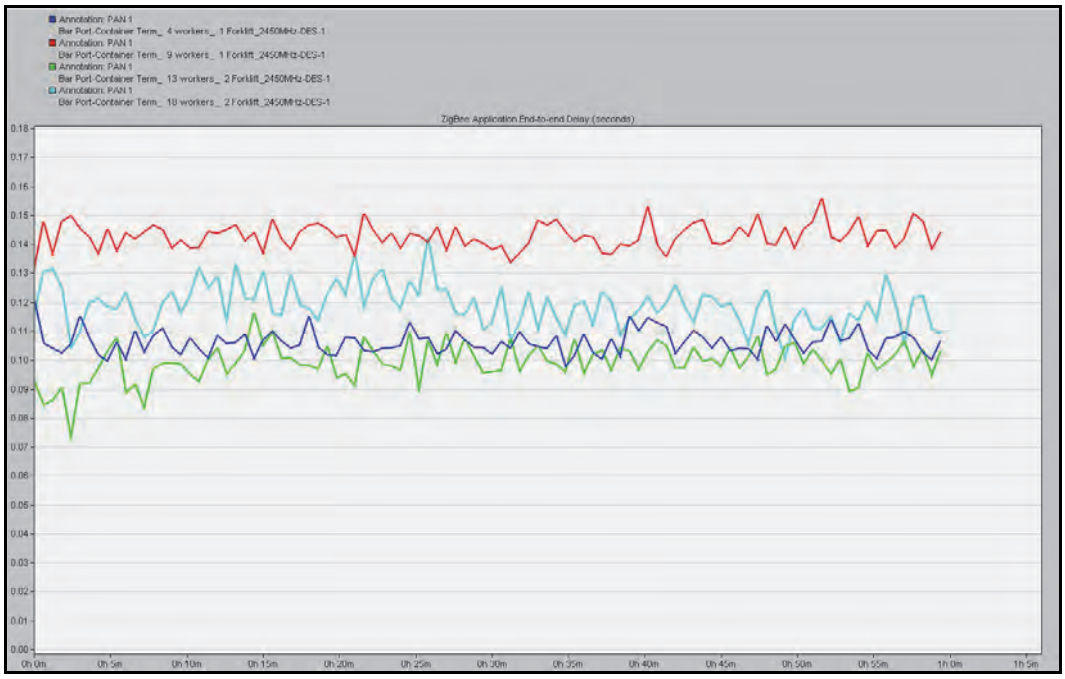

Fig. 7. End-to-end delay for 2.45 [GHz] carrier's frequency

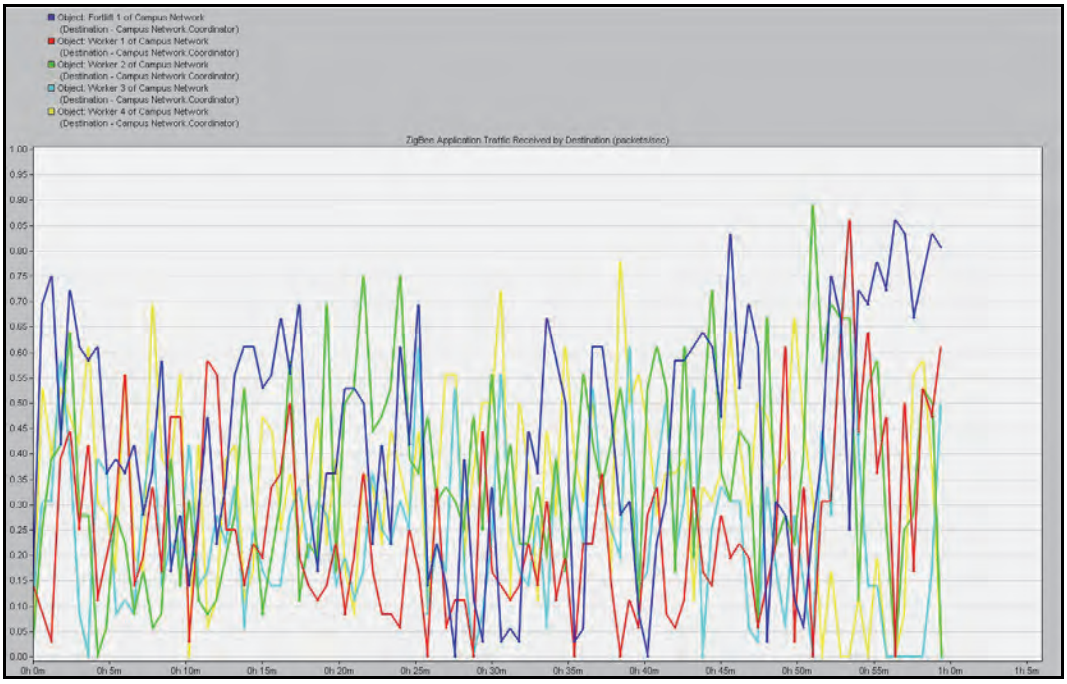

Fig. 8. Traffic received by destination from different routers and end nodes at 868 [MHz]

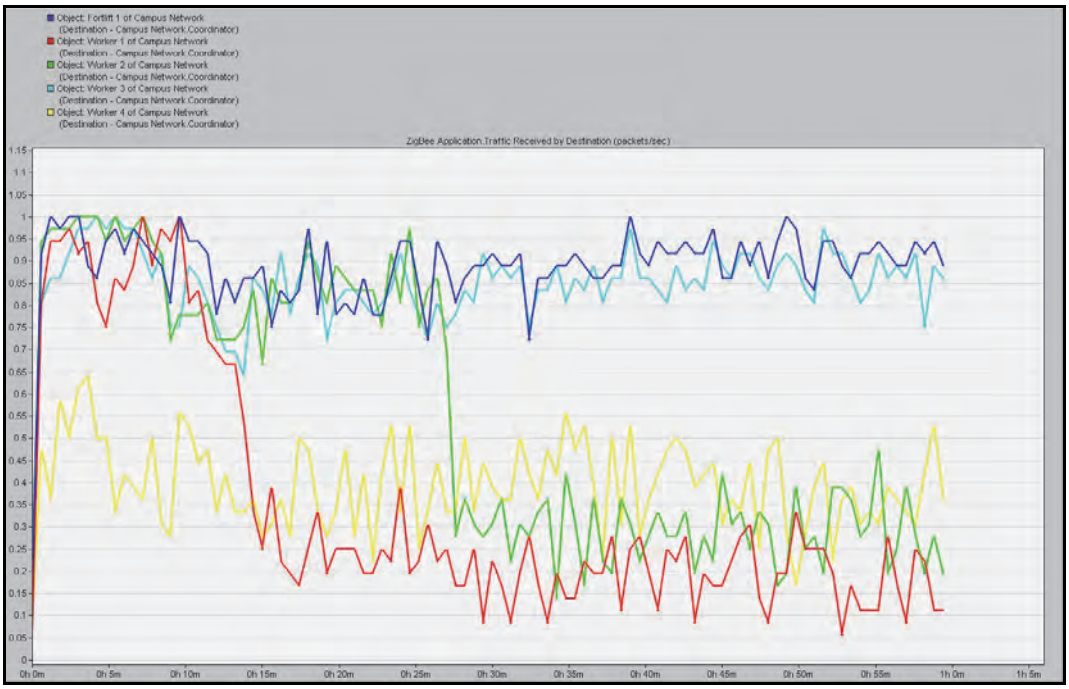

Fig. 9. Traffic received by destination from different routers and end nodes at 2.45 [GHz]

It is also interesting to consider traffic received by destination, i.e., network coordinator from certaing end nodes (workers) or moving routers (forklifts) as it is shown in Figures 8 and 9. The traffic received by destination reaches 1 package per second for 2.45 [GHz] and 0.75 package per second for 868 [MHz]. Although the received traffic have oscilations which mostly depend on the distance between end nodes and/or moving routers from the deastination at the certain time interval covered by the simulation period, there is no permanent interuption of receiving. This is of particular importance.

The simulations are realized for the actual number of workers and forklifts employed ordinary in the shifts due to the workload on the container and general cargo terminal at the Port of Bar. In the forthcoming analysis, a larger number of workers and mobile mechanization units should be involved in order to confirm experimentally ZigBee technology functionality for a greater number of network nodes, i.e., its reliability and scalability. Also impacts of different obstacles and environmental parameters should be analyzed. On port workers readiness to become constitutive parts of the proposed smart safety solutions is to be examined, as well. All these should help managers in making the port *safer* and *greener* at the global market of providing un-loading, transportation, and added-value services to the cargos and passengers.

6. Conclusions

The paper presents a continuation of previous authors' research work (Bauk et al., 2015; Bauk et al., 2016) and attempts towards repositioning the Port of Bar at the market of safety ports. It considers RFID based occupational safety solutions in ports and other similar harsh environments and proposes RFID system co-work with ZigBee technology in a satisfactory and efficient way for the purpose of enhancing on port work-

ers/pedestrians safety. The ZigBee as a communication technology is analyzed since it provides low energy consumption, larger range, and it works properly with quite a large number of end devices. XBee modules are proposed as a link between workers' and forklifts' RFID sub networks and ZigBee communication channel. Simulations are focused on ZigBee performances over the Port of Bar container and general cargo terminal. They are realized in the OPNET (Riverbed Modeler v.17.5.A) simulation environment and following outcomes are captured:

- As a number of end-nodes increases (from 15 to 20), the traffic received by coordinator decreases (from about 12 to 7 packages per second), but there is no interruptions in terms that coordinator does not receive traffic at all;
- The experiments show that the performances of the ZigBee network are in general considerably better at 2.45 [GHz] than in the case of 868 [MHz] carrying frequency. This is due to the greater data rate at 2.45 [GHz], greater number of available channels, more efficient modulation schemes, etc.;
- Better performances at 2.45 [GHz] than at 868 [MHz] are noticed when it comes to the number of received packages per second by coordinator, and when it comes to the end-to-end delay of the received signal;
- Also, the number of packages received by destination (coordinator) from different routers and end nodes varies depending on the current allocation of these devices and it is greater in the case of using 2.45 [GHz] than 868 [MHz]; and,
- Concerning the received power, it is in all cases higher than the power reception sensibility threshold, which is the minimum reception power that is needed at the receiver. In all our scenarios, it is set to -85 [dBm] to all the devices.

The experiments are done for real number of workers and forklifts being commonly in operation at the Port of Bar container and general cargo terminal. They show completely satisfying level of ZigBee network performances. In our experiments we assumed that ZigBee end nodes and moving routers are RFID sub networks joint to the ZigBee via XBee modules. In the forthcoming research, a larger number of end nodes and routers should be involved. Additionally, some more detail explanations of connecting possibilities of RFID and ZigBee technologies are to be considered. However, our goal here was to introduce managers and stakeholders of the developing Port of Bar, which functions in transitional economy, with the contemporary ICT solutions which might be adopted in improving human lives safety and environmental management system in the port. Since the industrial safety systems use whole panoply of technologies, we do not intend to offer *the best solution*, but just to open a discussion about cost and energy effective and at the same time reliable occupational safety measures. On the port's management is to develop strategies for their implementation in the future, with the ultimate goal of protecting on port workers'/pedestrians' lives and maritime ecosystem. These should promote the Port of Bar in the perspective as *safety* and *green* at the maritime market and upgrade its current position at the customers' perception maps.

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P.6. Teaching ECDIS by Camtasia Studio: Making the Content more Engaging[8]

Realizovanje nastave o ECDIS-u pomoću Camtasia Studio programa: Kreiranje interesantnijeg sadržaja

Abstract: The basic idea of this paper is to motivate teachers/instructors of maritime schools and colleges to create interesting and engaging screencasts for teaching students (future seafarers) ECDIS basis, by using new contemporary media and didactical solutions. Camtasia Studio has been proposed as suitable applied software for doing so. It is a multi-media, user-friendly environment, providing the customers with the variety of possibilities for editing PowerPoint presentations with the introduction of audio, video and different animations, in order to make teaching/learning content more interesting and to point out the most important issues. It allows computer screen video capturing, and adding of audio and numerous animated effects to it, as well as augmenting video recordings into the Camtasia project(s). Even though the proposed software tool possesses a broad palette of advanced features for recording and editing "lively" and edifying recordings, within this paper only brief descriptions of "reviving" classical PowerPoint presentations, taking the screen captures over Transas demo ECDIS software, and their editing is presented. Several examples of instructional recordings concerning ECDIS operational basis, and possibility of students' self-evaluation have been given, too.

Key words: education, MET, new media, Camtasia Studio, ECDIS.

Apstrakt: Osnovna ideja ovog rada je u motivisanju nastavnika/instruktora u pomorskim školama i na fakultetima, da kreiraju interesantne i angažujuće nastavne video materijale za studente (buduće pomorce) o osnovama ECDIS-a, korišćenjem novih, savremenih medijskih i didaktičkih rješenja. Camtasia Studio je predložen u ovu svrhu, kao pogodan aplikativni softver. Radi se o multimedijalnom okruženju prilagođenom korisniku, koje nudi brojne mogućnosti za uređivanje Power Point prezentacija uvođenjem zvuka, videa i raznih animacija, s ciljem dobijanja nastavnog/obrazovnog materijala koji je interesantan (angažujući) i stavlja akcenat na ono što je najbitnije. Ovaj alat omogućuje snimanje ekrana, dodavanje zvuka i brojnih animirajućih efekata, kao i umetanje video snimaka u Camtasia projekat. Iako predloženi softver ima široku paletu naprednih mogućnosti za snimanje i uređivanje dinamičnih i poučnih snimaka, u ovom radu dati su samo kratki opisi oživljavanja Power Point prezentacija, snimanja ekrana Transas demo ECDIS softvera, njihovog uređivanja i eksportovanja na web. Dato je nekoliko primjera snimanja instrukcionih sadržaja o operativnim osnovama ECDIS-a, uključujući i neke mogućnosti za samoevaluaciju studenata.

Ključne riječi: obrazovanje, MET (Maritime Education and Training, eng. – Obrazovanje i obuka u pomorstvu), novi mediji, Camtasia Studio, ECDIS.

1. Introduction

Contemporary sophisticated navigation equipment requires permanent rising the quality of teaching/learning level(s) at MET (Maritime Education and Training) institutions. Students, future seafarers, should have available resources in order to learn more: quickly and easily. It should be borne in mind that students are increasingly exposed to the dual pressure nowadays, i.e. most of them have to study and work at the same time. Offering them e- or blended learning materials is a kind of relief. On the software market there are a lot of new media tools that are available to teachers for creating e-learning educational/training materials. Some of them are free, which is an additional benefit. By exchanging experiences and through persistent experimentation, teachers can relatively easy create instructional materials that will encourage students to learn, in parallel with greatly facilitating their cognitive processes and acquiring new knowledge and skills.

[8] Bauk S., Radlinger R., Teachning ECDIS by Camtasia Studio: Making the Content more Engaging, *TransNav the International Journal on Marine Navigation and Safety of Sea Transportation*, Vol. 7, No. 3, September 2013, pp. 375-380.

Often, the prevailing students' motivation factor for choosing the profession of seafarer has been the income. Following this motif, seafarers (e.g. from Montenegro and the entire region) have been employed by mainly bad companies. This practice is to be gradually changed. With improved education, the students would become competent for finding employment in better and more successful companies investing in their staff and their professional training. This would create a new "class" of experienced seafarers, who could later take part in education and raise its quality to an enviable level. In other words, by introducing students to the space which facilitate easy acquisition of even theoretical knowledge, and getting more quickly competencies of considerably higher level, the previous mentioned should be slightly change in the future. To this end, the paper presents a few ideas on how to teach, and consequently easier learn basics of ECDIS (Electronic Chart Display and Information System) on the exemplar of Camtasia Studio software tool employment at METs in more efficient knowledge transfer.

The paper is organized in the following way: (a) A short description of ECDIS is given in order to emphasize its importance in providing safe and effective maritime navigation; (b) An overview on software tools that can be used in creating more interesting and engaging educational materials is given, with a particular emphasize on Camtasia Studio being used here; (c) Several examples of using Camtasia Studio in teaching/learning ECDIS are given, and (d) Some conclusion remarks, along with the directions for further research work in this field are given, as well.

2. ECDIS: as a content of the instructional materials

The ECDIS is an entirely electronically based navigation system that integrates real-time navigational data from ship sensors (GPS, Radar, AIS, etc.) and electronic navigational charts (ENCs - Electronic Nautical Charts) [17;18]. In its very nature, it is a centralizing instrument with the unique function of integrating many aspects of navigation [15]. More explicitly, it allows the integration of numerous operational data, such as ship's course and speed, depth soundings, and radar data into the display. Furthermore, it allows automation of alarm systems to alert the navigator of potentially dangerous situations, and gives him/her a complete picture of the instantaneous situation of the vessel and all charted dangers in the area [9]. ECDIS has been conceived in such a way to support and enforce the transition to the e-Navigation concept [17].

Although the International Maritime Organization (IMO) officially approved it as the equivalent to the classical paper charts in November 1995 [9], the transition to its full usage in practical maritime navigation is still slow. The causes are the lack of the official ENCs, the high cost of ECDIS, and a dose of skepticism in accepting this new technology by the traditional marine community. However, ECDIS has benefits in terms of time saving in route planning and monitoring, preventing accidents and thus protecting the ship and marine environment. ECDIS functions can be used effectively especially in restrictive waterway areas, during periods of poor visibility, i.e. under conditions of mist and during the night. In coastal waters it is generally very easy to derive the position with the view from the bridge windows, as well as with the information from other prime navigational devices. But, care must be taken to ensure that radar is always used as the primary collision avoidance aid and ECDIS as the primary charting aid [18].

The key components of ECDIS display, i.e. most of the visualized commands of ECDIS (on the exemplar of Navi-Trainer Professional NTPro 4000 nautical simulator manufactured by the Transas Marine) have been described in detail within some previously

published papers by the author in this field and cited in [1]. Also, the basic and some advance features of ECDIS have been covered by numerous referential literature resources, e.g. like [9-17;20-22;25-31]. Though, the focus will be given here on using new media tools in better teaching/learning ECDIS principles.

3. Camtasia Studio: as a tool for creating the instructional materials

Nowadays there is a quite large offer of different application software which can be used for producing:

- *audio* (Audacity, NCH Wave Pod, Adobe Audition, Cubase Steinberg, Logic Studio, Kristal Audio Engine, etc);
- *video* (Windows Movie Maker, Adobe Premiere, Avidemux, Magix Video, Video Spin, AVIedit, etc); and,
- *sreencapturing* (Adobe Capticate, Capture Fox, Camtasia Studio, Jing, ActivePresenter, BB Flashback, BB Flashback Express, ScreenPresso, VirtualDub, etc).

Web can be used, of course, as a resource for further search in the field [32;33].

Some of these software tools are proprietary commercial, while some are freeware. And it is difficult to give the recommendation which one should be used. Exploring *pros* and *cons* of these and numerous other software is beyond the scope of this article. However, at this moment of the authors' work in this domain, the most appropriate *seems* here employed and briefly presented Camtasia Studio software. However, this does not mean that the teachers/educators at METs should not experiment with other tools, and that the authors will not do so, what should undoubtedly create new opportunities for exchanging and mutual enriching experiences in this MET sphere in the future.

Hence, the following part of this section will provide the reader with some basic Camtasia Studio features. Camtasia Studio is a set of software applications for creating professional-looking presentations, video tutorials and/or screen captures, published by TechSmith [23]. It allows: creating professional videos easily, recording on-screen activity, customizing and editing content, adding interactive elements, and sharing videos with anyone, on nearly any device.

More precisely, the PowerPoint presentation recordings along with a variety of animated effects, the narrator's voice, background sounds (music), and web camera recordings of the presenter are enabled by this software. Additionally, the whole screen, or the exact pre-specified screen area (of any PC program, or, here the ECDIS Transas demo version) can be captured, and audio may be recorded simultaneously, or embedded latter, from any standard input source device. During the content production the presenter is able to *jump* from one application to another without interrupting the recording process. The presenter is able to stop recording with a hotkey combination at any time, at which point the software renders the input that has been captured, and applies user-defined settings. After the presentation had been captured, it is possible to revise it by cutting and/or pasting different parts, as needed.

The presenter is also able to overlay the voice sequences, sound effects or music onto the presentation, if it is needed. Camtasia allows audio recording while screen-capturing is in progress, so the presenter can narrate the demonstration as it is carried out. Most presenters, however, prefer to wait until they have finished the screen-capture, and then record the narration from a script as the application is playing back the recorded capture. The program allows files to be stored in its own proprietary format, which is only

readable by Camtasia itself; this format allows fairly small file sizes as well as longer presentations [23;24].

The completed video recordings can be also output to several different, popular common (video) file formats, such as AVI, Flash, SWF, Quick Time, RealMedia, etc., which can be easily read by most computers. Camtasia Studio can be used for quickly recording, editing and submitting variety of contents in variety of manners.

Within this context of learning ECDIS fundamentals, and some of its advanced functions – more efficient knowledge transfer and its acquisition by the students, particularly future seafarers among them, it is Camtasia Studio primary task.

3.1. On recording Power Point presentations about ECDIS basis

In general, recording PowerPoint presentations should be realized in two ways: recordings can be done directly from PowerPoint by using Camtasia Studio PowerPoint Add-in tool, or by saving each PowerPoint presentation slide in JPEG format, and importing them into the Camtasia Studio Clip Bin, and latter on, transferring them sequentially to the Timeline. Then, the JPEG files can be edited by associating them with voice narration, web camera recordings, different animated and transitioning effects, etc. The detail description on both procedures can be found in [23]. In introducing students with the ECDIS basis: historical facts, standards, types of navigational charts, performances, educational-training requirements, etc., both ways of PowerPoint recording have been applied by the authors. Also, the authors have realized some experiments with Web camera and inserted recordings into the video as Picture-in-Picture (PIP) augmentation, what makes the presentations more interesting and engaging for the students. Due to the voice narration, background sounding, and web camera recordings, along with the different animations, above listed topics became undoubtedly more interesting; firstly, in terms of keeping up students' attention and most probably, making them curios to learn more on this topic in the perspective.

Undoubtedly, it is more interesting and "lively" to present some examples of using Camtasia Studio in recording screen captures over ECDIS Transas demo software. Thus, in the following section some of these examples will be presented and briefly explained.

3.2. On recording the screen captures over ECDIS software

In the process of recording screen captures on ECDIS, the Transas demo version 2.00.012 (2010) has been used as a base upon which the recordings are done. The whole screen is recorded, along with the presenter narration, and after the recording had been finished, the capture is imported to the Camtasia Studio and edited. Different animated effects (callouts, captions, smart-focus tools: zoom, pan, etc.) are added, in order to make the captures more interesting, and ultimately more edifying to students. Although, all necessary details on screen recording, audio adding, and editing the recordings can be found in [23] – it is on a presenter, here teacher/instructor, to optimally allocate the place and duration of each animated effect within the presentation, aiming to make engaging and really worth audio/video record, prepared to be shared among students, colleges, and/or wider, e.g. Web audience.

Some screencasts which present the process of capturing the screen and editing the screen captures taken over ECDIS demo version software are given below (Fig. 1-5).

Example 1: The main object of the screen shot shown in Fig. 1, along with the voice narration of the presenter, was the route creating graphically, and scheduling it by enter-

ing ETD (Estimated Time of Departure) and ETA (Estimated Time of Arrival). The process of route saving (for later reference and potential output to the autopilot), along with the possibility of deleting some of its segments, or inserting new ones has been presented. The possibility of waypoints' parameter tracking in the control panel from the route data sub-window has been explained, as well, and it is marked on the screen (Fig. 1) as an important segment of ECDIS route monitoring. Within this context of route planning it is to be pointed that the operator should control the route parameters related to the alarms and indicators, like [9]:

– Cross-track error: set the distance to either side of the track the vessel can stay before an alarm sounds. This will depend on the phase of navigation, weather and traffic;
– Safety contour: set the depth contour line which will alert the navigator that the vessel is approaching shallow water;
– Course deviation: set the number of degrees off course the vessel's heading should be allowed to stray before an alarm sounds;
– Critical point approach: set the distance before approaching each waypoint or other critical point that an alarm will sound;
– Datum: set the datum of the positioning system to the datum of the chart, if different, etc.

Because of the demo version of ECDIS by means of which the Camtasia Studio presentation features have been applied in this work, there are certain limitations in setting on the critical values of the above listed parameters by the user, though for the purpose of continuing to meet the students with the functions of ECDIS, the real ECDIS simulator should be necessarily used (e.g. Navi-Trainer Professional NTPro 4000 nautical simulator, or an advanced version).

