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Constanta Maritime University, 104, Mircea cel Batran Street, 900663, Constanta, Romania
Tel: +40 241 664 740/ 107
Fax: +40 241 617 260
E-mail: jmte@cmu-edu.eu
http://cmu-edu.eu/jmte/

EDITURA NAUTICA
Constanta Maritime University
CONSTANTA MARITIME UNIVERSITY, 104, MIRCEA CEL BATRAN STREET, 900663,

CONSTANTA, ROMANIA

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GLOBAL CHALLENGES, FUTURE DIRECTIONS AND MET DEVELOPMENTS IN THE PHILIPPINES: THE MAAP EXPERIENCE

Angelica M. Baylon, PhD and Vadm Eduardo Ma R Santos, AFP (Ret)**

** Director for MAAP External Relations /Presenter
Maritime Academy of Asia and the Pacific, Mariveles Bataan Philippines
ambaylon@maap.edu.ph or ambaylon@gmail.com

Abstract : When we talk about globalization, then the partnership of the Philippines (MARINA) with global counterparts (*IAMU, GlobalMET, IMAREST, NI, and APEC*) in particular, is essential. This paper presents global activities that aimed to contribute to future global MET developments in the Philippines. MARINA and MAAP participated in both events and had noted essential ideas that need to be animated to develop MET in the Philippines in partnership with international MET organizations who share similar concerns and interest. First was the 2017 APEC meeting hosted by KIMFT in Korea, aimed at coming up with future MET direction of seafarers in the APEC region, with focus on enhancing seafarers' global capabilities and promoting their successful entry into the global shipping industry. The second was the 2017 IAMU-PAES-P project aimed at improving the quality of academic curriculum; to improve the learning experience of all concerned and to analyse and improve the MET system's organization. This paper presents the **outcomes of both global conferences** with a focus on the future Global MET developments in the Philippines in line with the Royal Institute Global Conference theme "*Global Challenges and Future Directions in the Maritime Industry."* Specifically, the paper presents, three distinct groups of knowledge, skills and attitudes (KSA) that will enhance the **global competency**. These are the empirically based knowledge and skills *(basic competency, numeracy, science, and technology skills)*; the Higher-order cognitive and metacognitive skills (*critical thinking and creative problem solving*); and the Global dispositions, perspectives, and attitudes. As this paper had explored future MET developments in the Philippines, there is a need for the adoption of global skills in MET curricula, assessments, and pedagogy. Therefore, while we may not know what the MET and global maritime arena will look like in 2100, MET students who will benefit from this transformation movement globally, will be prepared to excel and succeed. This paper examines, summarizes, and offers solutions to what may be the biggest challenge facing the Philippine MET in the coming decades. The Philippines must possess maritime professionals or seafarers who demonstrate sufficient levels of global competency- the right skills, attitudes, and dispositions necessary to navigate and excel in a highly fluid, globalized, and increasingly competitive environment. This paper presents the role of MET in enabling Filipino students with the skills, aptitudes, and dispositions required to be efficient and competing in the current and the future globally interconnected and interdependent world system. The Paper ends with concluding remarks.

Key words: Skills, aptitudes, and dispositions required to be efficient and competing in the current and the future globally interconnected and interdependent world system.

1. INTRODUCTION

Looking back over the past 2O years, since the establishment of MAAP in January 1998, can provide a sense of the rapidity and magnitude of the changes, having been experienced that is likely to accelerate in the future.

The rate of change over the past 20 years seems very fast for many people today, yet the circumstances that made those changes are accelerating. As a result, the changes over the next 20 years will be even more significant.

Imagine two maritime institutions in the Philippines. Both institutions were similar. Both of them follow the same national guidelines, except that one has an institutional objective of cooperating with international organizations to connect their educational systems into a global knowledge system to improve education for all in their country.

Now, 20 years later – today – which maritime