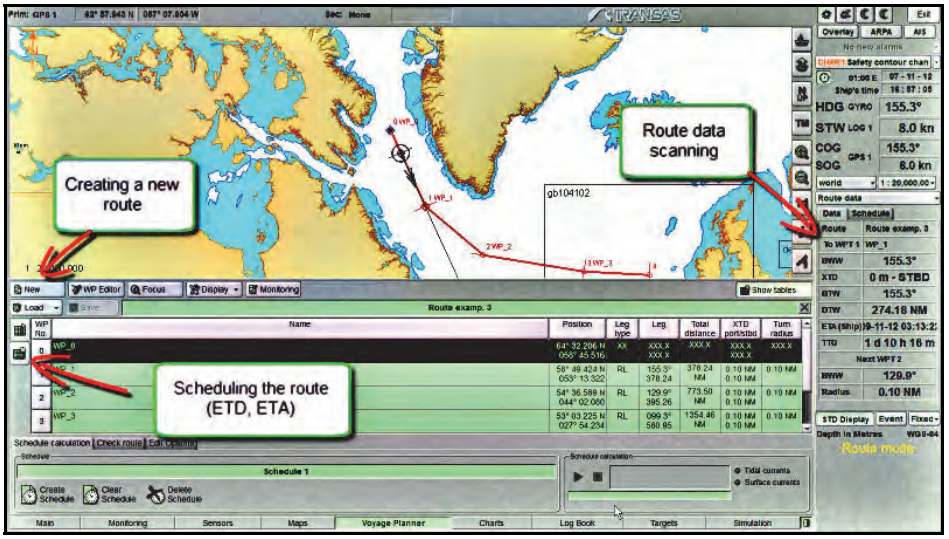


Fig. 1. Route planning procedure

Example 2: Here, the process of acquisition of the AIS (Automatic Identification System) target data (in manual, not in random mode in here employed ECDIS demo version) has been also shown in the short video presentation (Fig. 2). For the purpose of making AIS targets visible and selecting one of them, the AIS overlay command button must be

pressed in the command panel in the upper right corner of the display. In the simulation panel the random button has to be switched off and certain available AIS target is to be selected and enabled. Its position can be controlled by inserting manually its coordinates and course, or by cursor, i.e. by positioning it directly at the proper place, along with the direction onto the chart panel. These options are zoom in by zoom and pad (zoom-n-pan) Camtasia Studio tool, and marked in red by the callouts in Fig. 2.

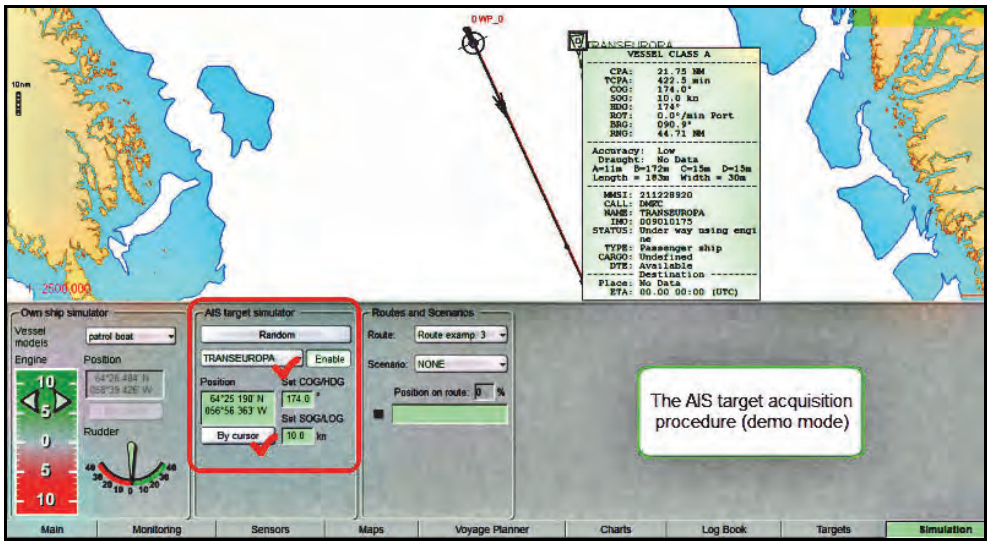


Fig. 2. AIS target acquisition

Example 3: In the Fig. 3 the imitation of the chart update procedure is outlined. The ECDIS operator has to find the available update of certain chart in Chart functional panel and to upload it into the system, i.e. to replace the old chart by the new one. The updates are marked in orange (in here used demo ECDIS version) in the new chart version, and the renewed data can be seen for each marked object in the updated chart, simply, by clicking the info button. It is to be mentioned that each vessel should have up-to-date charts for safe navigation. That is the requirement of SOLAS Convention regulationV/27. Updates can be manual or official (automatic or semiautomatic). The manual update is used for navigational warnings sent as MSI (Maritime Safety Information) by NAVTEX, or EGC (Exchange Group Call). Official updates are distributed by RENCs (Regional Electronic Navigational Chart Coordinating Center) throughout the update discs [17].

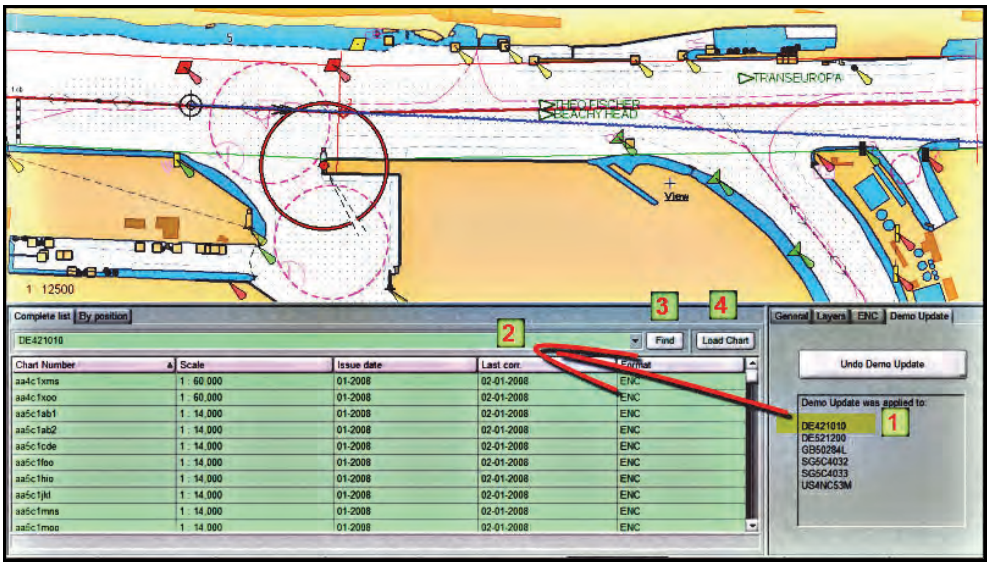


Fig. 3. Imitating charts updating procedure

Example 4: In the Fig. 4 and 5, is graphically presented the principle of checking primary (acquired by GPS) and secondary (acquired by referential object at the coast) position of the ship. Through such "picturesque" presentation it becomes clearer, i.e. more understandable to the students how they can realize this very important procedure of checking the position. Of course, the variations in manus and options are present from one to another version of ECDIS software, but the very basic idea of this common officer on watch action is similar.

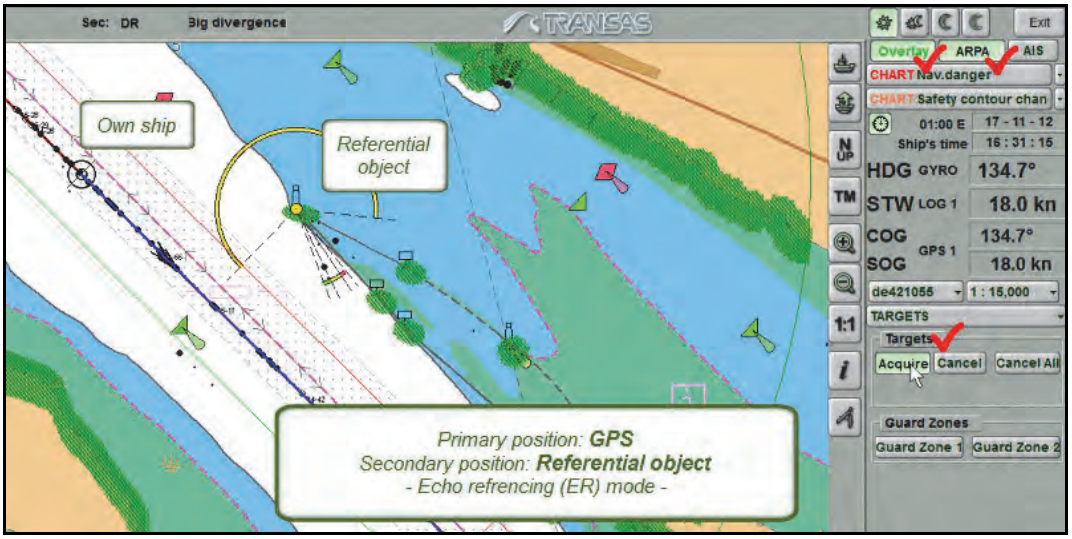
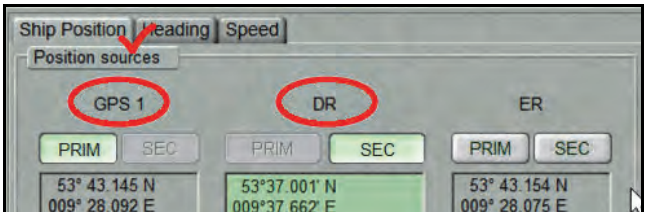


Fig. 4. Comparing primary and secondary position: GPS vs. referential object position on the coast



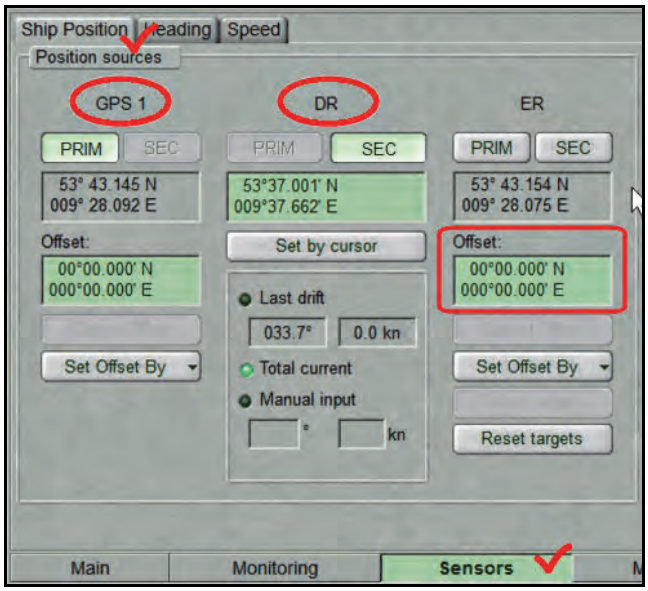


Fig. 5. Comparing primary and secondary position: offset checking

It is to be pointed out once again that by using the available preset scenarios in ECDIS Transas demo version 2.00.012 (2010) the ARPA overlay and the NAVTEX messages observing are available, as well as the possibility of imitating chart updating procedure. However, since the demo version of ECDIS is in matter, these options are available only for some preset route scenarios, but not in the free route planning mode. Of course, these and others, rather numerous restrictions, as those related to some relevant route parameters tracking (cross-track error, safety contour, course deviation, critical point approach, etc.) should be overcome by using *real* ECDIS simulator, or through underway exercise sequences on real ECDIS [14;15], as the sound and confident platforms for recording, editing, and post-producing educational/training videos by new media equipment and software tools devoted to providing more efficient knowledge transfer in this domain.

Though, such approach might be a challenge for forthcoming, more extensive and rigorous investigation work in this field. Also, instead of Camtasia Studio, some other applied software can be applied, e.g. Adobe Premiere, since it offers some advanced possibilities of video recording, editing and post-producing educational materials of higher quality.

4. Towards achieving better interactivity

The reader may get the impression that Camtasia Studio does not provide enough space to interact with the students. But still, there is a way that this lack of interactive dimension can "catch up", and that is through the creation of self-evaluation tests for students. With the intention to approach the procedural level in Camtasia Studio for creating self-evaluation tests, then it is to begin by using the options (Camtasia Studio ver.7): Tools => Quizzing ... => Add quiz ..., and then the options Move => Quizzing ..., are to be consulted. Tests may include the questions of the following types:

– Multiple choice;
– Fill in the blank; and,

– Short answer (which is not scored).

Within one quiz, or self-evaluation test all these types of questions may be included and combined in different ways, depending of the instructional material and the teacher's conceive of that how the test should be. Immediately after answering the question the students can get the score, and though check their knowledge about the topic(s). In Fig. 6 is given an example of self evaluation test (segments) with multiple choices and fill in blank options of providing answers, along with the form in which the students can see the score.

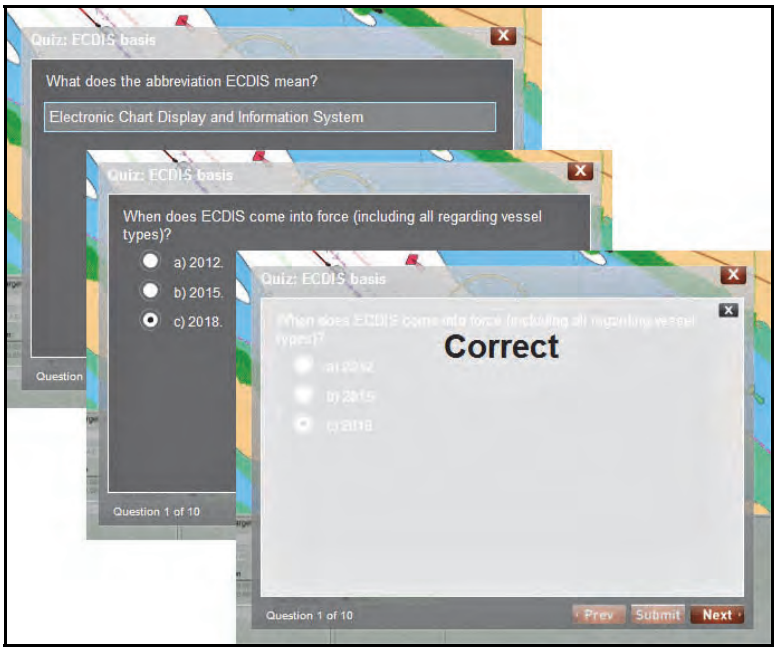


Fig. 6. An example of Camtasia Studio quiz on ECDIS basis

5. Some general recommendations

What should be treated as general recommendations for recording and editing engaging ECDIS learning captures? - Regardless of the content of the presentation, the answer is almost the same [19]. First of all, the presenter must have a good knowledge of the area which he/she presents. Additionally, he/she should be well prepared in a sense of having very clear idea about what, in what extent, and in which order it is to be said. The presentation should be clear and concise. And, the presenter should not be "in rush", at all, during the narration/explanation phase(s). Leaving some *free* or *silence* sequences is recommended, as well. The following animated effects should be of the appropriate length, and given in the appropriate amount. Students should be allowed to hear and understand what the presentation is about.

Since teaching/learning ECDIS is a very important issue, which directly touches the fully electronic integration of almost all vital navigational equipment and acquisition of the information that they provide, which ultimately implies the safety of navigation – these particularly reinforce previously given, rather general, suggestions.

6. Conclusions

The paper contains short description of ECDIS and its importance to the safe navigation, as it is previously mentioned, in terms of recalling the author's previous published papers referred in [1] and some well-known references in this field [9-17;20-22;25-31]. An emphasis is put on introducing contemporary methods and techniques into the process of learning students of maritime schools and colleges ECDIS principles and operational basis. Consequently, Camtasia Studio applied software has been recommended as a quite suitable tool by the authors, and briefly presented in order to draw the attention of teachers and instructors at METs in a manner how to make their lectures more interesting and engaging for students. The engagement of students is of crucial importance of the appropriate acquiring of the knowledge. Besides Camtasia Studio, many new technological solutions are available on the software market for educators to create a kind of alternative learning environment in which students learning should be expanded and reinforced [19]. Learning ECDIS by involving advanced media tools, such as Camtasia Studio, should be undoubtedly an interesting platform for developing more stimulating learning environment, and new active knowledge transfer (tele)channels between educators/trainers and students and/or trainees in the field of electronic navigation and in another fields, as well.

Acknowledgement

This work has been supported by JoinEU SEE Erasmus Mundus program and it has been realized at the Academy of New Media & Knowledge Transfer, Karl Franzens University of Graz, Austria.

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P.7. Concerning web based e-learning at a maritime higher education institution: Case study[9]

O web baziranom e-učenju na pomorskoj visokoobrazovnoj instituciji: Studija slučaja

Abstract: The purpose of this article is threefold. Firstly, it considers the real needs which led to the idea of conceiving and developing new study program supported by web based e-learning system (WELS) at the Faculty of Maritime Studies (University of Montenegro) as maritime higher education and training institution. In this part of the article the collaborative projects which enhanced this idea and its implementation are described briefly, as well. Secondly, the results of the polls realized among certain number of involved students, teachers, and experts in related activities, are presented and discussed in order to identify main features along with pros and cons of the WELS being here examined. And, thirdly, some empirically based suggestions when it comes to choose the appropriate software tools for creating more interesting, engaging, inciting, and thus of higher quality instructional materials being available through WELS, are given.

Key words: web based e-learning system (WELS), maritime higher education, audio, video and screen-recording software tools selection.

Apstrakt: Svrha ovog rada je trojaka. Prvo, u radu se razmatraju realne potrebe koje su dovele do ideje za osmišljavanje i razvijanje novog studijskog programa, podržanog web baziranim sistemom e-učenja (WELS - web based e-learning system, eng.), na Fakultetu za pomorstvo (Univerziteta Crne Gore), kao instituciji za obrazovanje i obuku pomoraca. U prvom dijelu rada opisani su ukratko i kolaborativni projekti koji su pomogli pri realizaciji ove ideje. Drugo, prikazani su i opisani rezultati anketeta sprovedenih među određenim brojem studenata, nastavnika i eksperata u ovoj oblasti, s ciljem identifikovanja glavnih svojstava, uključujući tu konkretne prednosti i nedostatke WELS-a. Kao treće, date su neke iskustvene smjernice u smislu, koje softverske alate bi trebalo koristiti u kreiranju zanimljivih, angažujućih, kvalitetnih instrukcionih materijala, dostupnih studentima putem WELS-a.

Ključne riječi: sistem web baziranog e-učenja (WELS), obrazovanje u pomorstvu, izbor softvera za audio, video i snimanje (računarskog) ekrana.

1. Introduction

Now-a-days numerous recognized and respectful maritime educational and/or training institutions and companies offer e-learning courses, like: Loyd's Maritime Academy, Maritime and Coastguard Agency, MPI Group, USCG Maritime Institute, etc. Of, course the list is long and should not be limited to the above given one. Also, there are a considerable number of scholars' analyses that support the concept of web based e-learning as additional mode of acquiring/transferring knowledge and skills, not only in maritime education, but in general [1;2;6;7;8;9]. However, like in the previous case, the readers should not be limited to these quotations. What supports additionally using WELS at maritime higher educational institutions is the document "The Manila amendments to the Standards of Training, Certification and Watchkeeping for Seafarers Convention and Code" (Philippines, 21-25 June 2010), which concerns, among other numerous issues: <<the introduction of modern training methodology including distance learning and web-based learning into maritime education and training>>. This strongly supports the efforts of conceiving, implementing and developing WELS at maritime higher educational and/or training institutions.

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2. Background

The Faculty of Maritime Studies of Kotor (FMS) has long lasting tradition being founded even in the medieval times, when captain Marko Martinović has his own nautical school for Russian feudal lords (in 17th century) in Perast, a little seaside town near Kotor (today Montenegro). Later on, this nautical school continues to exist in Kotor, and it still works as FMS, educating students and seamen for variety of both ship and port vacations. Also, graduated students can find employment in the agencies and firms which are focused on different maritime affairs. Although the tradition of nautical and maritime studies in general is long lasting and rich one in Kotor, and along the whole Montenegrin littoral zone, the awareness of existing new and demanding requirements of the actual world living and working flows is necessary. Above all, this awareness is unavoidable since the situation in Montenegro, in the sphere of maritime affairs, is not *flourishing* one. Accordingly, the management of the FMS recently came up to the idea of introducing web based e-learning environment for the needs of the students, especially seamen among them, and all other persons being interested in this mode of education and knowledge transfer. It is to be mentioned in this context that FMS, several years ago, was *forced* in a way to adapt the curricula to the Bologna system which recommends, among other things, presence of the students at almost all classes during the semester. Though, if the students are not present, or if they are usually absent from their classes, there is a risk that they will not pass the examinations! This is particularly case with the students who have to sail, i.e. to work as seamen to earn their salaries, and to study simultaneously. During the past few years, there were numerous requirements from their side to the FMS's management to organize for them condensed courses several times a year, or to develop and offer them e-learning educational modules. Consequently, the FMS's management decided to meet their requirements and objective needs, and to develop and implement an appropriate web based e-learning study program.

3. Perpetuators

What caused developing e-learning instructional modules at the Faculty of Maritime Studies (FMS), University of Montenegro, besides the enthusiasm of few teachers and their desire to enrich traditional channels of knowledge transfer - are three projects briefly presented below.

Project 1: The first one is the Tempus project (2010-2013): "Enhancing the quality of distance learning at Western Balkan higher education institutions" (www.dlweb.kg.ac.rs, last access: January, 2013). The objectives of this project are: to improve the quality and relevance of distance education at Western Balkan higher education institutions and to enable easier inclusion of partner country institutions into European Higher Education Area. These implies the specific objectives: to improve, develop and implement accreditation standards, guidelines and procedures for quality assurance of distance education study programs according to EU practices at national level in Western Balkan (WB) beneficiary countries; to establish the framework for improving distance learning (DL) quality assurance and e-learning methodology on higher education (HE) institutional level in WB countries; to provide training for relevant members of HE educational and public authorities responsible for accreditation and evaluation of DL programs and trainers involved in DL from each partner country, etc. The project leader is University of Kragujevac (Serbia). Owing to this large project, University's of Montenegro Center of Information System "set up" Moodle (1.94) server, what creates the opportunity for FMS to

use its capacities in preparing and realizing web based educational activities. Through this project a few teachers and assistants from FMS also had opportunities to attend short training courses being dedicated to e-learning, several times, and to participate in discussion process along with the experts from EU in this domain.

Project 2: The second is the small project of bilateral cooperation realized between FMS and the Academy for New Media and Knowledge Transfer – ANMKT (University of Graz). This project entitled: "Developing an e-learning module at Faculty of Maritime Studies (Kotor, Montenegro) for the seamen educational needs" had as its main aim: conceiving a new web based educational program at FMS devoted primarily to the seamen (among the students) needs. However, this module should be used by all other potential users, besides seamen, who are interesting in such kind of acquiring knowledge. The University of Graz supported the project by bringing in perennial expert knowledge in novel e-based didactical methods and techniques. In return developed e-learning methods and tools were tested on the basis of a concrete case study. Within this project (2011-2013) experts from ANMKT transferred very useful practical skills on the use of Moodle Management Learning System (MLS) in the effective implementation of e-learning to the teachers and system engineers of FMS throughout several trainings.

Project 3: The third important project within this context is a follow-up of the previously mentioned project of bilateral cooperation between FMS and ANMKT. This project entitled: "Distant learning implementation at the Faculty of Maritime Studies, University of Montenegro, as the additional mode of education" aims effective implementing and developing of web based e-learning at the FMS as additional mode of knowledge transfer, devoted, again, primarily to the seamen needs. ANMKT was the partner in conceiving this e-based instructional module and through this project it will support its effective implementation. In the mean time, this e-learning module has been accredited by the Montenegrin National Council for High Education, and the study program started officially in September, 2012. This e-learning module is still implemented by Moodle platform, and currently it is available at the FMS web portal: fzp.moodle.ac.me/login/index.php. The materials for some of the planned courses are uploaded at the platform, and they are currently available to the certain number of teachers and students who can test it on-line and suggest the improvements. In this second phase of the project, possibilities of enriching on-line resources by introducing audio/video/screencapturing records shall be considered, as well. The possibilities of extending this e-learning aid toward the mobile-learning one, by the Windows 7 Phone [11] and some other similar applications, for mobile devices like i-Phones, shall be considered as well. This project is approved and it will be realized within the ongoing two years period (2013-2014).

These three projects are in fact perpetrators of implementing and developing web based e-learning resources at the FMS as maritime higher education and training (MHET) institution.

4. Survey analysis

From the beginning of the WELS project implementation at FMS, several surveys among the students (e-learners) have been conducted in order to examine in a way how their perceptions of the advantages and disadvantages of WELS correspond with the creators' of this course ideas. In total, 110 students at the postgraduate level have been involved into the survey. Specifically, the interviewed students were supposed to identify the WELS advantages and disadvantages, according to their visions, among the offered

options (Table 1). What is indicative, more than 50% of the respondents agreed that the suggested advantages of WELS: A1, A2, and A3, are *indeed* benefits of WELS, as it was predicted by the creators of this system. On the other side, among the disadvantages of WELS, more than 50% of respondents identified only predefined disadvantage D2 as *real* disadvantage (Figure 1).

Table 1. The WELS advantages and disadvantages taken into consideration

Advantages	
A1:	The possibility of learning from home and working place (during the breaks)
A2:	Reducing the traveling costs and time saving
A3:	Easier access to the instructional materials
A4:	Possibility of self knowledge evaluation through on-line tests
A5:	Ability to communicate via the net with teachers and other candidates
A6:	More effective learning
Disadvantages	
D1:	Lack of *direct* contact with teachers
D2:	Inability to put a question, and get the answer immediately, when there is some ambiguity in knowledge transfer
D3:	A nonstandard form of learning that requires a strong will, self-discipline, and high level of concentration
D4:	Some exams are taken on-line, which is sometimes stressful, due to limited time, and present fear if the technique will/will not function properly

How the obtained results (Figure 1) can be interpreted? - Most of the surveyed students are still not convinced that the possibilities of self-controlling learning process, learning community activities, and more effective learning are the advantages of the WELS (A5 and A6 are lower than 50%). What does it imply? – It implies that students should be convinced into these WELS benefits, i.e. more intensive communication to the teachers and among the students themselves should be enabled, as well as more interesting and inciting self evaluation tests and educational games, etc. Consequently, the learning outcomes should be obviously higher.

If we now consider the supposed disadvantages of WELS, the e-learners do not see as big problems: on/line testing, need for a strong self motivation, and lack of direct contact to the teachers, otherwise offered through the traditional classroom teaching/learning. But, what e-learners really need is undoubtedly more frequent consultations with the teachers, in accordance to *one-to-one* principle. This conclusion directly corresponds to the recognized disadvantage D2. On the other hand, by achieving this, the WELS will give better results due to uprising learning effectiveness. Since this is only a preliminary study, it is to be extended throughout the future research activities planed by the authors, with the aim of scanning e-learners' satisfaction, and concerning the directions toward increasing the overall effects of WELS based learning process.

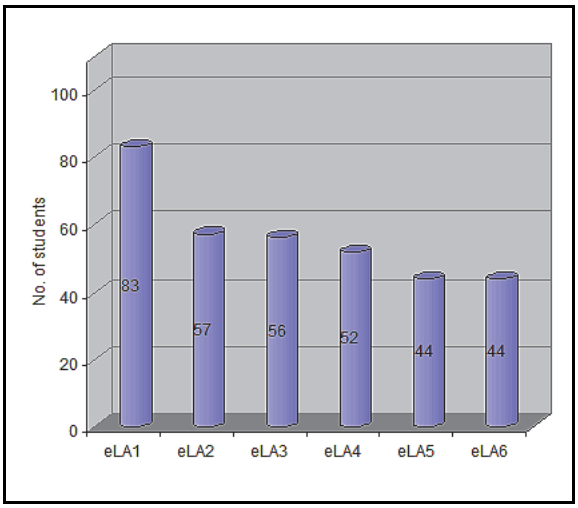

Fig. 1. Number of e-learners (students) who opted for the offered WELS advantages (ref. Table 1)

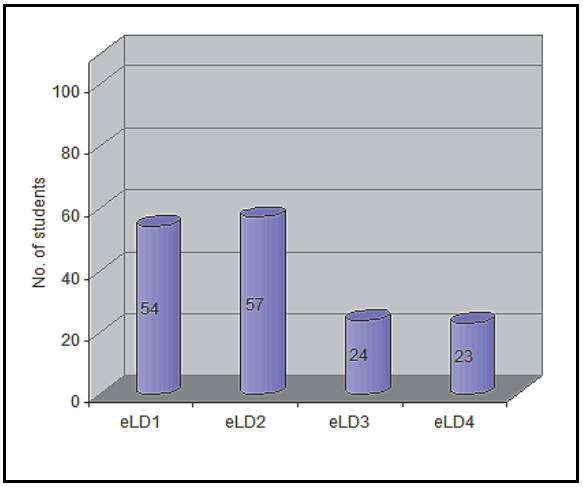

Fig. 2. Number of e-learners (students) who opted for the offered WELS disadvantages (ref. Table 1)

In order to obtain as complete as possible feedback in the current moment on the realized WELS, besides the surveys among the students of the specialist studies at the FMS, one survey is conducted among teachers at the FMS and experts in developing new IT-supported didactic methods from the ANMKT. The poll conducted among the teachers and the experts has been based on the well-known and in literature extensively used Saaty's AHP (Analytical Hierarchy Process) method and the author's previous research papers [3;5]. This approach enabled us to rank some WELS features, which have been in the context of this study identified as important ones (Table 2). The ranks are determined by the values of normalized average weight coefficients being previously calculated for each considered criteria, i.e. WELS feature. Certainly, the readers should not be limited by them in the sense that it is underlined the need for further, more extensive and rigorous research in this area.

Table 2. The rank of the analyzed WELS features by AHP approach, on the basis of the survey among experts (ANMKT) and teachers (FMS)

Features	***Rank***
- Availability on-line and high quality of all necessary materials for preparing the exam in a subject	1
- Stability and speed of the Internet connection (what is not always the case at the sea and in some ports)	2
- The existence of the tests for self evaluation of the acquired knowledge	3
- Possibility of regular communication with teachers via forum, chat and/or e-mail	4
- Possibilities of doing and evaluating tests and final exam on-line	5
- Conducting regular students' surveys	6

The obtained ranks of in the paper analyzed WELS features could be qualified in following manner:

- The teachers and the experts involved in this research assigned numerically by the largest marks, and gave consequently the greatest importance in the qualitative sense, to the availability on the web of the instructional materials (which implies their appropriateness and quality);
- In the second place, they positioned stability of Internet connection, which is understandable, since here examined WELS is devoted mostly to the seafarers. Namely, it is often not possible to establish Internet connection on the vast sea, or it is usually unstable. Another interpretation should be that the teachers and the experts consider a stable Internet connection fundamental pre-condition for WELS establishing;
- On the third position is the availability of tests for students' (here mostly seafarers') self-evaluation during the process of acquiring knowledge, what is also a very important segment of e-learning, which indirectly should involve the existence of *smart* educational games, as well;
- The fourth position is reserved here to the possibilities for the students to communicate to teachers via forum, chat, e-mail, etc, which is of course very important segment of e-learning, but it is sometimes difficult to achieve this due to the previously mentioned problems with Internet connection and its stability at the sea (and sometimes in the ports). On the other side, teachers are usually too busy, and they are practically sometimes *physically* prevented to devote more time to the communication to students; and,
- At the lowest positions are WELS technical possibilities of doing exams on-line, and conducting regular on-line (or classical) surveys among the students, related to their degree of satisfaction with offered e-learning services, respectively. This is understandable, since the Internet as an *open* communication channel is not *perfect* for testing students on-line. In addition, even surveys conducted among students are very important, in comparison with the previously considered components of e-learning they are for sure slightly less important. However, this does not mean at all that they should be ignored.

This conducted survey reflexes profoundly very subtle nuances in mutual positions of the analyzed e-learning features, and it remains us to associate them to the high degree of expertise and sensitivity of the responders in this domain [3].

Further analysis should be directed toward evaluating e-learners' satisfaction with offered WELS and this will be realized by multi-criteria evaluation technique based on Saaty's AHP [10;12;13]. Since the large number of respondents is necessary for conducting such analysis, the possibility of involving some other institutions that offer WELS is in consideration. Namely, a large number of responders is a kind of guaranty that the sur-

vey will be successful and reliable, i.e. that the largest number of responds will be consistent in accordance to the Saay's AHP method requirements.

5. Choosing the software tools for creating inciting instructional materials

If we look at the above presented ranking of the WELS features, it is evident that the availability and quality of the instructional materials are rated as the most important factors by teachers and experts in WELS. Undoubtedly, the quality of the instructional material is one of the key factors for successful implementation of WELS. Since the appropriate IS/IT solutions and tools are necessary in their creating, this part of the article offers a short overview of some available up-to-date software tools for creating interesting and engaging instructional WELS materials, along with the recommendations, based mostly on the authors' experience, which of them is the most appropriate for certain application.

Today, there is a quite large offer of different proprietary commercial and freeware application software which can be used for producing (Table 3):

- *Audio*: Audacity, NCH Wave Pod, Adobe Audition, Cubase Steinberg, Logic Studio, Kristal Audio Engine, etc.;
- *Video*: Windows Movie Maker, Adobe Premiere, Avidemux, Magix Video, Video Spin, AVIedit, etc.; and,
- *Sreencapturing*: Adobe Capticate, Capture Fox, Camtasia Studio, Jing, ActivePresenter, BB Flashback, BB Flashback Express, ScreenPresso, VirtualDub, etc.

Web can be used as a resource for further search [14;15].

Table 3. List of the software tools for post-production of e-learning teaching materials

Software / Feature	**A**	**V**	**S**	**C**	**F**
Audacity	X				X
NCH Wave Pod	X				X
Cubase Steinberg	X			X	
Logic Studio	X			X	
Kristal Audio Engine	X				X
Windows Movie Maker		X			X
Lightworks		X			X
Avidemux		X			X
Magix Video		X		X	
Adobe Premiere		X		X	
Video Spin		X			X
AVIedit		X			X
Adobe Captivate			X	X	
Camtasia Studio			X	X	
Jing			X		X
CamStudio			X		X

Legend: **A**-audio; **V**-video; **S**-screencapturing; **C**-commercial; **F**-freeware

The list above is not exhaustive as there are many more software tools on the market, proprietary commercial, as well as, freeware and shareware. Of course, there is also a difference concerning the available functions but it is definitely possible to produce up to professional results with selected freeware software.

The following recommendations can be done according to the authors' experiences:

- The open source software *Audacity* is the most powerful freeware tool for audio editing. It offers various effects and analyzing tools for the signal processing, e.g. powerful noise reduction (even adaptive noise reduction) and dynamic processing as well as

equalizing, multi-track editing for sophisticated mixes and of course supports recording from any microphone or signal source connected to the computer. Professional commercial audio editing software mainly aims at professionals like sound engineers or sound designers. These professional tools provide further interfaces to audio hardware and various 3rd party plugins for high end audio editing.

- In the field of video editing it is the freeware *Lightworks* that offers the most functions and editing tools. Even commercial movies have been cut and produced with that software but however it is not especially designed for beginners, so it requires time to get familiar with the production workflow. A more intuitive way and therefore more appropriate for beginners is the *Windows Movie Maker* (last built version is No. 12). It does support most of the latest video formats and has also build in effects to make transitions and/or color effects and animated titles. It also supports most picture formats so that the producer can combine still and moving pictures in the project. Background sound or speech can be added and mixed.
- Screenrecording tools have become very popular as it is very easy to make engaging tutorials or presentations of what is happening on the monitor. The freeware tools *Camstudio*, *Jing* and *AutoScreenrecorder* offer the general possibility to record the screen but do also include restrictions which can be watermarks, a limited time for recordings or not supported audio recordings along with the screenrecording. Also the choice of output formats is limited in freeware tools.
- Two market leaders offer a professional tool that combines the above mentioned types of recording: *Adobe Captivate*, and *Camtasia Studio*. Camtasia Studio lets the user create professional screenrecordings, you can include other media like pictures, movies or sound. The footage can be arranged in multi track layers, with additional zoom or pan effects as well as highlighting options you can increase the professional look of the production. Below are given some examples of employing Camtasia Studio (ver. 7) in teaching students ECDIS simulator basis. Though, in Figures 3, 4, and 5 are shown some examples of using callouts and zoom or pan effects in teaching students ECDIS (Electronic Chart Display and Information System) basis over Transas NAVI Sailor 4000 demo version simulator [4].

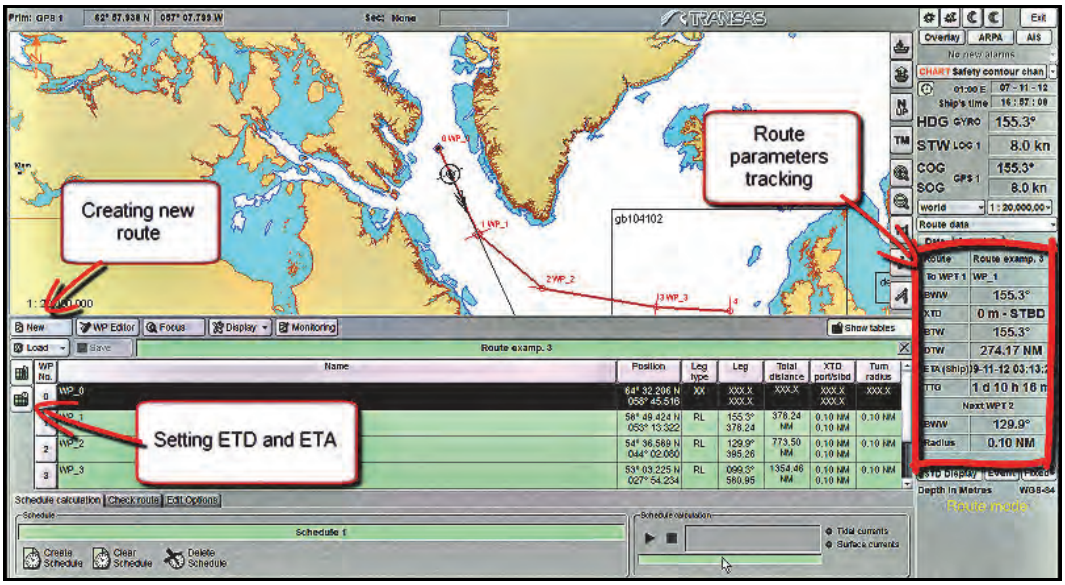

Fig. 3. Callouts for route planning and scheduling in graphical mode

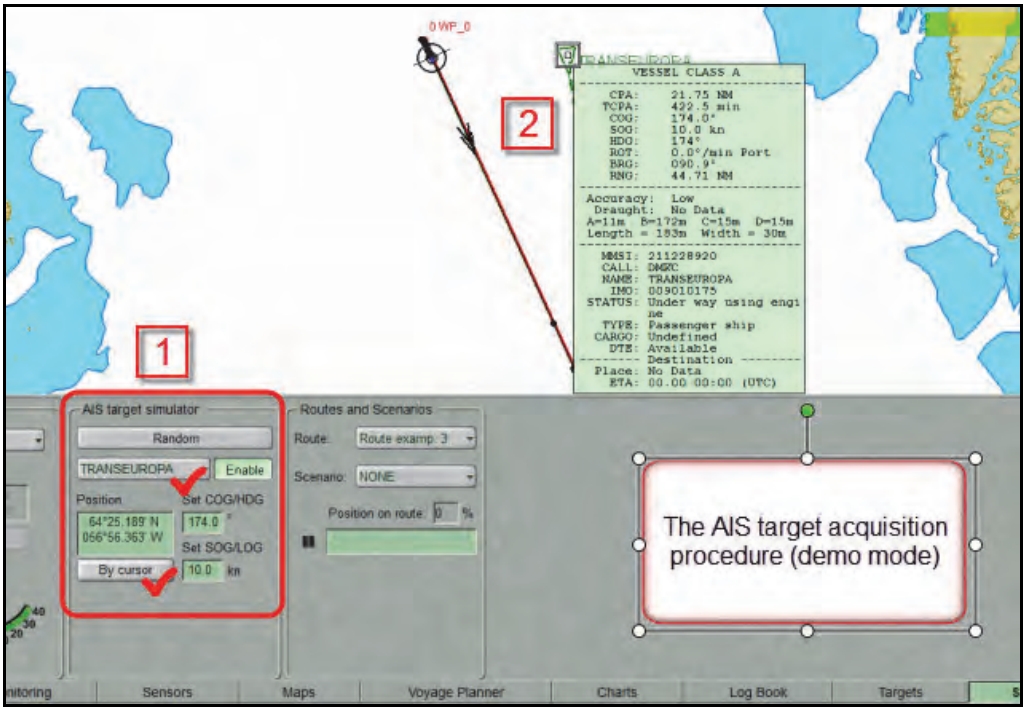

Fig. 4. Callouts and zoom-n-pan effects for explanation of AIS target acquisition

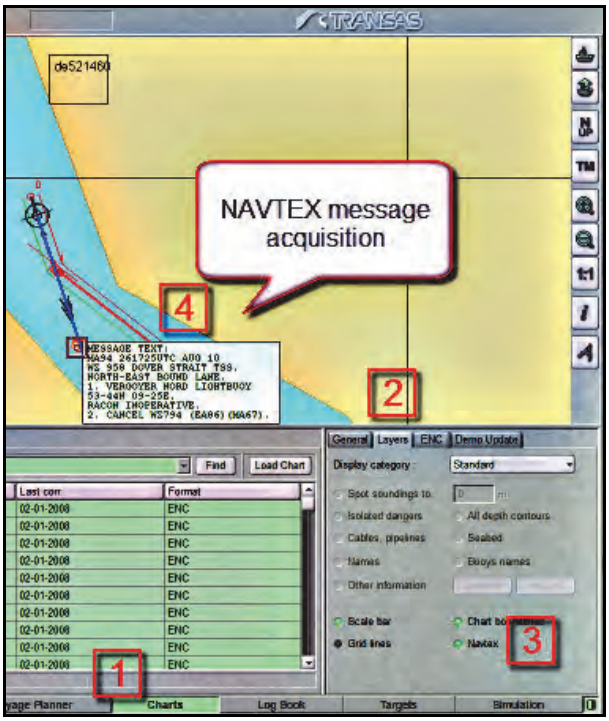

Fig. 5. Callouts and zoom-n-pan effects for explanation of NAVTEX message acquisition

6. Conclusions

All previously mentioned efforts over the introduction and development of e-learning resources at the FMS should improve the overall educational quality standards at MHETs in the Region. However, the need for greater investment in seafarers' higher education (HE) in terms of personnel and infrastructure is indisputable. The networking is also very important, and not "networking just for networking", but a real one is necessary, being based on professional cooperation (on the EU level) among the MHET institutions, through more intensive exchanges of teachers and students for the sake of mutual enrichment of knowledge and implementation of joint projects. It is necessary to establish permanent connections with the maritime industry, e.g., shipping companies interested in providing practical training onboard ships, as well. The national legislation has to be modernized in the sphere of higher education in terms of recognition and proper interpretation and implementation of the STCW (Standards of Training, Certification and Watchkeeping) requirements in terms of faster deployment of virtual learning as a supplement to the traditional education and training of the seafarers. The newest STCW Code amendments concern, and recommend: the introduction of modern training methodology including distance learning and web-based learning in seafarers' knowledge acquiring and upgrading. Within this context, it should not be lost the sight of the fact that STCW Convention itself calls for a proper education - as the foundation of successful training and acquiring competences (see for more data: "The Manila Amendments" - Chapter II, Section B-II/1, Paragraph 14, 2010). It is to be expected that at least some of these recommendations should be shortly considered and accepted by the responsible HE bodies.

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P.8. A Case Study on Introducing E-learning into Seafarers' Education[10]

Jedna studija o uvođenju e-učenja u obrazovanje pomoraca

Abstract: This paper considers beginning steps in introducing e-learning into seafarers' education, as additional mode of acquiring knowledge at the Faculty of Maritime Studies which is a part of the University of Montenegro. Related activities are the result of the enthusiasm of few professors and they are partly supported by a small, initial project of bilateral scientific and technological cooperation between Austria and Montenegro. The paper is conceived in a way that it considers following issues: (a) a brief discussion of some current shortages in maritime education and training in general; (b) possibilities of getting advantages through introducing e-learning into this respectable field of education; (c) some advantages and disadvantages of Moodle which has been used as a technological platform for introducing e-learning in the analyzed case; (d) results of the surveys conducted among involved students, teachers, and professionals in the field of employing new media techniques into the knowledge transfer, and (e) some conclusion remarks regarding possibilities of optimal combining maritime and virtual education.

Key words: seafarers' education, e-learning, surveys' analysis.

Apstract: U radu se razmatraju početni koraci u uvođenju e-učenja u obrazovanje pomoraca na Fakultetu za pomorstvo, koji je jedinica Univerziteta Crne Gore. Odnosne aktivnosti su rezultat entuzijazma nekolicine profesora i dijelom su podržane malim, inicijalnim projektima bilateralne saradnje između Austrije i Crne Gore. Rad je koncipiran tako da razmatra sljedeća pitanja: (a) neke postojeće nedostatke u obrazovanju i obuci pomoraca, uopšteno; (b) mogućnosti postizanja određenih poboljšanja putem uvođenja e-učenja u ovo područje obrazovanja; (c) prednosti i nedostatke Moodle-a kao tehnološke platforme za uvođenje e-učenja u ovdje analiziranom slučaju; (d) rezultate anketa sprovedenih među uključenim studentima, nastavnicima i profesionalcima u oblasti korišćenja novih medija u transferu znanja, i (e) neke zaključne primjedbe u smislu optimalnog kombinovanja klasičnog i virtualnog obrazovanja u pomorstvu.

Ključne riječi: obrazovanje pomoraca, e-učenje, analize anketa.

1. Introduction

The education and training of seafarers should represent very responsible posts, and consequently appreciated ones. However, it is evident that in the world, at the level of national legislation, there are large differences in the interpretation of the STCW (Standards of Training, Certification and Watchkeeping) Convention and its realization through teaching programs at MET (Maritime Education and Training) institutions [3]. This causes the issuance of a large number of certificates, which do not correspond to objectively sufficient knowledge, skills and competencies of future seamen, that is, of those who may in the perspective educate the next generations of seafarers. This is, of course, a serious problem that could be overcome only by serious top-down approach and far greater investment in education and training (i.e. wages and mobility of teachers/trainers; simulators and other supporting equipment; literature; providing training onboard ships, or so called *underway* training, etc). It is necessary to engage and motivate competent teachers in the field of theoretical teaching (education) of seafarers (people with academic titles and corresponding references) as well as experienced (active) captains and officers in the field of practical teaching (training) to establish active cooperation with referential METs in EU and worldwide, and also with successful shipping companies that should provide students with the appropriate training. All mentioned above is far beyond the scope of this paper in which the authors can only focus on one small segment related to the improvement of education of (future) seafarers based on the implementation of e-learning. So, the

[10] Bauk S., Kopp M., Avramović Z., A Case Study on Introducing E-learning into Seafarers' Education, *JITA - Journal of Information Technology and Applications*, Vol. 3, No. 1, June 2013, pp. 34-43.

following chapters contain the discussion about the motives for the introduction of blended learning at the Faculty of Maritime Studies (FMS), University of Montenegro, and the potential benefits that primarily students (active and future sailors), then teachers, and consequently, the MET at which such kind of education is realized, might have.

2. Motives for implementing e-learning

The main motive for the introduction of e-learning in the case examined in the paper were numerous seafarers' demands to enable them to have an alternative possibility of upgrading the education that goes beyond the limits of the Bologna Declaration, which has been applied at the FMS since 2006 year. Namely, the strict requirements for attendance of lectures and exercises and limited number of terms for the exams are absolutely inappropriate to the needs of active sailors, who are for a few months, half a year, or longer onboard ships but would like to, or are pressured to improve their knowledge in order to preserve their jobs and/or get career advancement. Another motive was quite natural attempt of a few professors to do something about modernizing traditional ways of teaching through the introduction of new technological solutions. What also has contributed is the fact that the FMS indirectly participated in the Tempus project: "Enhancing the quality of distance learning at Western Balkan higher education institutions" (http://www.dlweb.kg.ac.rs), since it is a part of the University of Montenegro as one of the formal partners on this project. Though, this was a big project, based on which the FMS got the possibility of using the University server by means of which Moodle system was 'set up' and a few teachers had the opportunity to attend short training courses being dedicated to e-learning several times. In addition, the FMS and the Academy for New Media in the Transfer of Knowledge – ANMKT (University of Graz), have successfully implemented a project of bilateral cooperation: "Developing an e-learning module for the educational needs" (2011-2012) and they are currently working on preparations for the realization of the second, follow-up one: "Distant learning implementation at the Faculty of Maritime Studies (University of Montenegro) as an additional mode of education" (2013-2014). Colleagues from Graz transferred very useful practical skills on the use of Moodle in the effective implementation of e-learning to the teachers and system engineers of FMS through several trainings. The results of polls conducted among students during the past (2011-2012) and this academic year (2012-2013), which are depicted and analyzed in the separate parts of this article, speak in favor of success of this collaboration.

3. Advantages and disadvantages of the used platform

In the implementation of e-learning at the FMS as an additional type of education the Moodle platform (1.9.4.) has been used [1;4;5;6;11]. The Web portal to access the on-line courses is available on the location: http://fzp.moodle.ac.me. Moodle is an open source course management system, also known as a learning management system or a virtual learning environment. It can be relatively easily used by teachers for creating online dynamic web sites for students. It is very sound tool to manage and promote learning. Some institutions use it as the platform to conduct fully online courses while some use it simply to augment "face-to-face" courses, i.e. as blended learning, what is in fact the case of the FMS as a MET institution. In other words, Moodle is used to support and combine "face-to-face" interaction with e-learning, mobile learning and other forms of learning. According to enabling mobile learning there were some plans at the FMS for implementing

Windows 7 Phone application [9] that can be viewed as a proxy for Moodle sites, simplifying and adapting user interface for mobile devices. But this currently remains only on the level of the potential future solution.

Within the following parts of the paper some advantages and disadvantages of a Moodle (1.9.4) will be listed. It is indisputable that the number of benefits is larger, but after dealing with some limitations of the used version of Moodle, in this particular case, we started work on the "raising" of the new (experimental) server with more advanced Moodle (2.3) version. However, since a lot of information on Moodle can be found on the website: https://moodle.org, so much attention will not be given to them, but to some of our personal observations and experiences related to the use of Moodle (1.9.4).

Since the currently released version of Moodle is 2.4 it has to be explained why at the FMS there is still a rather old version of the platform in use. When Moodle was installed at the FMS release 1.6 was the current version. This version was regularly updated until version 1.9.4. Since the program surface of Moodle rather changed with the release of Moodle 2.x FMS decided to stick to the older version. Mainly this is due to two reasons: 1) Teachers and students are used to the look and feel of the 1.9.x versions and it seemed problematical for them to grow accustomed to a new surface especially at an early stage of working with the platform; and/or 2) The installation of Moodle 2.x demands an enhanced technical environment which is not totally available at the FMS at the moment.

3.1. Advantages of Moodle (1.9.4.)

From the standpoint of teachers (educators) the advantages of Moodle (in comparison of not using a course management system) are numerous. First of all using electronic boards, forums and/or mail teachers can very elegantly direct students to the sites which contain meticulously prepared materials (textual, audio and video recordings) including links to the relevant Web sites, educational games, tests for self-evaluation and others. In the considered case, students are mostly sailors, who spend most of the time of the year on the ship (i.e. at the sea or in the ports located all around the world). While students use on-line educational materials available and mostly are self-taught (here we are talking about students at the postgraduate level), teachers may do the research work, or e.g. work on projects. Thus, they improve their own competence and enhance the reputation and quality of the MET institution at which they are employed. So, the benefits are undeniable manifold. From the standpoint of students, especially seafarers among them, the availability of materials and the opportunity to learn while they are on board is of up most importance. That enables them to work, learn and gain achievements in the career, in parallel. In acquiring new knowledge they can be guided by their own living and working paces because they are in a "classroom without walls" and not in a traditional one with, abstractly saying, „multiple walls“.

In using Moodle (1.9.4) platform, the possibilities of students' self-testing and playing educational games (of course, with the automatic generation of the results in both cases) are of particular importance and worth. When it comes to educational games, we used a special software package Hot Potatoes (which includes options: JCloze, JQuiz, JCross, JMatch, and JMix). More about this package can be found on the Web location: http://hotpot.uvic.ca. At the first sight, one might conclude that the last is a trivial tool, but it is in fact a very useful didactic approach, which encourages students to achieve a better result by continuously playing the game and consequently to learn more. What some of the involved students have concluded in the affirmative sense according to this

(for them new) aspect of the knowledge acquisition, readers can find out from the section in which the analysis of students' surveys are given.

3.2. Disadvantages of Moodle (1.9.4)

When the disadvantages of using Moodle, specifically of version 1.9.4., are on the board, we should say that our experience in working with mathematical expressions, lessons, wikis and the setting up of an online survey for students were not completely satisfying in the sense that we have encountered (in fact as the end users) some obstacles in the implementation of some of our ideas. That actually encouraged us to start thinking more intensively about the rapid transition to Moodle 2.3 version. What some of the involved students have noticed as shortcomings (not only for the Moodle as a platform, but in general for the whole concept of blended learning) readers also can find out in the section where the results of students' surveys are analyzed.

4. Realization of the surveys

In order to obtain a feedback on the realized program of e-learning for students of the specialist studies at the FMS we conducted several surveys. One survey was conducted among professors at the FMS and experts in developing new IT-supported didactic methods from the ANMKT. The other one was realized among students (seafarers), i.e. users of this new IT tools enriched type of education, in two different time intervals, i.e. in the academic years 2011-2012 and 2012-2013.

4.1. Survey conducted among the teachers and the experts – based on the AHP approach

The survey conducted among the teachers at the FMS and the experts from the ANMKT is based on the Saaty AHP (Analytical Hierarchy Process) method [12-18] and this approach has actually enabled us to rank some features of e-learning, which are in the framework of this study identified as important. But certainly we are not limited by them in the sense that we underline the need for further, more extensive and detail research in this area.

Namely, the idea of certain e-learning features (eFs) ranking is associated with AHP with respect to the estimates of the respondents (here professors at the FMS and professionals from ANMKT). In general, ranking is a procedure, where the most significant e-learning feature is given the highest rank and the last significant feature is given the lowest rank while the other considered features are somewhere in between these two upper and down rank boundary values.

Here, the respondents were asked to compare each pair of the criteria sets eF1-eF6 (Table 1) according to the Saaty scale by using grades: 1-same importance; 3-weakly more importance, 5-moderately more importance, 7-strongly more importance, and 9-absolutely more importance of the first than the second considered criterion; or, by the corresponding reciprocity values depending on the mutual importance of the compared elements composing the certain pair(s).

Table 1. Considered e-learning features

eFs	Features
eF_1	Stability and speed of the Internet connection (what is not always the case at the sea)
eF_2	Availability on-line of all necessary materials for preparing the exam in a subject
eF_3	The existence of the tests for self evaluation of the acquired knowledge
eF_4	Conducting regular students' surveys
eF_5	Possibility of regular communication with teachers via forum, chat and/or e-mail
eF_6	Possibility of making tests and final exam on-line

The example of the Saaty matrix created by one of the respondents (experts) for the purpose of the conducted case study and then used in determining the rank of criteria is given below:

$$\begin{bmatrix} eFs & eF_1 & eF_2 & eF_3 & eF_4 & eF_5 & eF_6 \\ eF_1 & 1 & 1 & 1 & 1 & 1 & 3 \\ eF_2 & 1 & 1 & 1 & 3 & 3 & 5 \\ eF_3 & 1 & 1 & 1 & 3 & 3 & 5 \\ eF_4 & 1 & 1/3 & 1/3 & 1 & 1/3 & 3 \\ eF_5 & 1 & 1/3 & 1/3 & 3 & 1 & 5 \\ eF_6 & 1/3 & 1/5 & 1/5 & 1/3 & 1/5 & 1 \end{bmatrix}.$$

Although, for the purpose of this research work, twenty competent persons were asked to create the Saaty matrixes, only ten of these matrixes have been taken into further consideration since they were consistent. By the normalized eigenvector values calculus [19;20], the ranks of the considered criteria eF1-eF6 (per each respondent) have been calculated (Table 2), along with the values of the largest eigenvalue λ_{max}, and the ratio of consistency index CR, while the random index RI is equal to 1.24 in all cases, since the number of criteria is constant and equal to six, in this case. It is obvious that all λ_{max} values, for each considered matrix, are less than 0.01, which is to be fulfilled in order to provide a satisfying degree of the Saaty matrix consistency (Table 3). For these calculus, the appropriate Mathematica (5.1) programs have been used [2].

Table 2. The ranks of the considered eFs assigned by each of the ten competitive respondents

eFs/Rs	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_{10}
eF_1	2	1	1	1	2	1	3	1	2	1
eF_2	1	1	1	1	1	2	1	2	1	2
eF_3	1	2	1	2	3	3	4	3	3	2
eF_4	4	5	3	5	5	5	5	4	4	3
eF_5	3	3	1	3	1	4	2	2	2	4
eF_6	5	4	2	4	4	2	6	5	5	5

Table 3. The largest eigenvalue and relative consistency index for each matrix estimated by the respondents

Rs	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_{10}
λ_{max}	6.36016	6.60484	6.03873	6.56456	6.53663	6.53540	6.54947	6.54948	6.05530	6.56732
CR	0.05809	0.09755	0.00625	0.09106	0.08655	0.08862	0.08862	0.08866	0.09766	0.09150

The results presented in Tables 2 and 3 have been realized in Mathematica (5.1) program, and the following pseudo-code is given in Table 4 [2].

Table 4. Mathematica program pseudo-code for determining eFs rank per each responder [2]

Pseudo-code 1: Off[General::spell1]
(*n=Input["Number of criteria is (n):"];*)
(*A=Table[0,{n},{n}];
For [i=1,i≤n,i++,
For [j=1,j≤n,j++,
A[[i,j]]=Input["Input Saaty matrix A ["<>ToString[i]<> ","<>ToString[i]<> "]:"];
If [A=[[i,j]]= =$ Canceled ∨ A[[i,j]]= =Null, Abort[]]]];*)
n=6;
A={{1,5,9,3,5,5},{1/5,1,7,3,3,3},{1/9,1/7,1,1/5,1/5,1/3},
{1/3,1/3,5,1,3,3},{1/5,1/3,5,1/3,1,3},{1/5,1/3,3,1/3,1/3,1}};
wn=Table[0,{n}]; wp=Table[0,{n}];
For[i=1;ws=0, i≤n,i++,wn[[i]]= $\prod_{j=1}^{n} A[[i,j]]$;wp[[i]]=wn[[i]]^(1/n);ws=ws+wp[[i]]]
w=Table[0,{n},{1}];
For[i=1;i≤n,i++,wn[[i,1]]=wp[[i]]/ws]
V=A·w; l=V/w;
$\lambda=\frac{1}{n}\sum_{i=1}^{n} l[[i,1]]$;
CI=(λ-n)/(n-1);
RI={0,0,0.58,0.9,1.12,1.24,1.32,1.41,1.45};
CR=CI/RI[[n]];
Print ["λ= ",N[λ]];
Print ["CI= ", N[CI]];
Print ["RI= ", N[RI]];
Print ["CR= ", N[CR]]; If CR≤0.1,
Print ["Saaty's matrix is consistant"],
Print ["Saaty's matrix is not consistant"].

The main point is to determine the overall rank of in the paper considered features of e-learning (Fe1-Fe6) on the basis of the individual ranks establish by Saaty matrix, i.e. given by each of the experts individually. For this purpose it is necessary to determine the weight coefficients for each of the considered eF criteria and the process of their determination follows.

The idea of evaluating above mentioned weight coefficients is associated with the sum of ranks of each criterion c_q, with respect to the estimates of respondents (1):

$$c_q = \sum_{r=1}^{10} c_{qr}, q = \overline{1,6}. \qquad (1)$$

Where,

c_q - is the sum of ranks of each criterion (eF), while q is the number of considered features (here 6), and r is number of experts, or respondents (here 10); and,

c_{qr} - is rank of the q-th criterion estimated by the r-th respondent. Now, the average weight coefficient for each criteria ($q = \overline{1,6}$) can be calculated by the following formulae (2):

$$w_q = \left[\frac{c_q}{\sum_{q=1}^{6} c_q} \right]^{-1} . \qquad (2)$$

Finally, the normalized average weight coefficients are to be calculated for each concerned criterion (3):

$$\overline{w}_q = \frac{w_q}{\sum_{q=1}^{6} w_q} . \qquad (3)$$

The overall ranking of eF_1-eF_6 criteria according to their significance, carried out by ten respondents, is demonstrated in Table 5.

Table 5. The final rank of the eF_1-eF_6 criteria formed on the basis of the respondents' questionnaires

eFs	Features	$\overline{w}_q$	Rank
eF_1	Stability and speed of the Internet connection (what is not always the case at the sea)	0.244808	**2**
eF_2	Availability on-line of all necessary materials for preparing the exam in a subject	0.282471	**1**
eF_3	The existence of the tests for self evaluation of the acquired knowledge	0.153005	**3**
eF_4	Conducting regular students' surveys	0.085398	**6**
eF_5	Possibility of regular communication with teachers via forum, chat and/or e-mail	0.146885	**4**
eF_6	Possibility of making tests and final exam on-line	0.087432	**5**

In order to examine the level of consistency of the respondents' estimates, the concordance coefficient W is to be calculated by (4):

$$W = 12S / r^2 q\left(q^2 - 1\right). \qquad (4)$$

Where,

$S = \sum_{q=1}^{6} \left(c_q - \sum_{q=1}^{6} c_q \right)^2$ - is analogue to the variance of the ranks;

r – is the number of the respondents (10); and,
q – is the number of the considered eF criteria (6).

Now, the smallest value of W, i.e. W_{min} is to be calculated by the formulae (5):

$$W_{min} = \chi^2_{\alpha,v} / r\left(q - 1\right). \qquad (5)$$

Where, $\chi^2_{\alpha,v}$ - is critical chi-square statistics, found in the table [7] by assuming the degree of freedom $v = 6 - 1 = 5$, and the significant level $\alpha = 0.010$. Here, it is $\chi^2_{\alpha,v} = 15.09$. By taking into account the previous assumptions $W_{min} = 0.3018$, while $W = 0.476571$. Since the condition $W_{min} \le W$ has been satisfied, it implies that

the estimates of the respondents are consistent, what means the previously obtained rang of criteria eF1-eF6 (Table 4) is the valid one. The previous calculi have been realized by Mathematica (5.1) program and the associated pseudo-code is given in Table 6 [2].

Table 6. Mathematica program pseudo-code for testing the consistency of the respondents' estimates [2]

Pseudo-code 2: Off[General::spell1]
n=Input["Number of criteria is(n):"];
m=Input["Number of respondents is (m):"];
Cm=Table[0,{n},{m}];
For [i=1,i≤n,i++,
For [j=1,j≤n,j++,
Cm[[i,j]]=Input["Input rank for the criterion "<>ToString[i]<> "and respondent"<>ToString[i]<>"]:"];
If [Cm=[[i,j]]= =$Canceled ∨ Cm[[i,j]]= =Null,Abort[]]]];*)
c=Table[0,{n}];

For[i=1;cs=0, i≤n,i++,c[[i]]= $\sum_{j=1}^{m} Cm[[i,j]]$;cs=cs+c[[i]]]/n

$S = \sum_{i=1}^{n} \left(c[[i]] - cs\right)^2$;

$W = \frac{12S}{m^2 n\left(n^2-1\right)}$;

$\chi^2 = Wm\left(n-1\right)$;

$\chi^2_{\alpha,v}$ =Input["Input the critical chi-square, from the statistical table: "];

$W_{min} = \frac{\chi^2_{\alpha,v}}{m\left(n-1\right)}$;

Print["S= ",S];
Print["W= ",W];
Print[" χ^2 = ", χ^2];
Print["", W_{min}];
If[W_{min} ≤W, Print["The estimates of the respondents are consistent."],
Print["The estimates of the respondents are not consistent"].

Quantified results of the survey among the experts in the field of e-learning could be qualified as follows:

- The experts involved in this research assigned numerically by the largest marks and gave consequently the greatest importance in the qualitative sense, to the availability of educational materials (which implies their appropriateness and quality).
- In the second place, the experts positioned stability of Internet connection, which is understandable, since in the paper very specific application of e-learning related primarily to the needs of seafarers has been considered. Namely, it is often not possible to establish Internet connection on the vast sea, or it is usually unstable. Another reason for the second highest rating of this parameter might be that the experts might consider a stable Internet connection as a fundamental basis for the establishment of e-learning offers.
- Experts put on the third position the availability of tests for students' (here seafarers') self-evaluation, which is also a very important segment of e-learning, which indirectly should involve the existence of *smart* educational games, as well.

- The fourth position is reserved here to the possibilities for the students to communicate with teachers via forum, chat, e-mail, etc, which is of course very important segment of e-learning, but it is sometimes difficult to achieve this due to the previously mentioned problems with Internet connection and its stability at the sea (and sometimes in the ports). On the other side, teachers are usually too busy, and they are practically sometimes *physically* prevented to devote more time for communication with students.
- On the last positions are technical possibilities of doing exams on-line, and conducting regular on-line (or classical) surveys among the students, related to their degree of satisfaction with offered e-learning services, respectively. This is understandable, since the Internet as an *open* communication channel is not *perfect* for testing students on-line. In addition, surveys conducted among students are very important, but in comparison with the previously considered components of e-learning are for sure slightly less important. However, this does not mean at all that they should be ignored.

This survey reflexes profoundly very subtle nuances in mutual positions of the analyzed e-learning features, and it remains us to associate them to the high degree of expertise and sensitivity of the interviewed experts in this field.

4.2. Survey conducted among students

The survey was implemented among the students at the FMS and it was done on a larger sample than the previous one. It is considerably simpler in terms of the content and results analysis, but not less revealing. Respondents were students from the different FMS departments and with different experiences according to their employment and the length of the navigation service. The survey was conducted in two rounds, i.e. in two different time sections: during the academic years 2011-2012 and 2012-2013.

Some of the results are presented in Table 7. Thus, the table shows the percentage of surveyed students who had opted for the offered advantages and disadvantages of e-learning. Distinctly the highest percentage of students opted for "the possibility of learning from home and working place", while for the disadvantages of e-learning the highest percentage of students opted for "lack of direct contact with teachers" (2011-2012) and "inability to interrupt the class, put a question, and get the answer immediately when there is some ambiguity in knowledge transfer" (2012-2013).

When it comes to the results of surveys conducted among students, some inconsistencies have to be noticed, as for example a quite large discrepancies in some results obtained in (2011-2012) and (2012-2013). The largest differences are observed when it comes to e-learning advantages regarding the possibilities of students' self-evaluation of acquired knowledge, and more effective learning that allows e-learning. This discrepancy inspired us to think about it, and led to the conclusion that the results obtained in (2012-2013) should be taken, however, as more reliable. The question is why? – The e-learning facilities that are offered to students this year are far more extensive and of higher quality than those of the previous year.

Table 7. The results of the students' surveys
(conducted in 2011-2012 and 2012-2013 academic years)

Academic year:		**2011-2012**	**2012-2013**
No.	**Advantages of e-learning**	„Yes" answers	„Yes" answers
1.	The possibility of learning from home and working place (during the breaks)	60.78 %	91.38 %
2.	Reducing the traveling costs and time saving	25.49 %	79.31 %
3.	Easier access to the instructional materials	27.45 %	74.14 %
4.	Possibility of self knowledge evaluation through on-line tests	13.73 %	79.31 %
5.	Ability to communicate via the net with teachers and other candidates	15.69 %	63.79 %
6.	More effective learning	13.73 %	65.52 %
No.	**Disadvantages of e-learning**	„Yes" answers	„Yes" answers
1.	Lack of direct contact with teachers	45.10 %	53.45 %
2.	Inability to "interrupt" the class, put a question, and get the answer immediately when there is some ambiguity in knowledge transfer	43.14 %	60.34 %
3.	A nonstandard form of learning that requires a strong will, self-discipline, and high level of concentration	13.73 %	31.03 %
4.	Some colloquiums are taken on-line, which is sometimes stressful, due to limited time, and present fear if the technique will/will not function properly	11.76 %	29.31 %
Number of students involved into the survey:		51	58

Additionally, some of interviewed students were using e-learning services at the FMS for two years continuously, and therefore they should be treated as more competent to judge what is important to them due e-learning and to what extent. Though, if we focus on the assessment of the students in the "second round" (2012-2013), then we should make the following conclusions:

- Due to the **benefits** of e-learning, the opportunity to learn from home or from work or at leisure time was identified as the greatest advantage. This is not really remarkable because learning anytime and anyhow is an – meanwhile well known – essential benefit of e-learning.
- The second position in terms of the students surveyed is shared by the reduction of commuting costs and the possibility of self-evaluation (either through on-line tests and different educational games). Again, reducing travelling costs and saving time is a rather obvious advantage of e-learning. More interesting is the fact that the availability of self-evaluation is very important for almost 80% of the students. This rating shows that students are very well aware of additional educational possibilities that come along with e-learning and that students are willing to use these possibilities for their own learning purposes. Moreover evaluations of the use of the Moodle courses show that self evaluations are very popular among the students especially immediately before exams.
- The third place belongs to the greater availability of educational materials than in the case of traditional teaching. This good rating is probably owed to the fact that the polled students are seafarers with a lot of travel activities who do not have the chance to spend much time in the classroom.
- In the fourth position is placed the possibility of learning more effective, which could mean that it is still in some ways easier to the students to learn if they have a teacher

"in front of them", i.e. physically present (even this conclusion should be treated as hypothetical one).

- The last place among the advantages of e-learning belongs to the ability to communicate (regularly) with teachers. How can this be explained? - Teachers are often not able to meet the requirements of the students (all their questions sent by e-mail, e.g.) and to be available though the chat and/or forum sessions. Therefore, the most likely students agreed that this possibility is not (unfortunately) of essential importance to them. This should of course be considered and corrected in the perspective.
- Due to the **disadvantages** of e-learning, students have cited the inability to directly ask the teacher what they do not understand in the learning materials as the greatest shortcoming. Thus, this greatly complicates their understanding and learning processes. Anyway, the rating is consistent with the rather poor rating of the ability to communicate with teacher as an advantage.
- In the second place, students positioned the lack of physical presence of the teacher, which is directly linked to the previous and therefore quite logical. And this can be explained as indeed the biggest and the most profound dilemma concerning traditional vice-versa e-learning.
- The necessity of students' strong will, concentration and learning self-discipline is placed in the third position. This should be fortunately interpreted in the way that most of the students fulfilled these very important preconditions of successful e-learning.
- The fourth place among the disadvantages of e-learning, students have associated to the stress caused by taking some colloquiums and tests on-line. This is logical, since most of the students are familiar with PCs and doing the tests on-line, in the technical sense, is not a big problem for them.

Within the additional survey conducted at the end of the semester of 2012-2013 the students should respond affirmatively/negatively to these three questions [10]:

- E-learning has a future in the sense that it will be increasingly used? (Answer "Yes": 100%);
- E-learning will lose its importance in the coming years? (Answer "No": 100%); and,
- Do you (personally) prefer e-learning than traditional lecture "face-to-face"? (Answer "Yes": 76%).

In the brackets next to these questions are given the percentages of surveyed students (58 of them) who responded affirmatively/negatively (depending on question). There is no doubt, according to the results of this short survey conducted among the students at the FMS, that the future learning channels shall be based on novel technical and didactical e-learning solutions.

5. Conclusions

By comparing some observations from the first part of the paper to those of the following sections, it could be concluded that it is about building *a new roof on the old and damaged walls*. And what does it really matter? – A vain job, or however something else? - We believe, it is still something else. All this effort over the introduction and development of e-learning at the FMS should be one more in a series of incentives toward improving the educational process at the MET institutions in terms of recommendations which are generally given in the introduction. Thus, the need for greater investment in seafarers' higher education in terms of personnel and infrastructure is indisputable. Addi-

tionally, the networking is very important, not just for networking, but a real one is essential, based on professional cooperation and reciprocity on the EU level and among the referential MET institutions, exchanges of teachers and students for the sake of mutual enrichment of knowledge, the launch and implementation of joint projects, etc. All of this is to be done to the extent that is feasible and before it becomes too late. Also, it is necessary to establish a connection with the maritime industry, e.g., shipping companies interested in providing practical training onboard ships. The national legislation has to be modernized in the sphere of higher education in terms of recognition and proper interpretation and implementation of the STCW Convention requirements and in terms of faster deployment of virtual learning as a supplement to the traditional education and training of the seafarers. Within this context we should not lose the sight of the fact that STCW Convention itself calls for a proper education as the foundation of successful training and acquiring competences [8]. In order to confirm this observation the quotations from the STCW Manila Amendments, Chapter II, Section B-II / 1, Paragraph 14 are given: "Scope of knowledge is implicit in the concept of competence. This includes relevant knowledge, theory, principles and cognitive skills which, to varying degrees, underpin all levels of competence. It also encompasses proficiency in what to do, how and when to do it, and why it should be done. Properly applied, this will help to ensure that a candidate can: work competently in different ships and across a range of circumstances; anticipate, prepare for and deal with contingencies; and adapt to new and changing requirements." Additionally, of importance within the context of this paper is that the newest STCW Code amendments concern and not only concern, but strongly recommend - the introduction of modern training methodology including distance learning and web-based learning in seafarers' knowledge acquiring and upgrading.

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P.9. Estimating students' satisfaction with web-based learning system in blended learning environment[11]

Procjena zadovoljstva studenata web baziranim sistemom učenja u blended okruženju

Abstract: Blended learning became the most popular educational model that universities apply for teaching and learning. This model combines online and face-to-face learning environments, in order to enhance learning with implementation of new web technologies and tools in learning process. In this paper principles of DeLone and Mclean success model for information system are applied to Kano two-dimensional model, for categorizing quality attributes related to satisfaction of students with web based learning system used in blended learning model. Survey results are obtained among the students at "Mediterranean" University in Montenegro. The (dys)functional dimensions of Kano model including Kano basic matrix for assessment of the degree of students' satisfaction level, have been considered in some more detail through corresponding numerical, graphical and statistical analysis.

Keywords: blended learning, DeLone and Mclean success model, Kano (dys)functional model, students' satisfaction.

Apstrakt: Blended učenje je postalo najafirmativniji model obrazovanja na univerzitetima, kako za potrebe predavanja, tako i u svrhe učenja. Ovaj model kombinuje on-line i face-to-face učenje, s ciljem pružanja podrške obrazovanju kroz implementaciju novih web baziranih tehnologija i alata. U ovom radu su principi DeLone i Mclean modela uspjeha za informacione sisteme, primijenjeni na Kano-ov dvodimenzionalni model za kategorizovanje atributa kvaliteta, koji se odnose na zadovoljstvo studenata web baziranim sistemom učenja u blended okruženju. Rezultati anketa su dobijeni ispitivanjem studenata na "Mediteran" Univerzitetu u Crnoj Gori. (Dis)funkcionalne dimenzije Kano modela, uključujući osnovnu Kano matricu za procjenu nivoa zadovoljstva studenata, takođe su detaljno razmotreni kroz odgovarajuće numeričke, grafičke i statističke analize.

Ključne riječi: blended učenje, DeLone i Mclean modeli uspjeha, Kano (dis)funkcionalni model, zadovoljstvo studenata.

1. Introduction

Facing many rapid changes and challenges brought by new technologies and competitive pressure, higher education institutions are trying to innovate their service and raise their public reputation concerned by their learners. Education is undergoing a dramatic transformation. Technology plays a powerful role in the life of today's students and institutions can no longer meet their needs through classroom-based instruction alone. Higher education institutions are increasingly focusing on determining the right model to integrate technologies in teaching and learning in order to fulfill students' needs and provide education and skills needed for the future society.

Blended learning is one way in which institutions can prepare themselves for the next era in education (Garrison, & Kanuka, 2004; Owston, 2013). It offers new opportunities for combining face-to-face and online teaching and learning. This includes different learning or instructional methods (lecture, discussion, guided practice, reading, games, case study, simulation), different delivery methods (live classroom or computer mediated), different scheduling (synchronous or asynchronous), and different levels of guidance (individual, instructor or expert led, or group/social learning).

There are many definitions of blended learning and yet no single accepted one. In the scope of this study we should refer blended learning to a formal education program in

[11] Bauk S., Šćepanović S., Kopp M., Estimating Students' Satisfaction with Web Based Learning System in Blended Environment, *Education Research International*, Vol. 2014, Article ID 731720, April 2014, pages 11.

which a student learns at least in part through online learning, with some elements of student control over time, place, path, and/or pace (Clayton Christensen Institute for Disruptive Innovation, 2012-2013).

Measuring student satisfaction with web based learning systems has been an important issue for the researchers and academia. At the AMCIS (Americas Conference on Information Systems) as early as 2001, e-learning was identified as one of the nine meta-tracks for information systems (IS) discipline, and multiple studies in both education and the IS literature measure student satisfaction with the online courses (Summers et al., 2005). Research shows that perceived usability, value, and quality are critical factors that affect user satisfaction with e-learning systems (Chiu et al., 2005; Seddon, 1997). However, there are insufficient studies investigating students' satisfaction with web based learning system used to support teaching and learning in blended environment. Clearly, understanding the factors influencing students' satisfaction with online component of blended learning is a critical issue. Given the role of information and system design in online customer satisfaction, McKinney et al. (2002) study has synthesized the IS research on users' satisfaction with marketing research on customer satisfaction to gain insight on web-based system satisfaction. Similarly, this study draws from both IS and marketing research to examine the factors that contribute to web-based learning systems benefits.

This research paper is organized in five sections. The first one examines literature and discuss models for IS success relating to user satisfaction. The second section gives theoretical overview of the considered problem and gives reference to the appropriate literature sources. The third and the fourth sections describe our study and the method of data analysis along with the obtained results discussion. Section five concludes the paper and presents directions for future work in this domain.

2. Theoretical background

Satisfaction of the users in the computer based and information systems is very important for developers and administrators of these systems, since the success of the computer based systems is generally associated within the users' satisfaction (Ives et al. 1983; Muylle et al., 2004). For the information systems quality and usability, there are international standards such as ISO 9241-11 which explain that information should be retrieved in a way that satisfy the standards in terms of measures of user performance and satisfaction. In the case of information technology systems, satisfaction is an outcome of a function or an interaction occurring when the results fit to expectations of a person; or it is a function of how well a product fits his requirement; or solutions within an acceptable range (Tessier et al., 1977). Satisfaction also can be defined as achieving success in the designated tasks (Beeler, 1981; Momenee, 1987).

Constructing theory and the measurement methods for user satisfaction is investigated by researchers and these efforts resulted in some models showing the components of users' satisfaction (Khalifa, & Vanessa, 2004; Applegate, 1993; Hinterhuter et al., 1997; Paechter, 2010). End-user computing satisfaction model (Doll, & Torkzadeh, 1988; Doll et al., 2004) is one of users' satisfaction models specified for information systems with five sub-categories which are: content, accuracy, format, ease of use, and timeliness. Additionally, DeLone and Mclean (2003) proposed a generic model for the information systems in order to understand the system success relating to user satisfaction with the six components: systems quality, service quality, information quality, use, user satisfaction,

and net benefits. Another analysis have been done by Ozkan and Koseler (2009) who proposed a conceptual hexagonal e-learning assessment model, suggesting a multi-dimensional approach for Learning Management System (LMS) evaluation in six dimensions: system quality, service quality, content quality, learning perspective, instructor attitudes, and supportive issues. The explanatory factor analysis conducted showed that each of the six dimensions of the proposed model had a significant effect on the learners' perceived satisfaction. Lee et al. (2009) analyzed learners' acceptance of the e-learning system throughout four independent variables: instructor characteristics, teaching materials, design of learning contents and playfulness; two belief variables: perceived usefulness and perceived ease of use; and one dependant variable: intention to use e-learning. They all confirmed several hypotheses within the researched field, but noticed that their study has certain limitations and that there is a requirement for larger, cross-cultural studies within this ever-growing area of this novel learning channel.

Considering e-learning systems as a part of information system there are also studies to measure and model the user satisfaction for e-learning system. For example, Matsatsinis et al. (2003) proposed a multi-criteria model to evaluate users' satisfaction on e-learning program using linear programming to measure a satisfaction index and to compute criteria weights. Since DeLone and McLean (D&M) developed their model of IS success, there has been much research on the topic of success as well as extensions and tests of their model. In her recent study Lee-Post (2009) interpreted the success model of DeLone and Mclean throughout an e-learning success model stating the related metrics of the model as in Fig.1.

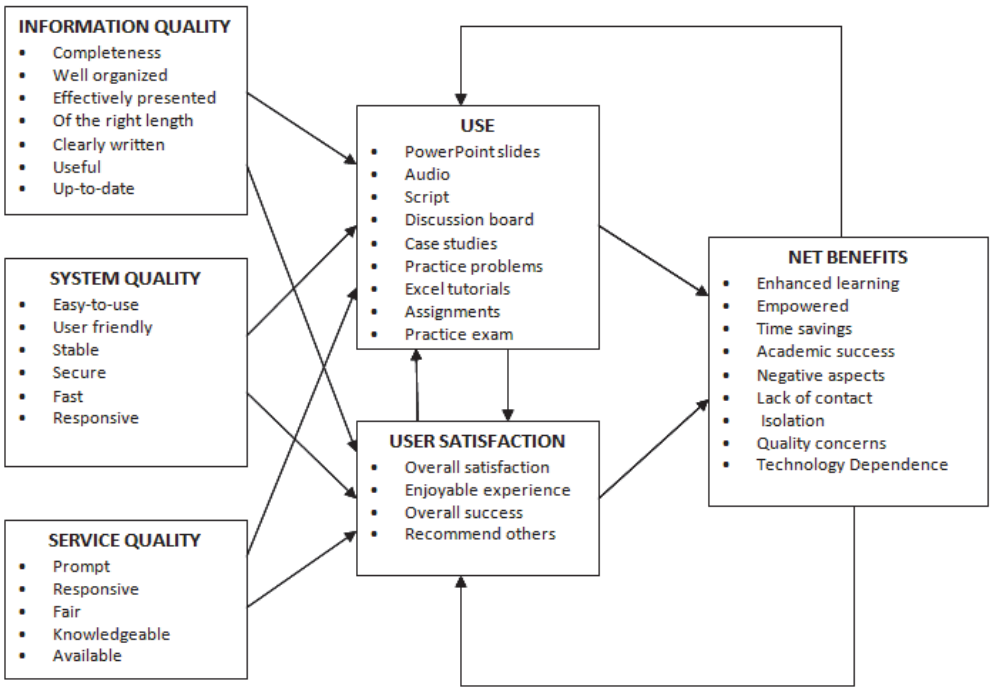

Fig. 1. DeLone and Mclean IS success model with e-learning success metrics

Extensive and valuable analyses in the domain of determining users' satisfaction with web based learning systems upon similar dimensions-category model have been done by Wang (2003) and Daniel and Wang (2008). Also, a number of studies used Kano two-way quality model to measure e-learning system satisfaction of users (Chen, & Lin, 2007). The review of Kano model previous applications in estimating e-learners satisfaction with e-learning courses/system is given in (Dominici, & Palumbo, 2013).

As in the above examples, there are research studies trying to establish a model to determine the success metrics for e-learning related with satisfaction of usage. In those models satisfaction is considered as a function of interaction between users and system or services provided via these systems. End results and outcomes fitting to user expectations and requirements are defined as the criteria of the success. There are limited research studies that clearly identify satisfaction of users with web based systems and no model showing the role of the students' satisfaction with web based system in the blended learning success models. Hence, the educational institutions and policy makers should consider in more detail students' satisfaction within this context, in order to success in their activities and operations.

3. Kano model

In the past, customer satisfaction has been perceived in one-dimensional terms: the greater the fulfillment of desired quality attributes, the higher would be customer satisfaction. However, there are some quality attributes that fulfill individual customer expectations to a great extent without necessarily implying a higher level of customer satisfaction (Matzler, & Hinterhuter, 1998). Several studies have therefore attempted to link the physical and psychological aspects of quality to see how specific attributes of a product or service actually relate to customer satisfaction or dissatisfaction, where the physical aspect is concerned with the physical state or extent of the specific attributes, and the psychological aspect is related to the customer's subjective response in terms of personal satisfaction (Schvaneveldt et al., 1991). Similarly, Kano (1984) considered two aspects of any given quality attribute: an objective aspect involving the fulfillment of quality, and a subjective aspect involving the customers' perception of satisfaction. Using this model, quality attributes are classified into six categories (first four of them are shown in Fig.2):

- *attractive quality attribute* (A): an attribute that gives satisfaction if present, but that produces no dissatisfaction if absent;
- *one-dimensional quality attribute* (O): an attribute that is positively and linearly related to customer satisfaction – that is, the greater the degree of fulfillment of the attribute, the greater the degree of customer satisfaction;
- *must-be quality attribute* (M): the presence of these product/service attributes will not increase customers' satisfaction level significantly, while their absence will cause extreme dissatisfaction;
- *indifferent quality attribute* (I): an attribute whose presence or absence does not cause any satisfaction or dissatisfaction to customers;
- *reverse quality attribute* (R): an attribute whose presence causes customer dissatisfaction, and whose absence results in customer satisfaction; and
- *questionable quality attribute* (Q): it means that is not clear weather customers expect these attributes since they gave unusable responds due to misunderstanding the questions on the survey, or making an error when filling out the questionnaire.

It is critical to identify must-be quality attributes and to meet demand for these at a minimum threshold level at least. Universities must also do their best on the one-dimensional attributes, which are typically articulated by customers as functionality they desire. The attractive quality attributes can be selected as competitive weapons to draw the attention of students, especially new ones (Bayus et al., 1997).

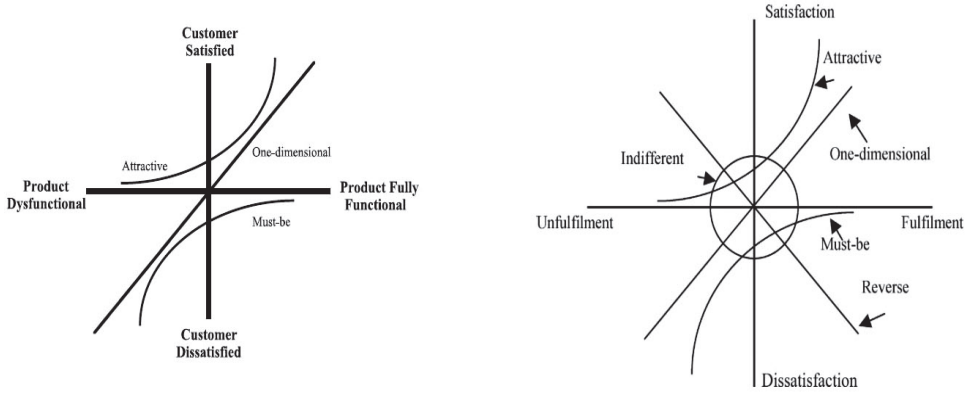

Fig. 2. Kano 2D graph with functional and dysfunctional dimensions

4. Research methodology

Within conducted study Kano model questionnaire is used to understand students' satisfaction with the web based learning system. In order to define quality attributes for Kano model, five quality components of DeLone and Mclean (D&M) model have been used (Table 1). The questions for each quality attribute of web based learning system: systems quality, service quality, information quality, use, and net benefits, have been created.

Table 1. Kano model quality attributes questionnaire defined by D&M model

Quality attribute	Kano model questionnaire
System quality	– Technical stability/reliability of the system – User-friendly interface
Service quality	– Available access to the system at any time
Information quality	– Quality/quantity of e-instructional materials
Use	– Presence of audio/video recordings (besides textual ones) – Mandatory e-test and assignments – Student self assessment possibilities – Collaborative activities – Presence/existing of e-tutor(s)
Net benefits	– Enhanced learning with combination of web based and traditional learning (blended learning model)

The responders have been asked about their mindset due to functional and dysfunctional dimension of web based e-learning system quality attribute, e.g. the offered answers in both cases, in accordance to Kano model, are: *I like it*; *It must be that way*; *I am neutral*; *I can tolerate it*; or, *I dislike it*. The respondents have to choose one of the offered options (answers) for both functional and dysfunctional dimension of the question.

Due to the chosen pairs the reviewers may get an overview of the students' satisfaction of the web based learning system quality attributes.

The population sampled was 115 students at the University "Mediterranean" (Montenegro). Among the interview results, 63 were valid, i.e. these students understood the basic principle of applied model and propositions for providing the researchers with the proper answers. More precisely, 52 students did not understand in fact that they have to give answers to the questions about both functional and dysfunctional components of a considered blended learning system features, or they were not enough motivated to do so.

The following section provides some more detail about blended learning model at University "Mediterranean" at which the described analysis has been done.

5. Blended learning at University "Mediterranean" (Montenegro)

University "Mediterranean" (UNIM) is a first private university in Montenegro established in 2006. It consists of six faculties located in tree different cities in Montenegro. A major element of UNIM's distinction relates to learning and teaching. During the early stages of the development of blended learning a plan for the utilization of learning technology at UNIM was created. The heart of the model of learning within UNIM is the method of optimal mixing ICT-based and human tuition within web based learning systems. The University has positioned itself part way from the traditional university with strong emphasis on online approaches. All of six faculties established and started to use blended learning (about 60% of courses) and core blended learning practices have been demonstrated within Faculty of Information Technology (100% of courses). In addition, UNIM participated in number of EU e-learning projects which brought important progress in the practice. UNIM is employing significant efforts to improve the quality of the teaching process in traditional and distance learning.

Across the University, students can study modules by: face-to-face tuition or using video-conferencing, both asynchronous and synchronous. Lectures and seminars are backed up by the use of a virtual learning environment (Moodle). The use of videoconferencing in particular enables small groups of students from remote locations to join together to form a single cohort for a module. This strategy enables students to undertake university study while based in their own cities.

Depending of particular subject lecturers can create different assignment types in web based systems with the support of Moodle tools for e-learning. Additionally, students can use web based learning system for discussion (forum) and communication with other students and lecturer (chat, message, e-mail) and they can create their own virtual communities of interest. This mixture of pedagogies characterizes UNIM's approach to blended learning. These pedagogies are not without challenge. This may be because cohort sizes are a disincentive for a blended approach, or because the subject requires a face-to-face experience. For example many elements of engineering or visual arts, would fall into this category, as students require physical access to facilities and equipment, or need to paint in studio.

6. Research results and analysis

In the following sub-sections are presented the results obtained by the analysis of:

- frequencies of certain Kano categories appearance in the set of responds;
- customers', here students', (dis)satisfaction indexes;

– two-dimensional (linear) graphical schemes; and
– some basic statistical parameters.

6.1. Evaluation according to the frequencies of Kano categories appearance

By analyzing the results of the survey conducted among the students who have used web based learning system in blended model at the University "Mediterranean" (Montenegro), the following has been noticed:

– The indifferent (I) category of applied Kano model has the greatest frequency of appearance among all the categories in even nine of offered ten questions! Simplified and looked though the eyes of Kano model, it means that customers, here students as e-learners, do not care about these features either way. How this could be explained? It could be realized that most of students among the responders are not interested in e-learning system, or, it was difficult for them to be "consistent" in giving answers on both functional and dysfunctional features/dimensions of the e-learning system at the same time, so the easiest for them was to be "indifferent". Or, they just want to fulfill the "form" by answering the questions, but they did not think deeply about the questions and scope of doing the interview. Anyhow, in our further analysis we have ignored the "indifferent" answers in the case of questions where they are present in the greatest number (these numbers are put in brackets in Table 2), and we focused on the second and/or third most frequent answers as rather indicative ones. As a kind of exception can be treated answers in cases Q5, Q6, Q7, and Q9 (collaborative activities; self-evaluation possibilities; mandatory exercises, tests, essays, etc., and availability of e-tutor). Namely, it has sense that students are indifferent about collaborative activities within e-learning platform, since they have a lot of another possibilities to collaborate through different social networks (Facebook, e.g.). Additionally, students are not usually aware about the importance of self-evaluation possibilities in making them learning easier and more interesting, though it can be reasonable that they do not care about this feature. But, the teachers should explain them the benefits of self-evaluation process and "convince" them in a way to treat this category as more important one. Further, students usually do not like obligations like mandatory exercises, tests, essays, etc. Therefore, this can be accepted as well as a category they estimated as irrelevant for them. And, finally, when we take into consideration the question of availability of e-tutor, then it is to be emphasized that most of the students are familiar with contemporary ICT, and though they do not have special requirements for e-tutor.
– Also the numbers of "questionable" answers were present, i.e. in three cases (Q2, Q5, and Q7), so they have been neglected (symbolically by putting into the brackets, see Table 2) and the accent were given to the next greatest numbers related to the other more relevant categories within the considered context. This can be again treated as a result of the lack of some students' understanding basic principle of the questionnaire. Hence, we have to be focused on, let's say, those answers which can be treated as more valid and relevant ones, and ignore these which do not have importance for planning an attractive e-learning systems in blended model due to learners' (reasonable) wishes/expectations. Sometimes, students are not aware what is indeed useful for them, and the obligation of e-learning systems designers, teachers and e-tutors is to

find the optimal solution(s). However, the judgments and feeling of the students should not be neglected.

Table 2. Classification of the requirements in accordance to the Kano model

Question	M	O	A	I	Q	R	Category
Q1: Technical stability/reliability of the system	**17**	10	6	(21)	5	4	Must-be
Q2: User-friendly interface	**9**	**9**	5	(23)	(12)	5	Must-be / One-dimensional
Q3: Quality/quantity of instructional materials	**13**	**13**	4	(23)	7	3	Must-be / One-dimensional
Q4: Presence of audio/video recordings	**14**	13	6	(17)	9	4	Must-be
Q5: Collaborative activities	**12**	9	4	(24*)	(12)	2	Must-be / Indifferent
Q6: Self-evaluation possibilities	10	**18**	3	(22*)	8	2	One-dimensional / Indifferent
Q7: Mandatory exercises, tests, essays, etc.	6	**10**	5	(25*)	(12)	5	One-dimensional / Indifferent
Q8: Combination of web based and traditional learning (blended learning model)	10	**15**	5	(21)	8	4	One-dimensional
Q9: Presence/existing of e-tutor(s)	10	**15**	4	(25*)	5	4	One-dimensional / Indifferent
Q10: Available access to the system at any time	14	**25**	7	8	8	1	One-dimensional

In order to explain better the meaning of marked (bold and italic) first, second, or third greatest frequency numbers among Kano categories per each question corresponding to certain e-learning system dimension/feature, it is to be recall the meaning of "must-be" and "one-dimensional" categories due to the obtained and above presented results:

- *Must-be* (M) means that customers, here e-learners, consider these requirements as basic factors; thus, their presence will not increase their satisfaction level significantly, while their absence will cause extreme dissatisfaction. In here conducted survey, after certain approximations explained above: technical stability/reliability of the web based e-learning system; presence of audio/video recordings; and, collaborative activities are within the domain of this category.
- *One-dimension* (O) means that these factors cause satisfaction if their performance is high, while they cause dissatisfaction if their performance is low. These attributes are linear and symmetric because they are typically considered customers' (here e-learners') explicit needs and desires. Within this survey and by taking into account

certain approximations: self-evaluation capacities; mandatory tests, exercises, essays, etc.; blended learning possibilities; presence/existing e-tutor(s); and, available access to the system at any time are of one-dimensional category.

Concerning the dimensions of the system: "user-friendly" and quality/quantity of the available instructional materials in a system of e-learning, it can be noticed that the frequencies of (M) and (O) are the same. Having in mind that (M) is stronger due to the hierarchical rule of category importance (i.e. M>O>A>I) (Dominici, & Palumbo, 2013), then to these attributes of the system - must-be (M) category should be assigned as more preferably one. It is important to note that such evaluation of the e-learners' responds to the questionnaire are rather fuzzy, particularly since in most of the cases the second, or even the third score in a series of frequencies, starting with the greatest one, have been considered as referral. The above results are obtained on the basis of Kano evaluation table being modified by Fred Poliot (Walden, 1993). The categories which are changed in comparison to primer Kano functional-dysfunctional matrix are marked (bold) in Table 3. In fact, Pilot changed only two values (2,2) and (4,4) replacing indifferent (I) with questionable (Q) categories in comparison to the Kano basic model. The detail logical and following graphical explanations of these two replacements are given in Walden (1993) work. Simply, the pairs of students' (here e-learners, or customers, more generally) responds, are "overlapped" over this etalon matrix (Table 3) being generated by Kano view (slightly modified), and the scores are acquired per each responder and per each question related to certain blended/e-learning system feature.

Table 3. Kano modified evaluation model with reversals

Customer requirement			**Dysfunctional**				
			1	**2**	**3**	**4**	**5**
			I like it	It must be that way	I am neutral	I can tolerate it	I dislike it
Functional	**1**	I like it	Q	A	A	A	O
	2	It must be that way	R	**Q**	I	I	M
	3	I am neutral	R	I	I	I	M
	4	I can tolerate it	R	I	I	**Q**	M
	5	I dislike it	R	R	R	R	Q
Customer requirements might be following ones:							
M: must-be O: one-dimensional A: attractive			I: indifferent Q: questionable R: reversal				

6.2. Evaluation according to customers' satisfaction indexes

Since the results of the analysis in the previous case are fuzzy, we do here an effort to "sharp" them slightly, throughout the further analysis being based upon Berger, et al. (1993) model (Dominici, & Palumbo, 2013, p. 92; Walden, 1993, p. 17). Namely, instead of concerning must-be (M), one-dimensional (O), and attractive (A) features, the responds of the customers are reduced here to two numbers: a positive number that is the relative value of meeting this customer requirement (versus the competition), and a negative number that is the relative cost of not meeting the customer requirement. These numbers are labeled as "better" (1) and "worse" (2) indexes and calculated in the following way, i.e. by equations (1) and (2):

$$\text{Better} = \frac{A + O}{A + O + M + I} \qquad (1)$$

$$\text{Worse} = -\frac{O + M}{A + O + M + I} \qquad (2)$$

Better (or, satisfaction index) indicates how much customer satisfaction is increased by providing certain feature of a system which is intended to be developed, while worse (or, dissatisfaction) indicates how much customer satisfaction is decreased by not providing the feature. More precisely, the positive better numbers are indicative of the situation where, on average, customer satisfaction will be increased by providing attractive and one-dimensional elements. The negative worse numbers are indicative of the situation where customer satisfaction will be decreased if these one-dimensional and must-be elements are not included into "ex-ante" blended/e-learning system which designers, teachers, e-tutors, etc., are intended to develop by meeting the learners' (customers') expectations.

Now, let's consider in the light of these two coefficients the results of the survey being conducted here and try to create more specified picture of the customers' expectations. The indexes better and worse are calculated and presented in Table 4.

Table 4. Satisfaction (better) and dissatisfaction (worse) indexes

The learning system requirement	"Better" index	"Worse" index
Q1: Technical stability/reliability of the system	0.296296	-0.50000
Q2: User-friendly interface	0.339623	-0.39623
Q3: Quality/quantity of instructional materials	0.357143	-0.46429
Q4: Presence of audio/video recordings	0.415094	-0.50943
Q5: Collaborative activities	0.368421	-0.42105
Q6: Self-evaluation possibilities	0.310345	-0.48276
Q7: Mandatory exercises, tests, essays, etc.	0.301887	-0.41509
Q8: Combination of e- and traditional learning	0.333333	-0.46296
Q9: Presence/existing of e-tutor(s)	0.272727	-0.45455
Q10: Available access to the system at any time	0.290909	-0.40000

By analyzing the results of the survey on the basis of previously described model, the following points can be derived due to the positive indexes:

- Presence of audio/video recordings seems very important for the customers, i.e. it implies must-be requirement. Its absence will cause consequently great dissatisfaction (the better index is the largest for Q4);
- Collaborative activities, quality/quantity of instructional materials, as well as user-friendly environment (Q5, Q3, Q2) have large better indexes what mean that their absence will also cause dissatisfaction among the users;
- To the availability of the access to the system at any time, as well as technical stability/reliability of the systems (Q10, Q1), the customers did not give high scores. This can be explained as something that they take for grand a priori. Or, in other words, it is quite normal for them that these two conditions are present, so they do not think they require special concerning. However, this statement should be taken with a certain dose of reserve; and

– Presence of e-tutor(s) is considered unimportant for the students (the smallest better index for Q9). This could be explained by the fact that students are sufficiently familiar with information systems, and that they do not need e-tutor.

Now, by taking into the consideration the negative indexes, the following can be observed:

– Absence of audio/video instructional materials causes dissatisfaction among the customers (the worse index absolutely value is the largest for Q4). This is completely in accordance to the previous statements due to this feature;
– Also, absence of e-learning system stability/reliability will imply customers' great dissatisfaction. This is logical, even it is not completely in accordance to the previous customers' judgments about this feature;
– The requirement that causes the lowest degree of dissatisfaction among users it is not providing user-friendly environment (the worse index absolutely value is the smallest for Q2). It can be concluded that its presence is convenient, but its absence will not cause excessive dissatisfaction; and,
– The levels of dissatisfaction which can be caused by the absence of the rest features are rather of equal level, what implies that their absence will not extremely affected the customers' needs.

Because of the slight fuzziness in the above (based of (dys)satisfaction indexes) and in the previous sub-section given statements (based on frequencies of categories appearances), the third assessment method, based on the graphical analysis of the survey results will be considered within the next part of the paper.

6.3. Graphical analysis of the survey results

The basic of graphical analysis implies that there are Q pairs of questions, $j = 1,\ldots,Q$, and N respondents, $i = 1,\ldots,N$. In accordance to Kano model, there may be two basic scores for each potential customer requirement being investigated: functional and dysfunctional ones. These two scores can be coded as follows (Walden, 1993):

– *Functional*: (dislake), -1 (live with), 0 (neutral), 2 (must-be), 4 (like); and
– *Dysfunctional*: (like), -1 (must-be), 0 (neutral), 2 (live with), 4 (dislake).

Since each answer of the respondents (here students) has been assigned by the appropriate numerical value it is possible to calculate average values for functional ($Y_{avg}(j)$) and dysfunctional ($X_{avg}(j)$) dimensions of the answers in a following manner, i.e. by equations (3) and (4):

$$Y_{avg}(j) = \frac{\sum_i Y_{ij}}{N} \qquad (3)$$

$$X_{avg}(j) = \frac{\sum_i X_{ij}}{N} \qquad (4)$$

These average pairs of values can be plotted on two-dimensional coordinate system with four quadrants representing key categories of Kano model: attractive, one-dimensional, indifferent, and must-be (like in Fig.2). For the purpose of this research, based on the collected students' answers, we take into consideration only must-be and like functional dimensions, and live with and dislike dysfunctional dimensions. Since neutral category implies pondering responds with zero value, it has in fact no impact on

the total score and considered average values. Questionable and reversal answers were ignored, too. Thus, all average values are in positive quadrants (between 0 and 4 per X and Y axis) and given as points in Fig.3.

On the basis of the plots in Fig.3, it is obvious that the most of average values are in indifferent quadrant, what is in correspondence with the analysis based of the greatest frequencies of appearance of certain answers. In a manner could be understandable that respondents (students) are indifferent according to the obligatory exercises, tests, essays, etc. (Q7), because they usually do not like them. Similarly, since students are commonly familiar with information and communication technologies, it sounds reasonable that they are indifferent when having available e-tutors is in question (Q9). It has also a sense that responders are indifferent toward collaborative activities existence within the system of blended/e-learning, though they have available such activities within different social networks, (Q5). And, social networks might be more comfortable in a way for collaborative activities than a conventional e-learning system, e.g.

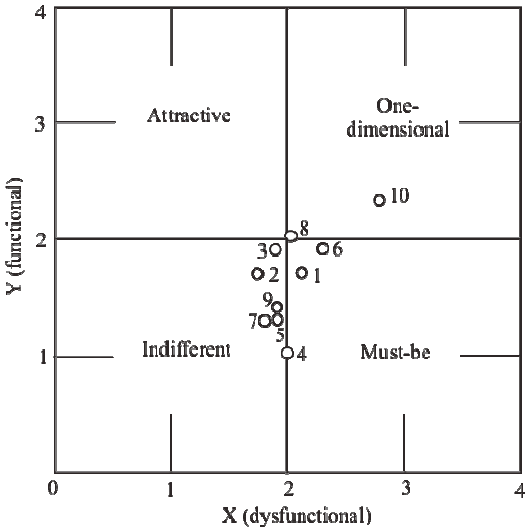

Fig. 3. Plots of average functional and dysfunctional points for the questions (Q1-Q10)

However, some interventions should be done by the evaluators and latter planers of a better system, for example: questions of optimal quality and/or quantity of available e-instructional materials (Q3) and presence of user-friendly environment (Q2) should be "shifted" into the attractive quadrant as it is symbolically shown in Fig.4 (dashed line). With better instructional materials and user-friendly environment the system will be more competitive on e-learning market within blended learning environment.

Average value which correspond to the answers on the question of presence of audio and video materials besides more traditional textual ones (Q4) is on the line between indifferent and must-be zone, and it could be more logical, from the researchers' and system creators' point of view, to move it to the must-be zone. Technical stability of the system represented by point 1 in Fig.3 is in the must-be zone what means that e-learners are more dissatisfied when the system has lower stability in technical sense; however, their satisfaction never rises above neutral no matter how functional this feature of the system becomes. Point 10 corresponding to the question of accessibility of the system at any time

(Q10) is in one-dimensional zone. This means more functionality of this feature leads to more students' satisfaction.

Points 6 and 8, which correspond to the questions of self-evaluation possibilities within the system (Q6) and blended learning features (Q8) are rather fuzzy and we consider they should be shifted to the one-dimensional zone in a future system planning in order to satisfy in greater extend users objective needs. All suggested "shifts" by the authors are given in Fig.4 (dashed lines).

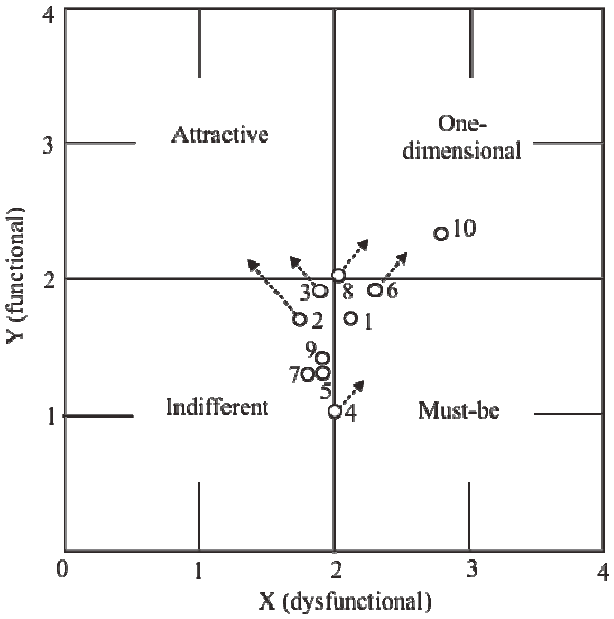

Fig. 4. Repositioning the plots of average functional and dysfunctional points for the questions (Q2, Q3, Q4, Q6, and Q8)

6.4. Some statistical refinements of the analyzed data by graphical method

In further analysis over the data set consisting of $(X_{avg}(j), Y_{avg}(j))$ pairs, where $X_{avg}(j)$ and $Y_{avg}(j)$ are calculated by expressions (3) and (4) for $j = \overline{1,10}$, following statistical values have been calculated: mean value, standard deviation or variance, covariance, correlation coefficient (Bertsekas, & Tsitsiklis, 2008; Weltner et al., 2009). The numerical values of these statistical measures are given in Table 5. Used notation is simplified and the analyzed data sets (pairs) are shown simply as X, Y and (X,Y).

Table 5. Values of some statistical indicators

Statistical measures	Values
Mean (X)	2.064
Mean (Y)	1.724
Var (X)	0.310
Var (Y)	0.341
Cov (X,Y)	0.074
Correl (X,Y)	0.779

Upon the calculated values of the statistical measures (Table 5) the following can be observed:

- If we consider the mean value for the parent population, then it is the hypothetical "true" value of the variable. This means that Mean (X) and Mean (Y) might be treated as a pair which represents "true" value of general answer to all ten considered questions within the questionnaire. Consequently, the general answer is equivalent to *must-be* category of Kano model. This has sense if we assume that questionnaire has been proposed by the experienced researcher and staff at the Universities in Montenegro, in consultations with the expert from the University of Graz. Truly, this pair is not in the lower right corner of the must-be guardant of Kano 2D graph, but it is within must-be quadrant and should be taken at the end as indicative one;
- Variations Var (X) and Var (Y), as well as covariance Cov (X,Y) are used as precalculus for determining correlation coefficient Correl (X,Y). In fact, the higher the absolute value of the correlation coefficient, the stronger the correlation.
- Relatively high value of correlation coefficient $[\text{Correl}(X,Y)] = 0.779$, or the coefficient of determination $[\text{Correl}(X,Y)]^2 = 0.607$ means that there is a strong correlation between X and Y variables. This is understandable if we concern the linguistic descriptors and corresponding numerical values for pairs of opposite (functional and dysfunctional) categories of Kano model. What makes that correlation stronger is that neutral (indifferent), questionable, and reversal responds have been excluded from the graphical analysis. In another words, $[\text{Correl}(X,Y)]^2 = 0.607$ means that more than 60% of the total variation in X can be explained by variations in Y. Or, another explanation might be that the ellipse representing correlation in this case should enclose more than 60% of the N considered points, i.e. (X_j, Y_j), $j = \overline{1,10}$ pairs on which it is based (Tailor, 1990).

Above given short analysis over the numerical values of some relevant statistical measures provides a certain refinement of the observations made upon graphical interpretation of Kano model based on plotting pairs of responders' quantified answers on both functional and dysfunctional aspects of the questions. These refinements will be better, i.e. more reliable, by introducing greater number of respondents and/or by having a greater number of questions forming the questionnaire, or by uprising the parent population in statistical terms, what should be a subject of further more extensive research.

7. Conclusions

This study aims to identify critical elements of web based learning system within blended environment using Kano (dys)functional model (Walden, 1993) and DeLone and McLean (2003) generic model for the information systems success, providing though the recommendations for creating better new teaching/learning system.

The population sampled was composed of students at University "Mediterranean" (in Montenegro). A total of 63 valid questionnaires were collected, with a response rate of 55% in comparison to the total number of interviewed students. Firstly, frequencies of each Kano model categories appearances have been measured and some approximations have been done in order to make the responds more meaningful. Also some additional analysis based on determination of "better" and "worse" indexes have been made with and aim to reduce the fuzziness in observations as much as it is possible. Some two-

dimensional graphical analyses have been realized, as well. This analysis results in "shifting" some points to other more appropriate Kano categories, or 2D graphic quadrants, due to the researchers' empirical point of view.

It is to be noted that there is a scattering among the obtained results, and that this is to be reduced throughout: repeating the questionnaire among another, considerably larger target group(s) of students, modifying the questions, and/or including some additional questions into the model.

In any case, it is to be recommended to the designers of e-learning systems in blended environment - using the combination of methods employed in this research work along with some other available analytical and/or stochastic methods for assessing degree of customers' satisfaction and their expectations of such learning systems. A holistic approach based on users' satisfaction level and the appropriate measurement analysis should give support to the designers in improving existing and designing new more attractive web based learning models in the contemporary educational blended schemes.

And finally, speaking more generally, as a powerful communications and commerce medium, the Internet is a communication and IS phenomenon that lends itself to a measurement framework (e.g. Kano and D&M models). Within the e-commerce context, the primary system users are customers or suppliers rather than internal users. Customers (students/learners) and suppliers (teachers/instructors) use the e-system for learning, but as well for buying or selling learning courses and kind of execute business transactions. These will undoubtedly impact in greater extend the whole process of learning including individual learners, universities, industries, and even national economies in the future.

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P.10. Da li obrazovanje treba izmjestiti u Klaud?[12]

Should the education be moved into the Cloud?

Apstrakt: Budući da na naslovno pitanje nije jednostavno dati jednoznačan odgovor, tekst koji slijedi treba prije prihvatiti kao eksperiment ili ogled, nego kao naučno-istraživački rad u klasičnom smislu. Sadžaj je organizovan u tri cjeline: (a) u prvom dijelu, dat je osvrt na neka iskustava autorke kao istraživača i predavača po ovom pitanju; (b) u drugom dijelu, akcenat je stavljen na digitalnu podjelu, budući da ona u velikoj mjeri utiče na ovo pitanje. Takođe, dat je pregled (potencijalnih) primjena interneta stvari, kao novog vida digitalne podjele, koji će nesumnjivo povećati disbalans između onih koji imaju i onih koji nemaju pristup savremenim ICT mogućnostima; (c) u trećem dijelu, predložen je model za prilagođavanje obrazovanja klaud okruženju u sredinama koje su, uslovno rečeno, u razvoju i koje na određeni način trpe posljedice digitalne podjele. Na poslijetku je dat kratak zaključak i neke smjernice za dalja istraživanja.

Ključne riječi: obrazovanje, digitalna podjela, model za prilagođavanje klaudu, sredine u razvoju.

Abstract: Since it is not easy to give an unambiguous answer to the title question, the text that follows should be rather accepted as an experiment or essay, than as a research work in the classical sense. The content is organized into three parts: (a) in the first part, it is given an overview of some author's experiences as a researcher and lecturer in this regard; (b) in the second one, the focus is on digital divide, since it greatly affects the issue. Also, this part of the paper provides an overview of (potential) applications of the Internet of Things as a new form of digital divide which will undoubtedly increase the imbalance between those who have and those who do not have access to modern ICT resources; (C) in the third part, it is proposed a model for adapting education to the cloud environment in the so-called developing areas, which to some extent suffer the consequences of the digital divide. After all it is given a brief conclusion along with some guidelines for future research.

Key words: education, digital divide, cloud computing adoption model, developing areas.

1. Uvod kroz prizmu ličnih iskustava

Danas je obrazovanje dobrim dijelom već izmješteno u klaud. Ali bez obzira na to, postoji još uvijek potreba za ljudskim susretom u javnom obrazovnom, odnosno, akademskom prostoru u cilju razmjene iskustava i sticanja novih (sa)znanja. Jedan primjer te vrste je i ova Konferencija.

(i) Ako pitanje: "Da li obrazovanje treba izmjestiti u klaud?", postavim sebi kao istraživaču, moram priznati da se ja već decenijama obrazujem pretežno zahvaljujući klaud resursima i to onima koji su za sada *free of charges*, ili besplatni. Drugim riječima, koristim ono što mi je dostupno. U slobodnom vremenu i dalje čitam knjige u klasičnom smislu te riječi, ali to se može smatrati hobijem. Za porebe profesonalnog usavršavanja, na neki način sam primorana da tragam po internetu za onim ono što me zanima i što mi u datim okolnostima treba. Više bih voljela da imam dostupna najnovija izdanja vodećih stručnih časopisa i knjiga, ali to nažalost nije slučaj. Tako da moram, sticajem (ne)prilika, da se snalazim u *džungli* sadržaja koje web nudi. Može se na web-u dosta toga korisnog pronaći, ako je čovjek zainteresovan i uporan, ali daleko od toga da je to, po mom sudu, idealan vid sticanja novih (sa)znanja.

(ii) Ako ovo pitanje postavim sebi kao predavaču na Pomorskom fakultetu u Kotoru, u Crnoj Gori, onda je odgovor znatno drugačiji. Naime, prije par godina sam uložila prilično vremena i truda da pripremim, snimim i prilagodim eksportovanju na internet video materijale za studente nautike. Ti materijali su se odnosili na teorijske osnove i elemente korišćenja ECDIS-a (Electronic Chart Display and Information System, eng.),

[12] Bauk S., Da li obrazovanje treba izmjestiti u Klaud? – Uvodno predavanje na 8. ITeO skupu, Panevropski Univerzitet "Apeiron", Banja Luka, B&H, 30. septembar, 2016.

kao savremenog ICT navigacionog alata, koji će najvjerovatnije u budućnosti biti primaran u kontekstu e-navigacije i pomorskog klauda. Po mojoj procjeni, ti instrukcioni video materijali su bili sadržajno i tehnički sasvim solidni. Međutim, nakon određenog vremena, broj pristupa/posjeta tim istim materijalima od strane studenta, bio je veoma mali. S druge strane, moram da kažem, da većina studenata redovno dolazi na moja predavanja i s pažnjom ih prati. Zaključujem da studenti u Kotoru više vole da čuju gotove odgovore, nego da ih sami traže, jer su prosto na takav pristup u obrazovanju navikli u osnovnoj i srednjoj školi. Niko ih nije naučio da sami postavljaju pitanja i traže odgovore. Niko ih nije zainteresovao za tako nešto.

(iii) Ako, sada, isto pitanje postavim sebi kao nekome ko je u dva navrata, po par mjeseci, učestvovao u izvođenju nastave na Lund Univerzitetu u Švedskoj, onda je odgovor negdje na sredini između ova dva prethodna. Nastavnik na Fakultetu u Lundu je uporedo i istraživač (to se podrazumijeva), putuje po svijetu, snabdijeva se knjigama u Njujorku, Berlinu, Sidneju, redovno dobija časopise koje je izabrao u svoje poštansko sanduče, čita puno, posjećuje vođeće konferencije u svijetu u svojoj oblasti, ali je na predavanjima u drugom planu. On preporuči literaturu na početku semestra, tj. nova, važna izdanja knjiga u odnosnoj oblasti po njegovoj procjeni, a onda postavlja pitanja i studenti samostalno i u grupama traže odgovore, kao i načine na koje će te odgovore što bolje i uvjerljivije predstaviti nastavniku i drugim studentima, svojim kolegama. Nastavnik je tu da ih sasluša i da svoje kritičko mišljenje, tj. da ih pohvali, ukaže na ono što je moglo biti bolje i da ponekad (oštro) kritikuje ono što smatra da nije dobro. Nakon toga studenti pišu asajmente, ili svoje radove, na temu koju sami odaberu na fonu predmeta i nastavnik ih potom ocjenjuje. U međuvremenu, dakle, u toku semestra, nastavnik održi svega 3-4 eks-katedra predavanja i organizuje 2-3 gostujuća predavanja. Gostujući predavači nisu nužno iz akademije, tj. mogu biti stručnjaci iz privrede (obično vođećih kompanija u oblasti).

Naravno, neki vid opštijeg zaključka bi se mogao izvesti tek na bazi većeg skupa individualnih iskustava ovoga tipa, a analiza bi mogla da bude bazirana na raznim vidovima obrazovanja (formalno: osnovno, srednješkolsko, dodiplomsko, postdiplomsko; neformalno; cjeloživotno i sl.) i klaud okruženju, u različitim društveno-ekonomskim i kulturološkim sredinama. Tu bi svakako trebalo uključiti mogućnosti pristupa ICT resursima, njihovo korišćenje, zdravstveno i imovinsko stanje korisnika, društveni status, starosnu dob, rod i sl. U istraživanje bi trebalo uključiti i tzv. *non-user*-e, tj. one koji svjesno odbijaju da koriste nove tehnologije.

U svijetu danas postoje tehnološki visoko razvijene zemlje (npr. zemlje Sjeverne Amerike i Kanada, neke zemlje Evrope, Japan, Australija i dr.), one koje su u ekspanzivnom (vidnom) razvoju (npr. Kina i Indija) i one koje su uslovno rečeno u razvoju ili zemlje trećeg i četvrog svijeta (npr. sub-saharska Afrika, neke zemlje Južne Amerike, neke azijske zemlje, neke zemlje Balkana i dr.). Naravno da se stepen ekonomskog i tehnološkog razvoja direktno odražava na nivo obrazovanja, kao i na nivo digitalne podjele. Radi se o jednom, u uzročno-posljedičnom smislu zatvorenom sistemu, pri čemu je potreban poseban napor da se savladaju neke barijere i naprave pozitivni iskoraci. Ne samo da postoji veliki disbalans po pitanju nivoa obrazovanja i postignuća u korišćenju ICT mogućnosti između onih u većoj i manjoj mjeri (ne)razvijenih, nego i unutar samih granica onih najrazvijenijih država u Evropi i svijetu [1].

2. Digitalna podjela: dostupnost i korišćenje ICT-a

Na Svjetskom samitu za informaciono društvo UN-a [2], iznijeto je da je globalni izazov novog milenijuma, uspostavljanje društva „u kome će svi moći da kreiraju informacije i znanje, pristupe im, koriste ih i razmjenjuju, što će omogućiti pojedincima, zajednicama i nacijama da ostvare puni potencijal u smislu promovisanja sopstvenog održivog razvoja i poboljšanja kvaliteta života.“ S druge strane, postojanje digitalnog disbalansa između i unutar država, predstavlja glavnu prepreku u ostvarivanju ICT potencijala. Digitalni disbalans, ili digitalna podjela, određuje se kao „postojanje razlika kada su u pitanju pojedinci, domaćinstva, poslovne i geografske regije, na različitim socio-ekonomskim nivoima, u mogućnosti pristupa ICT resursima i korišćenju interneta u različite svrhe.“ [3]

Bez obzira na brojne prednosti koje ICT mogu da donesu, ne dovodi sve što je vezano za njih do pozitivnih ishoda. Ideja da će ICT stvoriti jedan novi svijet neograničenih mogućnosti, oslobođen od uticaja problematičnih socio-kulturoloških aspekata: rase, starosne dobi, roda, geografskog porijekla, standarda življenja i sl., pokazala se kao utopija [4]. Dodatno, ICT su *iznevjerile* brojna obećanja koja su prvobitno dale [5;6]:

- Nisu smanjile jaz između bogatih i siromašnih. Naprotiv, preme nekim statistikama trenutno 1% svjetske populacije raspolaže sa preko 50% svjetskog bogastva;
- Sve je više sirotinjskih naselja, ili tzv. *crnih rupa* socijalno isključenih, u velikim svjetskim metropolama;
- Osim što su iznevjerile obećanje ekonomskog blagostanja, ICT su iznevjerile *green* koncep. Primjera radi, ITC uređaji su najveći potrošači energije po jedinici površine koju zauzimaju;
- Ne da je koncept *green* iznevjeren, već je iznevjeren i onaj *paperless office*. Godine, 2013. u svijetu se potrošilo 400 miliona tona papira, a procjenjuje se da će potrošnja do 2025. godine, porasti na 500 milina tona;
- Godišnje se u svijetu odlaže 20-50 miliona tona e-otpada, od čega samo oko 12% ispravno. Ostalo se transportuje ilegalno i nepropisno odlaže u zemlje trećeg i četvrog svijeta;
- Uprkos propagiranju naglog industrijskog razvoja baziranog na ICT inovativnim rješenjima, preovlađuju naučno zasnovane tvrdnje o neodrživosti savremenog načina življenja zbog sve izraženijih klimatskh promjena (povećanog obima padavina, porasta nivoa mora, ogromanih prostranstava zagađenog zemljišta, okiseljavanja okeana i dr.);
- Pored ekonomskih i ekoloških problema, ne može se zaobići ni problem kiber kriminala, koji je u porastu. Kriminalci sve češće koriste brzinu, udobnost i anonimnost interneta za širok spektar kriminalnih radnji koje ne poznaju granice, bilo fizičke, bilo virtualne i tako izazivaju ozbiljne štete;
- Umjesto propagiranog lagodnijeg života u informatičkoj eri, paradoksalno, ljudi su sve više izloženi pritisku da rade kao mašine;
- Prisutan je i problem zamjene stvarnog međuljudskog kontakta, postvarenim komunikacijama putem društvenih mreža u hiperkonektovanom društvu. Sve je više onih koji boluju od različitih vidova zavisnosti od interneta;
- U realizaciji ideje tzv. *human-centric* računarstva, tj. ICT rješenja koja čovjeka i njegove potrebe stavljaju u prvi plan, kroz razvijanje intuitivnih interfejsa sa

jednostavnom navigacijom, takođe, ima brojnih propusta koji se nastoje riješiti putem tzv. *testbeds*, eng., ili testova u konkretnim situacijama;
- Kada je u pitanju obrazovanje, bez obzira na mogućnosti pristupa brojnim i obimnim otvorenim repozitorijumima instrukcionih materijala na internetu, pitanje je da li više informacija generiše više znanja, ili naprotiv, stvara konfuziju i smanjuje jasnoću, itd.

Sa razvojem ICT, postalo je jasno, istraživačima i političarima, da pristup i korišćenje ICT resursa ne može biti univerzalan i trenutan. Tu je i nastao termin digitalne podjele. Američko Ministarstvo trgovine je digitalnu podjelu vrlo pojednostavljeno odredilo kao [7]: „podjelu između onih koji imaju pristup novim tehnologijama i onih koji ga nemaju."

2.1. Vidovi digitalne podjele

U literaturi su prisutni različiti pristupi digitalnoj podjeli. Jedan se odnosi na digitalnu podjelu prvog i drugog reda. Digitalna podjela prvog reada se vezuje za disparitet u pristupu ICT resursima, dok se ona drugog reda vezuje za razlike u modelima korišćenja novih tehnologija između pojedinaca i/ili organizacija koji već imaju pristup ICT. Na primjer, neki koriste internet samo za pretraživanje web-a ili e-mail, dok ga drugi koriste i za e-obrazovanje, kroz društvene-mreže, za apliciranje za posao, za e-bankartsvo, za potrbe e-zdravstva, itd. Istraživanja su pokazala da su ove podjele uslovljene socio-ekonomskim nejednakostima između pojedinaca, grupa i država. Oni koji su ekonomski i društveno u lošijem položaju više su izloženi digitanoj nejednakosti (npr. pojedinci sa nižim primanjima i nižim nivoom obrazovanja, oni sa posebnim potrebama, oni koji žive u ruralnim sredinama, oni koji pripadaju etničkim manjinama, žene i stariji ljudi, itd.). Takođe, ne treba izgubiti iz vida ni velike razlike u ponašanju korisnika nakon implementacije ICT rješenja. Istraživanja su pokazala u Španiji, npr., da bez obzira na prisutnost ICT infrastrukture, njeno korišćenje varira od regiona do regiona, zavisno od ličnih primanja članova ispitivanih domaćinstava, nivoa njihovog obrazovanja i starosne dobi [8]. Neka istraživanja su pokazala da postoje velike razlike u pogledu korišćenja ICT-a kod djece bez i sa poremećajem u učenju, npr., na Tajvanu [9]. U radu [10], pokazano je da različiti vidovi disbalansa zahtijevaju različit pristup: nejednakosti u pristupu mogu se prevazići subvencioniranjem novih tehnologija, s obzirom da je njihov nedostatak uglavnom uslovljen ekonomskim ograničenjima koja dovode do restrikcija u pristupu; dok nejednakosti u korišćenju zavise uglavnom od sposobnosti i osviješćenosti korisnika u ovom pogledu, gdje se obrazovanje i obučenost za korišćenje ICT smatraju ključnim faktorima.

Postoji i drugi pristup digitalnoj podjeli koji razlikuje: prvi, drugi i treći talas digitalne podjele [5;11]. Prvi talas se vezuje za dostupnost i korišćenje mobilne telefonije, drugi za dostupnost i korišćenje interneta, dok se treći odnosi na razvoj i primjenu koncepta interneta stvari i pametnih okruženja.

Prvi talas digitalne podjele vezan za dostupnost mobilnih telefona, maker na nivou brojki, može se smatrati savladanim. Naime, 2005. godine procenat broja mobilnih telefona u odnosu na broj stanovnika u razvijenim zemljama svijeta je bio 82%, a u onim manje razvijenim, ili nerazvijenim, oko 23%. Godine 2015., ovaj procentualni odnos se znatno izmijenio: u razvijenim zemljama iznosio je 121%, a u onim drugim 92%. Naravno, ostaje otvoreno pitanje u koje svrhe i sa kakvim krajnjim ishodom se koriste mobilni telefoni, ali u svakom slučaju, barem na nivou brojki, prvi veliki talas digitalne podjele je prevaziđen.

Drugi talas digitalne podjele, koji se vezuje za mogućnost pristupa internetu, još uvijek nije prevaziđen. Prema nekim procjenama, 2015. godine, 3 biliona ljudi u svijetu je imalo pristup internetu, od toga 76% stanovništva u razvijenim djelovima svijeta, a svega 30% u nerazvijenim (Tabela 1). Više od polovine svjetske populacije, dakle, još uvijek nema pristup internetu (oko 4,2 milijarde ljudi) prema UN podacima [12]. Prema procjenama iz istog izvora, trebalo bi oko 450 milijardi $ da se za 1,5 milijardi ljudi obezbijedi pristup internetu do 2020. godine. Kako bi se ovaj proces ubrzao, preporučuje se korišćenje „white-fi" spektra, jednovremeno postavljanje više optičkih kablova na istim lokacijama, kao i razvoj sadržaja koji su po mjeri potencijalnih korisnika u određenim geografskim regijama.

Tabela 1. Prvi i drugi talas digitalne podjele: procentualni pokazatelji dostupnosti po stanovniku (izvor: web)

Godina	2005.		2015.	
Korisnici	Zemlje u razvoju	Razvijene zemlje	Zemlje u razvoju	Razvijene zemlje
Prvi talas dig. pod. - Mobilna telefonija	23%	82%	92%	121%
Drugi talas dig. pod. - Internet	8%	51%	30%	76%

Iako drugi talas digitalne podjele još uvijek nije savladan, treći vezan za implementaciju interneta stvari (IoT – Internet of Things, eng.) već uveliko nadolazi.

U poglavlju koje slijedi dat je pregled i kratak opis (potencijalnih) primjena interneta stvari u idustriji, zdravstvu i pametnim gradovima, budući da će ovaj novi tehnološki koncept umnogome uticati na promjenu načina življenja i otvoriti nove mogućnosti i u domenu obrazovanja, makar kada su u pitanju razvijeni djelovi svijeta.

2.2. Internet stvari kao novi talas digitalne podjele

Internet stvari (IoT) omogućuje veliki broj industrijskih i korisničkih aplikacija. Dok uređaji i mreže obezbjeđuju fizičku povezanost, IoT aplikacije omogućuju komunikacije na relacijama uređaj-uređaj, ili čovjek-uređaj, na pouzdan i robustan način. Uređaj-uređaj aplikacije obično ne zahtijevaju vizualizaciju, dok sve više IoT aplikacija koje uključuju čovjeka, kao krajnjeg korisnika, obezbjeđuju vizualizaciju za prikazivanje informacija na intuitivan način. Za IoT aplikacije je bitno da budu *inteligentne*, tako da uređaji mogu da snimaju okruženje, komuniciraju jedni sa drugima, identifikuju i rješavaju određene probleme bez neophodne intervencije čovjeka.

Prema Cisco Visual Networking Index-u iz 2015. godine, preko 10,5 biliona mašina-mašina (M2M - Machine-to-Machine, eng.) uređaja, koji međusobno komuniciriju i izvršavaju akcije bez posredstva čovjeka, je bilo umreženo. Kako na nivou brojki stvari stoje u ovom pogledu u pojedinim dijelovima svijeta, prikazano je u Tabeli 2.

Tabela 2. Treći talas digitalne podjele: broj M2M uređaja po stanovniku (izvori: [5;11])

Dio svijeta / Godina	2014.	aproks. 2019.
SAD	6,1	11,6
Zapadna Evropa	4,4	8,2
Latinska Amerika	2,0	2,9
Srednja i Istočna Afrika	1,0	1,4

2.2.1. Internet stvari u industriji

Logistika i kontrola kvaliteta proizvoda. Važna industrijska primjena koncepta IoT je u domenu logistike i lanaca snabdijevanja. RFID (Radio Frequency Identification, eng.) tagovi i/ili senzori se pridružuju objektima i koriste se za identifikaciju proizvoda (odjevnih predmeta, namještaja, razne opreme, prehrambenih proizvoda i dr.). Korišćenje tagovanih objekata povećava efikasnost upravljanja skladištenjem i prodajom, pojednostavljuje inventarisanje, tako što daje tačne podatke o stanju na zalihama u realnom vremenu i sl. Takođe, moguće je automatski pratiti čitav „životni“ ciklus proizvoda. Ovdje treba pomenuti i mogućnost korišćenja naprednog koncepta *pametnih* rafova, koji smanjuju mogućnost materijalnih gubitka, a isto tako automatski generišu informacije o količini raspoložive robe. Interesantan je podatak da se prodaja smanjuje za oko 10% ako se rafovi samo djelimično isprazne [5], što dodatno ukazuje na značaj ove IoT mogućnosti. Korišćenjem senzora moguće je u realnom vremenu otkriti oštećenja lako kvarljive robe (npr. voća, povrća, smrznute hrane i sl.). Senzori snimaju kontinuirano temperaturu i vlažnost unutar hladnjača, a aktuatori ih modifikuju, kako bi se obezbijedilo očuvanje namirnica. Dodatno, integritet proizvoda može se obezbijediti korišćenjem procesa RFID autentifikacije, itd.

Zanimljiva IoT aplikacija je i inteligentni sistem za kupovinu. Ovaj sistem snima navike potrošača, praćenjem nabavki preko mobilnog telefona, pa kasnije vodi kupce kroz zabavne parkove, prodavnice, supermatkete i/ili molove, sugerišući im kupovinu proivoda koji su na popust (npr. Disney’s MagicBand, Kroger's, Macy's shopBeacons ili iBeacons i dr.) i omogućuje brzo plaćanje, odnosno, automatsko čekiranje posredstvom očitavanja biometrijskih podataka.

Poljoprivreda. IoT se može koristiti u stočarstvu i agronomiji. Kontrola poljoprivrednih proizvoda i stočne hrane korišćenjem naprednih senzorskih sistema (npr. utvrđivanje prisustva GMO, aditiva, melanina, itd.), spada u tehnologije u razvoju. U domenu poljoprivrede treba spomenuti i napredne IoT aplikacije koje ubrzavaju proces upravljanja registracijom, prenamjenom, ili zatvaranjem poljoprivrednih gazdinstava (farmi), kontrolu njihovog rada i izdavanje odgovarajućih sanitarnih sertifikata. Korišćenjem IoT-a, poljoprivredni proizvođači mogu da skrate lanac snabdijevanja, uspostavljanjem direktne veze otvaranjem tzv. „prozora za javnost“ (publicity windows, eng.) gdje mogu da prikažu svoje proizvode, koje kupci potom naručuju putem računara ili mobilnih telefona.

Industrijski procesi. IoT daje napredna rješenja za automobilsku industriju (npr. BMW, Tesla Motors i dr.). Dijagnostika kvarova u realnom vremenu je ključna aplikacija. Gotovo svi važni parametri se mogu kontrolisati putem posebnih senzora: pritisak u gumama, stanje motora, potrošnja goriva, lokacija, brzina, udaljenost od drugih vozila, vrijeme vožnje i sl. Snimljeni podaci se šalju kontrolnom centru. Takođe je moguća dinamična optimizacija rute do cilja, u zavisnosti od trenutnih uslova na putu. Moguće je, takođe, automatski parkirati automobil. U pametnim automobilima, postoje pametne igre za interakciju sa pametnim okruženjem. Postoje i samohodna vozila (bez vozača), npr. Google's *self-driving car*s, eng. Pretpostavlja se da će do 2020. godine, 250 000 vozila biti konektovano na Internet. Dodatno, korišćenjem kombinacije RFID-a, GPS-a, senzora i odgovarajućih softvera, u IoT kontekstu, moguće je pratiti opasne terete u transportu (npr. kontrolisati temperaturu plutonijuma unutar posebnih kontejnera i dr.).

2.2.2. Internet stvari u zdravstvu

Medicina i briga o zdravlju. Medicina i briga o zdravlju će biti pod velikim uticajem IoT. Napredni senzorski uređaji već danas omogućuju praćenje u realnom vremenu medicinskih parametara i vitalnih funkcija pacijenata (npr. tjelesne temperature, krvnog pritiska, rada srca, akceleracije, položaja tijela, nivoa glukoze, holesterola i dr.). Prikupljeni podaci se emituju posredstvom standardnih ili posebnih komunikacionih tehnologija (npr. Bluetooth, ZigBee, WirelessHart, ISA100, itd.) medicinskom osoblju na dijagnostikovanje i kontrolu zdravlja pacijenta. Bežične mreže u opsegu ljudskog tijela (BANs - Body Area Networks, eng.) formirane od nosivih, neintruzivnih senzora, u sadejstvu sa odgovarajućim pristupnim tačkama, omogućuju ljekarima da kontinuirano prate pacijente van bolnice. Druga važna aplikacija je vezana za identifikovanje i praćenje medicinske opreme i materijala. Npr., korišćenje pametnih labela na medicinskoj opremi sprječava gubitak, ili zaboravljanje materijala (npr. gaze) u tijelu pacijenta tokom operacije. Nadalje, efikasni sistemi upravljanja bolnicama uključuju optimalno korišćenje energije i kontrolu klime (HVAC - Heat Ventilation and Air Conditioning, eng.). U ovom kontekstu važno je pomenuti i kontrolu pristupa bolnici i pojedinim odjeljenjima, putem aktivnih RFID bedževa (narukvica) i fiksnih čitača postavljenih na ključnim pozicijama. Takođe, prisutno je nastojanje da bolnički kreveti budu opremljeni *screentouch*, eng., terminalima za zabavu, koji će omogućavati pristup TV-u, Internetu; uspostavljane komunikacije sa porodicom i sl. Pacijentima školskog uzrasta i studentima, biće na ovaj način omogućeno praćenje on-line nastave i dr.

Samostalan život osoba sa posebnim potrebama. IoT može takođe da poboljša kvalitet života starih osoba i osoba sa invaliditetom. Praćenje zdravstvenog stanja i emuliranje medicinskih konsultacija kod kuće su dvije osnovne aplikacije. Snimanjem fizioloških signala u realnom vremenu posredstvom odgovarajućih senzora, sistem je u stanju da uključi alarm u slučaju: da dođe do pada osobe; da je potrebna hospitalizacija; da je dijagnostikovana demencija (npr. parkisonova ili alchajmerova bolest) u najranijem stadijumu i dr. Pod pretpostavkom da se stariji ljudi obično slabije kreću, IoT im može omogućiti uključivanje u razne socijalne mreže, učestvovanje u debatama i/ili diskusionim grupama i sl. (tzv. e-inkluzija). IoT može da pruži pomoć starijim osobama i/ili osobama sa invaliditetom prilikom kretanja po gradu i korišćenja javnog prevoza. Kombinovanjem podataka prikupljenih putem mobilnog telefona (pozicije, orjentacije, prepreka i dr.) i senzora postavljenih u okruženju, posebni sistemi bazirani na vještačkoj inteligenciji mogu da rekonstruišu percepciju okruženja i potom sintetičkim glasom daju instrukcije osobi kako da se kreće ili reaguje u određenoj situaciji. Ovakvi sistemi mogu biti od pomoći i slabovidim osobama.

Usluge vezane za poboljšanje kvaliteta života. One se odnose na snimanje navika korisnika i davanje odgovarajućih savjeta. Pozitivne povratne informacije o količini potrošenih kalorija tokom šetnje, mogu da djeluju podsticajno, u smislu da motivišu pacijente da upražnjavaju svakog dana ovu ili neku drugu aktivnost. Takođe, postoji težnja da se odredi korelacija između individualnog ponašanja i uticaja koje ono ima na životnu sredinu.

2.2.3. Internet stvari u pametnim gradovima

Internet stvari treba da transformiše tradicionalni grad u *pametan*. Mreže senzora, kamera, ekrana, zvučnika i sl. - sakupljaju informacije, a potom ih operativna platforma procesuira i prilagođava različitim uslugama/infrastrukturama u gradu. Npr. senzori na

vozilima, ili u mobilnim telefonima putnika, sakupljaju informacije na putevima (intenzitet saobraćaja, uslove na putu i sl.) i prosleđuju ih kontrolnom centru. Pametan sistem parkinga može da navodi vozača do slobodnog parking mjesta, čime se postižu uštede u vremenu i gorivu, uz smanjuje emisije štetnih gasova. Senzori na parkinzima, takođe mogu da posluže gradskoj upravi da identifikuje nepropisno parkiranje (na primjer na mjestima za osobe sa posebnim potrebama) i pošalje pauk vozilo da ukloni nepropisno parkirano vozilo. Nadalje, sistem plaćanja postaje jednostavniji i brži. Umjesto korišćenja kovanica, vozači mogu da koriste NFC (Near Field Communication, eng.) tehnologiju i da plaćaju putem mobilnih telefona. Slično, sistem RFID kartica i čitača se koristi za naplatu putarine na autoputevima. Ovdje treba pomenuti i mogućnosti pametnih usluga kada je u pitanju animiranje turista. Uz pomoć posebnih aplikacija za mobilne telefone, turisti se mogu upoznati sa glavnim obilježjima i istorijom grada i sl.

Pametne mreže. Intenzivnije korišćenje obnovljivih izvora energije uslovilo je izmjene u klasičnim sistemima za distribuciju energije. Tako se uvodi pojam *pametnih* mreža, ili *inteligentnih* sistema za prenos energije od proizvođača ka korisniku, ali dvosmjerno. Za razliku o tracionalnih distributivnih mreža, gdje se energija generisala u nekoliko centralnih postrojenja i koja je od njih distribuirana korisnicima, posredstvom velike mreže kablova, transformatora i trafo-stanica, kod pametnih mreža, potrošači mogu biti takođe proizvođači energije. Energija proizvedena u potrošačkim mikro-mrežama (npr. solarnim panelima, turbinama na vjetar i sl.), šalje se u mrežu, gdje njome upravlja sistem za kontrolu energije i njeno čuvanje u posebnim energetskim spremištima (akumulatorima). Korišćenjem posebnih, *pametnih* mjerača, automatski se kontrolišu postrojenja, tako da mreža može unaprijed da odredi obim potrošnje i da uskladi proizvodnju i potrošnju, da izbjegne preopterećenja i eliminiše ispade, ili potpuni prekid napajanja. Takođe, korisnicima su dostupne informacije o energiji koju su potrošili, s ciljem povećanja svijesti o potrebi mijenjanja potrošačkih navika i racionalnijeg korišćenja energije. Za obim potrošnje mogu biti vezane i mogućnosti varijabilne, fleksibilne naplate i dr. Ovdje treba pomenuti i e-stanice za punjenje baterija e-vozila.

Pametne zgrade/kuće. Automatski sistemi u zgradama/kućama su veoma privlačni, jer omogućuju daljinsku kontrolu putem web aplikacija: video nadzor, vođenje brige o biljkama (izloženost sunčevoj svjetlosti i navodnjavanje); kontrolu zagrijevanja, hlađenja i ventilacije; korišćenje *pametnih* pećnica, mašina za pranje rublja i dr. Složenije aplikacije omogućuju interakciju električnih aparata i pametnih mjerača u cilju optimizacije potrošnje energije, itd.

Pametne škole. *Pametne* škole, slično drugim *pametnim* zdragama, kotiste IoT za kontrolu pristupa školi, ili pjednimim djelovima škole; za kontrolu klime i štednju potrošnje energije i sl. Danas su veoma aktuelni tzv. *pametni* markeri, kojima se markirani dio u štampanom tekstu direktno prebacuje na računar ili mobilni uređaj [14]. Ovim markerima se, pored đaka/studenata, često koriste advokati i istraživači, npr. Takođe su aktuelne *pametne* table i namjenske web-bazirane platforme putem kojih nastavnici i studenti brže razmjenjuju instrukcione materijale, projektne zadatke i zajednički rade na istim dokunetima/projektima. *Pametne* škole imaju za cilj, između ostalog, pripremanje studenata da budu visoko opismenjeni u *high-tech*-smislu (highly tech-literate, eng.).

U Tabeli 3 je dat pregled oblasti u kojima se koristi IoT. Preciznije, dat je pregled nekih IoT aplikacija koje se već uveliko koriste, kao i onih koje su još uvijek u razvoju. Nesumnjivo, IoT će poboljšati kvalitet života i pozitivno uticati na očuvanje životne

sredine u razvijenim djelovima svijeta. Postavlja se pitanje: što je sa onim drugim, manje razvijenim dijelom? - Pitanje je, dakle, da li će IoT produbiti digitalnu podjelu i jaz između sve manjeg broja bogatih i sve većeg broja siromašnih u svijetu. Moguće da bi snažnije zagovaranje principa solidarnosti bilo djelotvorno, u smislu, da se jedan dio novca za razvoj i implementaciju novih, futurističkih IoT rješenja sistemski usmjeri na razvoj nedovoljno razvijenih, tako što bi im se za početak obezbijedile neke najosnovnije potrebe, a transfer i difuzija novih tehnologija prilagodili njihovim individualnim potrebama i preferencijama [5].

Tabela 3. Pregled nekih oblasti u kojima se koriste IoT rješenja (izvor: [13], adaptirano)

1. Industrija
1.1. Logistika (SCM[13]) i kontrola kvaliteta robe
- Otktivanje oštećenja ili kvarenja lako-kvarljive robe (npr. prehrambenih namirnica)
- Upravljanje skladištenjem (zalihama), maloprodajom i inventarisanje
- Brza kupovina i plaćanje, itd.
1.2. Poljoprivreda
- Praćenje životinja
- Sertifikovanje životinja
- Kontrola kupoprodaje životinja
- Kontrola navodnjavanja
- Poljoprivredna proizvodnja i kontrola stočne hrane
- Registrovanje poljoprivrednih gazdinstava, itd.
1.3. Industrijski i podržavajući procesi
- Praćenje idustrijskih postrojenja
- Automatska montaža
- Dijagnostikovanje kvarova (vozila, npr.)
- Pomoć u vožnji
- Upravljanje ukrcajem putnika/prtljaga/tereta
- Upravljanje elektronskim kartama/ulaznicama, itd.
2. Zdravstvo
2.1. Medicinska njega
- Daljinska kontrola medicinskih-zdravstvenih parametara i tele-dijagnostika
- Praćenje medicinske opreme
- Kontrola ulaza/izlaza u/iz zdravstvenih ustanova
- Pametne bolničke usluge
- Pružanje on-line obrazovnih i zabavnih sardžaja pacijentima, itd.
2.2. Pordška samostalanom zdravom življenju
- Pomoć starijima
- Pomoć osobama s invaliditetom
- Daljinska podrška za socijalnu inkluziju
- Analize uticaja ponašanja pojedinaca i njihovog dobrog zdravstvenog stanja na društvo, itd.
3. Pametni gradovi
3.1. Pametni saobraćaj i turizam
- Upravljanje transportom i saobraćajem
- Snimanje stanja na putevima
- Kontrola slobodnih parking mjesta
- Upravljanje otpadom
- Upravljanje plaćanjem

[13] SCM – Supply Chain Management, eng. – Upravljanje lancima snabdijevanja

- Pružanje zabavnih sadržaja
- Turistički vodiči, itd.
3.2. Pametne mreže
- Upravljanje generisanjem, distribucijom i potrošnjom energije
- Upravljanje opterećenjem mreže i akumuliranjem energije
- Identifikacija (prepoznavanje) korisnika
- Čekiranje i naplata
- Obezbjeđivanje održive mobilnosti, itd.
3.3. Pametne kuće/zgrade
- Održavanje biljaka (osvjetljenje, zalivanje i sl.)
- Grijanje, ventilacija i hlađenje
- Video nadzor/kontrola ulaza/zaštita djece
- Zabava i udobno življenje, itd.
3.4. Pametne škole
- Kontrola pristupa školi (putem *pametnih* kartica ili narukvica)
- Kontrola klime i potrošnje energije
- Korišćenje MLS (npr. Moodle-a i dr.)
- Korišćenje *pametih* tabli
- Korišćenje *pametnih* markera, itd.
3.5. Javna bezbjednosti i zaštita životne sredine
- Nadgledanje teritorije
- Video/radarsko/satelitsko nadgledanje
- Stanice za slučajeve hitnosti
- Praćenje osoba koje su u opasnosti
- Planovi za situacije hitnosti i bezbjednosti
- Kontrola parametara životne sredine (ekosistema), itd.

U cilju pružanja odgovora na pitanje kako stvari stoje po osnovu obrazovanja i njegovog izmiještanja u klaud, u kontekstu digitalne podjele, u smislu mogućnosti pristupa internetu i naglog razvoja tehnologije interneta stvari, uključujući širok spektar njenih primjena - data su samo neka, da kažemo, razložna tumačenja i smjernice za dalja istraživanja u poglavlju koje slijedi.

4. Nivo obrazovanja, socio-ekonomski status i digitalni disbalans

Razlike u nivou obrazovanja pojedinaca su među važnijim uzročnicima digitalne podjele. Ovaj uzročno-posljedični odnos je višestruk i objašnjava ga nekoliko teorija. Prema teoriji o širenju inovacija (DOI – Diffusion of Innovation, eng.), složenost je glavna prepreka za usvajanje (adaptaciju) novih tehnologija. Dakle, što je tehnologija jednostavnija, to će prije biti prihvaćena. Ovdje obrazovanje igra ključnu ulogu. Naime, obrazovaniji ljudi su spremniji da se uhvate u koštac sa složenijim problemima i na efikasan način premoste kompleksne zahtjeve koje pred njih postavlja nova tehnologija i njena implementacija. Drugim riječima, veći nivo obrazovanja čini lakšim savladavanje barijera u korišćenju novih ICT-a. Veće obrazovanje omogućuje bolje prihvatanje i razumijevanje informacija, što ponovo dovodi do informacione podjele između onih sa većim i onih sa nižim nivoom obrazovanja. Ovo je u osnovi glavni argument na koji se oslanja i teorija razlika u obrazovanju [15], razvijena u kontekstu širenja masovnih medija (TV-a, radia, itd.). Naime, Tichenor et al. [15], tvrde da „infusija mas-medijskih informacija u društveni sistem raste, tako što dio populacije sa većim socio-ekonomskim statusom usvaja odnosne informacije brže nego onaj dio populacije sa nižim statusom ove vrste, pri čemu se pokazuje da ovaj disparitet ima trend rasta, prije nego opadanja“. Ako

je ovo slučaj sa mas-medijima, koji su daleko manje komplesni i zahtjevni od interneta; u slučaju interneta, prethodno uočen problem podjele, biće još izraženiji. Tehnologije mas-medija, naime, nisu tako zahtjevne kao ICT, jer ne traže neko veliko angažovanje od strane korisnika. ICT i internet aktivnosti zahtijevaju od korisnika navigaciju kroz velike količine informacija, umjesto da su samo recipijenti onog što im se nudi, kao što je to slučaj kod unilateralnih mas-medijskim sadržaja. Dodatno, u slučaju interneta, iako je dostupnost preduslov, ona nije dovoljna, *per se*, za ostvarivanje svih prednosti koje ova tehnologija može da donese, tako da važne razlike mogu da ostanu u domenu prirode (načina) njenog korišćenja. Vicente i Lopez [16] naglašavaju: „ne samo da je korisniku potreban pristup infrastrukturi, potrebna mu je i sposobnost pristupa informacijama, tj. sposobnost da ih pronađe i upotrijebi“. Takođe, ima smisla hipoteza da će obrazovanije osobe raditi u informaciono-intenzivnim industrijama, odnosno, da će intenzivnije koristiti ICT na poslu i kod kuće. U skladu sa ovim Howard et al. [17] su došli do zaključka da će obrazovanije osobe koristiti internet produktivnije i sa većim ekonomskim efektom, u odnosu na one sa nižim stepenom obrazovanja. Peng et al. [18] su pokazali da su osobe koje koriste PC-e na poslu i u školi spremnije da prihvate nova ICT rješenja. Tengtrakul i Peha [19] su pokazali da „što je veći obrazovni nivo studenta, to je veća vjerovatnoća prihvatanja ICT u domaćinstvima“ (kojima ti studenti pripadaju). Na osnovu ovdje ukratko prezentiranih rezultata nekoliko (pilot) istraživačkih studija, jasno je da postoji pozitivna korelacija između nivoa obrazovanja, socio-ekonomskih prilika pojedinaca i adaptacije novih ICT rješenja. Implicitno, ova hipoteza bi se mogla proširiti i na korišćenje klauda u generisanju i diseminaciji znanja, odnosno, u obrazovanju.

4.1. Model za izmiještanje obrazovanja u klaud u sredinama u razvoju

Klaud računarstvo je danas sveprisutna paradigma, koja je unijela značajne promjene u načine pružanja usluga, kada su u pitanju korišćenje računarske infrastrukte, različitih platformi i softverskih rješenja. Vrlo jednostavno, klaud računarstvo je računarstvo bazirano na internetu. Klaud se može opisati i kao skup klastera distribuiranih računara (sa *farmama* servera, kao ogromnim centrima za prikupljanje i obradu podataka), koji obezbjeđuju resurse i usluge putem mrežnog medijuma, tj. interneta. Ranije su se korisnici služili aplikacijama instaliranim na sopstvenim (fizičkim) računarima ili kompanijskim (lokalnim) serverima, dok danas mogu da pristupe tim istim aplikacijama, ali sada izmještenim u klaud. Kada korisnici provjeravaju, npr., svoj gmail nalog, stanje na bankovnom računu on-line, ili ažuriraju svoj facebook status – oni su, zapravo, u klaudu.

Postavlja se pitanje zašto se veliki broj djelatnosti, pa i obrazovanje izmiještaju u klaud? – Brojni literaturni izvori kažu da je to u cilju povećanja fleksibilnosti i skalabilnosti korisničkih potreba, oslobađanja korisnika kapitalnih investicija u infrastrukturu i softver, plaćanja usluga prema potrebi („pay as you go“, eng.), automatskog ažuriranja softvera, povećanja mogućnosti kolaboracije, mogućnosti pristupa resursima sa bilo kog mjesta, efikasnijeg grupnog rada na istim projektima, povećanja kompetitivnosti [20] i sl.

Pored ovoga, nesumnjivo da tu udjela ima ekspanzivan i sve manje kontrolabilan rast tehnicističkih oblika materijalne kulture, koje smo često, na određeni način, prinuđeni da usvajamo. Radi se, zapravo, o nekoj vrsti imperativa novog doba. S druge strane, obrazovanje se sve češće tretira kao trošak, prije nego kao investicija (i to ne samo u

zemljama u razvoju, već i u onim razvijenim), tako da je i to jedan od razloga izmještanja obrazovanja u klaud. Svi oni izazovi za izmještanje obrazovanja u klaud u razvijenim djelovim svijeta, a to su prije svega spremnost da se upravljanje znanjem i (povjerljivi) podaci o ljudskim resursima izmjeste u klaud, još su izraženiji u sredinama u razvoju. Stoga je u nastavku načinjen pokušaj da se da predlog modela za implementaciju klauda u ovim sredinama, uzimajući u obzir kontekstualne faktore, prije svega socio-ekonomska i politička ograničenja.

Ukoliko pođemo od pretpostavke da će porast usvajanja klaud računarstva biti prisutan i u sferi obrazovanja (posebno višeg/visokog i cjeloživotnog), otvoriće se neosporno nove mogućnosti u ovom domenu i za zemlje u razvoju. Za ove zemlje su od posebnog značaja mala kapitalna ulaganja i elastičnost u korišćenju resursa. Sa otvaranjem klaud mogućnosti, zemlje u razvoju bi trebalo da budu u prilici da koriste istu infrastrukturu i resurse kao i tehnološki visoko razvijene zemlje [21].

Ima veoma malo preliminarnih istraživanja o adaptaciji klaud resursa u obrazovanju u zemljama u razvoju. Model koji je ovdje predložen (Slika 1), baziran je na studiji koja je vršena u sub-saharskoj Africi [22] i predstavlja osnovu za osmišljavanje upitnika putem kojih bi se mogla analizirati spremnost visokoobrazovnih ustanova u nekim zamaljama u razvoju (npr. zemljama Zapandog Balkana) za implementaciju ovakvog vida obrazovanja.

Ovaj model je baziran na triangulaciji (*pomirenju*) dvije teorije usvajanja i šitenja ICT-a: (i) teoriji difuzije inovacija (DOI – Diffusion of Innovation, eng.) [23] i (ii) teoriji tehnološki prihvatljivog modela (TAM – Technology Acceptance Model. Eng.) [24].

U predloženi model uključene su dvije zavisne promjenljive: (zp.a) Namjera da se uvede klaud u obrazovanje i (zp.b) Aktuelno korišćenje klauda u obrazovanju. S druge strane, nezavisne promjenljive su organizovane u nekoliko podskupova: (np.a) Ekonomski faktori (troškovi); (np.b) Tehnički faktori (rizici, bezbjednost podataka); (np.c) Kontekstualni faktori (infrastrukturni, socio-ekonomski, obrazovni) i (np.d) Inovativni faktori (relativne prednosti u odnosu na postojeća/druga rješenja, kompleksnost, kompatibilnost, mogućnost prethodnog testiranja/isprobavanja novih rješenja i sl.). Takođe, u domen nezavisnih promjenljivih uključeni su: (np.e) Faktori vezani za korišćenje (korisnost i jednostavnost pri korišćenju) i (np.f) Organizacioni atributi (prosječna starosna dob zaposlenih, veličina i lokacija organizacije). Na Slici 1 su predstavljene direktne i indirektne veze između nezavisnih i zavisnih faktora u modelu.

Ispitivanje na nivou zemalja Zapadnog Balkana, po osnovu ovog modela, moglo bi se realizovati tako da se osmisli upitnik za eksperte u oblasti obrazovanja, čijom bi se analizom dobile korelacije između pojedinih zavisnih i nezavisnih promjenljivih, kao i korelacije između samih skupova zavisnih promjenljivih. Na osnovu dobijenih korelacionih koeficijenata, mogle bi se dati određene kvalitativne smjernice za implementaciju klauda. Takođe, uz pomoć višekriterijumske regresione analize mogao bi se odrediti stepen u kome pojedine nezavisne promjenljive utiču na zavisne i sl.

Preliminarnu verziju upitnika bi trebalo poslati ekspertima, kako bi mogli da daju svoje preporuke u smislu poboljšanja jasnoće, tj. nedvosmislenosti pitanja i u cilju postizanja što relevantnijih zaključaka nakon sprovedenih analiza. Takođe, ne treba odbaciti mogućnosti isključivanja nekih od ovdje predloženih, odnosno, uključivanja nekih novih (setova) nezavisnih promjenljivih, za koje eksperti procijene da tako nešto ima uteljenje u teoriji i/ili empiriji.

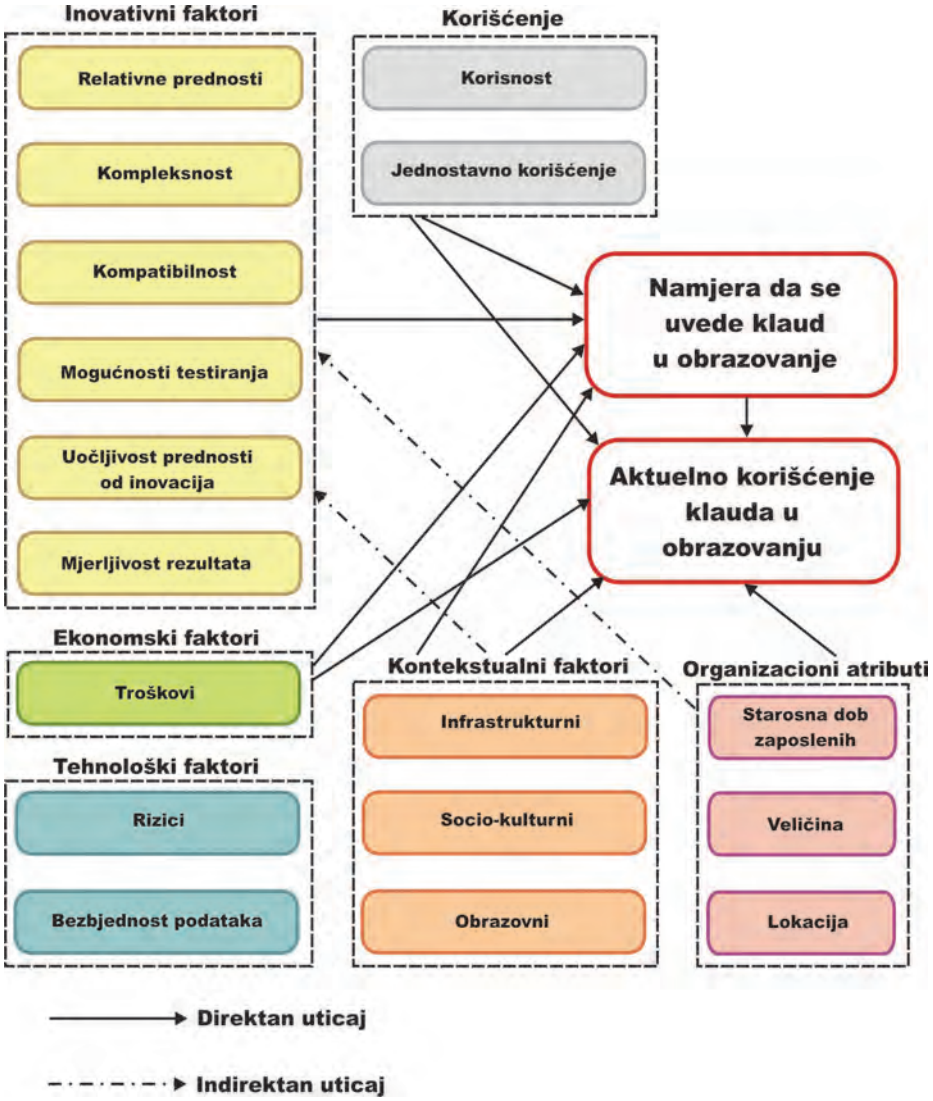
Upitnik koji bi se uputio ekspertima/menadžerima u viskoobrazovnim institucijama, trebao bi da sadrži najmanje dva dijela. U prvom dijelu ispitanici bi trebalo da odgovore

na set demografskih pitanja vezanih za instituciju, u drugom dijelu na nekoliko podgrupa pitanja koja se odnose na različite strukturne komponente predloženog modela, čime bi trebale da budu potvrđene preliminarno postavljene hipoteze tipa:

(h1) Troškovna efikasnost je u pozitivnoj korelaciji sa nastojanjem da se klaud računarstvo uvede u (visoko) obrazovanje;
(h2) Rizik je u negativnoj korelaciji sa uvođenjem klauda u obrazovanje;
(h3) Bezbjednost podataka je u pozitivnoj korelaciji sa adaptacijom klaud računarstva u ovom domenu;
(h4) Dostupnost ICT infrastrukture je takođe u pozitivnoj korelaciji sa uvođenjem ovog novog koncepta u obrazovanje;
(h5) Starosna dob korisnika je u negativnoj korelaciji sa adaptacijom klauda. Drugim riječima, mlađi ljudi su obično pro-inovativniji od starijih;
(h6) Kompatibilnost sa postojećim ICT rješenjima je takođe u pozitivnoj korelaciji sa zavisnim promjenljivima;
(h7) Kompleksnost je u negativnoj korelaciji sa zavisnim promjenljivima;
(h8) Postojanje mogućnosti da se isprobavaju nova rješenja prije adaptacije je u pozitivnoj korelaciji sa adapatacijom nove tehnologije;
(h9) Jednostavnost korišćenja je u pozitivnoj korelaciji sa adaptacijom;
(h10) Korisnost je u pozitivnoj korelaciji sa uvođenjem i korišćenjem klaud računarstva u sferi obrazovanja, itd.

Dodatno, multidimenzionalna priroda prihvatanja (usvajanja, adaptacije) ICT inovacija, povlači sa sobom različite nivoe prihvatanja, koji se ne mogu objasniti isključivo ekonomskim i tehnološkim faktorima, već se neizostavno moraju uključiti i oni socio-kulturološki. Ovi faktori u zemljama u razvoju, znatno se razlikuju od onih u (visoko) razvijenim zemljama.

U slučaju višekriterijumske linearne regresione analize moglo bi se, posredstvom predloženog modela, utvrditi u kojoj mjeri navedeni faktori utiču na namjeru uvođenja, odnosno, na korišćenje klaud računarstva u obrazovanju. Takođe bi se moglo utvrditi koliko analizirani setovi nezavisnih promjeljivih u modelu utiču na zavisne promjenljive, tj. da li bi u model trebalo uključiti veći broj nezavisnih promjenjivih, itd. Sve ovo treba raditi s ciljem stvaranja što boljih pretpostavki za postepeno izmiještanje obrazovanja u klaud.



Slika 1. Relevantni faktori za izmiještanje obrazovanja u klaud u zemljama u razvoju (izvor: [22], adaptirano)

5. Zaključak

Na pitanje da li obrazovanje treba izmjestiti u sferu klaud računarstva, u literaturi se nalaze različiti odgovori. Neki izvori zagovaraju prelazak na klaud računarstvo kao jedino danas prihvatljivo rješenje, kao imperativ novog digitalnog doba, kojim se obezbjeđuje veća efikasnost u obrazovanju [20;25]. Drugi ovaj prelazak vide prvenstveno kao pokušaj da se smanje troškovi obrazovanja, posebno visokog, ali ne sasvim uspješan. Prelazak sa dobro uhodanog, tradicionalnog, rutinskog *face-to-face* obrazovanja na nove vidove tehnološki podržanog obrazovanja stvara veće inicijalne troškove, uz neizvjesne ishode [26].

S obzirom na podijeljena mišljenja, može se zaključiti da opredjeljenje za izmiještanje obrazovanja u domen klaud računarstva, još uvijek zavisi od individualnih

preferencija i brojnih kontekstualnih faktora, posebno u regijama gdje je prisutna (izražena) digitalna podjela. Stoga bi trebalo dalje raditi na razvijanju efikasnih modela za procjenu stvarnih potreba, kada su u pitanju obezbjeđivanje pristupa, usvanje i širenje novih ICT rješenja za generisanje i distribuciju (novih) (sa)znanja. Drugim riječima, trebalo bi tražiti rješenja koja odgovaraju individualnim potrebama i mogućnostima raznorodnih obrazovnih entiteta u sredinama sa različitim geolokacijskim, a posljedično ekonomskim, tehnološkim i socio-kulturološkim atributima.

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O autorki

Prof. dr Sanja Bauk je rođena u Kotoru (Crna Gora) 1972. godine. Kao odličan đak, dobitnica je nagrada Luča I, u osnovnoj i u srednjoj školi. Diplomirala je 1997. godine na Fakultetu za pomorstvo u Kotoru, Univerziteta Crne Gore. Dobitnica je Plakete Univerziteta, kao jedan od najboljih studenata.

Magistarske studije, završila je na Saobraćajnom fakultetu Univerziteta u Beogradu, odbranivši magistarski rad: „Informaciono-komunikacione tehnologije u optimizaciji vođenja broda“, 2001. godine. Doktorske studije, završila je na istom Fakultetu, odbranivši doktorsku disertaciju: „Inteligentni informacioni sistemi u optimizaciji rute u pomorskom i lučkom transportu“, 2005. godine. Post-doktorke studije, u oblasti didaktičke informatike, završila je na Akademiji za nove medije u transferu znanja na Univerzitetu u Gracu (Austrija), 2013. godine.

Dobitnica je više međunarodnih nagrada za akademske boravke u svojstvu gostujućeg istraživača i predavača na Univerzitetu u Koimbri (Portugalija), Univerzitetu u Barseloni (Španija), Univerzitetu u Pitsburgu (Pensilvanija, SAD), Univerzitetu u Odesi (Ukrajina), Univerzitu u Gracu (Austrija), Lund Univerzitetu (Švedska), RWTH Ahen Univerzitetu (Njemačka), City Univerzitetu u Londonu (Velika Britanija) i dr.

Područje istraživačkog interesovanja prof. dr Sanje Bauk je višeslojno. Jednim dijelom je u domenu metoda kvantitativne optimizacije, a drugim u domenu savremenih informaciono-komunikacionih tehnologija (ICT). U oblasti kvantitativne optimizacije, prof. dr Sanja Bauk se bavila nekim optimizacionim problema transporta, logistike, održavanja, tržišnog pozicioniranja, procjene stepena zadovoljstva korisnika i dr. U oblasti informatike, bavila se svojstvima raznih ICT aplikacija, uglavnom u pomorstvu, kao i didaktičkom informatikom i post-produkcijskim alatima. Trenutno je njeno interesovanje usmjereno ka evoluciji web-a, internetu stvari, *pametnim* okruženjima i humanoj dimenziji thenološkog razvoja.

Prof. dr Sanja Bauk je autorka dvije naučne monografije i jednog univerzitetskog udžbenika. Kao autorka i koautorka, objavila je značajan broj radova u naučnim časopisima koji se referišu u vodećim bazama (oko 25), kao i u drugim međunarodnim naučnim časopisima (oko 100). Objavila je veliki broj članaka u zbornicima međunarodnih i domaćih naučno-stručnih konferencija. Članica je uredništva i recenzent u nekoliko međunarodnih naučnih časopisa. Takođe, članica je naučnih odbora nekoliko međunarodnih konferencija u pomorstvu. Aktivno je učestvovala u realizaciji brojnih nacionalnih, bilateralnih i međunarodnih projekata.

Od 1998. godine zaposlena je na Fakultetu za pomorstvo Univerziteta Crne Gore. U zvanje vanredne profesorke, izabrana je 2013. godine, na grupi predmeta vezanih za Operaciona istraživanja i Informacione tehnologije u pomorstvu, na dodiplomskim i postdiplomskim studijama.

Aktivno se služi engleskim i pasivno njemačkim jezikom.

Izvodi iz recenzija

Radi se o aktualnoj, kvalitetnoj, visokostručnoj i istraživačkoj naučnoj monografiji, koja će obogatiti crnogorsku i reginalnu literaturu iz složene oblasti koja je veoma malo obrađena na našim prostorima. Posebno me impresionirao smjeli (i uspjeli) pokušaj autorke da u tekstu spoji menadžment i tehničke aspekte (vještine). Takođe, čitaoci će primijetiti dobronamjerni gest Prof. dr *Sanje Bauk* da objavi deset istraživačkih radova, koji su (ili će tek biti) objavljeni u referentnim međunarodnim časopisima, uglavom na SSIe listi. To je značajno povećalo rejting Pomorskog fakulteta Kotor i Univerziteta Crne Gore, i to upravo u vremenu realizacije visokoškolskih reformi, koje su usmjerene prema povećanju kvaliteta i kvantiteta naučno-istraživačkog rada. Zbog toga objavljivanja ove vrijedne naučne monografije trajnog značaja predstavlja ne samo autorski, nego i sinergijski doprinos.

U periodu krize knjige i nauke u Crnoj Gori i regionu, koja rezultira, pored ostalog i zbog proceduralnog zaobilaženja (da ne upotrebljavam neke teže riječi) naučnih monografija uopšte (naravno, zbog iskjučivo subjektivnih razloga: deficita istih u opusu “”reformatora”), navedeni rukopis ocjenjujem kao svetionik u upornoj i teškoj borbi referentnih autora za afirmaciju svijesti i istine o dominantnom značaju monografskih istraživačkih publikacija kao najvišeg oblika naučne djelatnosti. Ovom svojom novom monografjom, autorka se svrstala u veoma uski krug crnogorskih (ali i regionalnih) naučnika, koji su iste uopšte objavili ne samo u međunarodnim i regionalnim granicama, nego čak i lokalnim.

U maniru iskusnog i dokazanog naučnika, Prof. dr *Sanja Bauk* je u tehničkom, funkcionalnom i koncepcijskom smislu uspjela majstorski da poveže savremene teorijske i praktične teme i aspekte ključnih informaciono-komunikacionih sistema u pomorskoj navigaciji i pomorstvu uopšte. Njeno projektno i pedagoško međunarodno iskustvo je na zavidnom nivou, a ona ga je na briljantan način primijenila u razmatranom tekstu. Zbog toga zaslužuje najveće pohvale. Nadam se da će konačno uslijediti i (potrebno i zasluženo) priznanja crnogorske naučne i društvene zajednice, koja bi na najbolji način potvrdila navedene objektivne I iskrene recenzentske konstatacije.

Ocjena ove naučne monografije zaslužuje ponovljanje moje davnašnje izjave da svaka nova knjiga predstavlja veliki praznik za crnogorsku izdavačku djelatnost i da mi je izuzetna čast što kao recenzent učestvujem u ovom značajnom projektu. Posebno zbog činjenice što je autorka u ovom originalnom tekstu uspjela da pruži nova saznanja, kao i nove odgovore na neka stara pitanja. “*Ex astris scientia*”!

dr *Veselin Drašković*, redovni profesor
Univerzitet Crne Gore, Pomorski fakultet Kotor

Autorka je na 290 strana visoko kvalitetnog naučnog teksta, koji je obogaćen mnogim šemama, slikama, tabelama i prikazima uspjela da uspješno obradi jednu zanimljivu, savremenu i složenu tematiku iz informaciono-komunikacione oblasti, koja je izuzetno značajna za crnogorsku naučnu i praktičnu (pomorsku) djelatnost. Razmatrana naučna monografija je logično strukturirana u dva dijela, koji se funkcionalno prožimaju i dopunjuju.

U tom smislu, ova knjiga će korisno i inspirativno poslužiti svim budućim istraživačima navedene oblasti, praktičnim djelatnicima i studentima.

Dodatni kvalitet ove vrijedne naučne mnografije predstavlja njena tehnička obrada i veliki trud autorke da većinu šema i slika nacrta u bojama. To će olakšati razumijevanje osnovnog teksta i svih analiza i proračuna svim budućim čitaocima i korisnicima. Isto se odnosi i na brojne prikazane praktične aplikacije.

Tekst je koncizno i originalno koncipiran, a napisan je jasnim, preciznim i jednostavnim jezikom i stilom. Obiluje brojnim podacima, konstatacijama, tumačenjima i objašnjenjima. Zbog toga će čitaocima biti zanimnjiv, posebno u dijelu brojnih uzornih modela. Vidi se da je dugogodišnji autorkin marljivi i stručni rad na predmetnoj problematici pomogao da kreira specifičnu i originalnu simbiozu teorije i prakse iz navedene oblasti. Tekst je u metodološkom pogledu sasvim prilagođen svjetskim standardima.

Iskreno preporučujem studentima, svim zainteresovanim čitaocima i cijenjenim izdavačima ovu vrijednu naučnu monografiju Prof. *Sanje Bauk*, jer je napisana izuzetno stručno i profesionalno.

dr *Radislav Jovović*, redovni profesor
Univerzitet Mediteran, Podgorica

Monografija Prof. dr *Sanje Bauk* obrađuje jednu od najznačajnijih praktičnih pitanja iz pomorske privredne djelatnosti, od čijeg trenda će direktno zavisiti budući društveni i privredni održivi razvoj pomorskih država Crne Gore, Hrvatske i Slovenije. Autorka je kvalitetno, originalno i stilski izuzetno lijepo koncipirala tekst, koji sadrži veliki broj naučnih analiza, podataka, konstatacija i tehničkih formi. U tom smislu, tekst svojim mnogim aspektima zaista inspiriše na dodatna buduća naučna istraživanja.

Radi se o konciznom i koncentrisanom naučnom tekstu, namijenjenom uglavnom profesionalcima – teorijskim i praktičnim. Jer, razumijevanje nekih segmenata monografije od čitalaca zahtijeva veoma dobro poznavanje materije.

Knjiga sadrži veliki broj naučnih članaka autorke, koja ih je vješto ukomponovala s raznim udžbeničkim temama i materijalima, a funkcionalno i tehnički formatizovala na vrlo dopadljiv način, koji je skladno metodološki prilagođen strukturi ovog vrijednog rukopisa.

Autorka je uložila ogroman stvaralački napor i energiju da napiše ovu knjigu, koja će biti objavljena u vremenu koje, kako navodi uvaženi recenzent Prof. Veselin Drašković - nije naklonjeno ni knjizi i naučnom stvaralaštvu, jer je opšta kriza deformisala vrijednosne kriterijume, preferencije, potrebe i motivaciju. To povećava značaj ovog naučnog djela i doprinosa referentne autorke. Njena temeljna i studiozna obrada razmatrane problematike s mnogih i bitnih aspekata biće izuzetno korisna svim čitaocima i profesionalcima, kojima je ova naučna monografija i namijenjena.

Koristim priliku da u svakom pogledu preporučim publikovanje ovog vrijednog i tematski rijetkog teksta.

dr *Borut Jereb*, vanredni profesor
Univerzitet u Mariboru, Fakultet za logistiko Celje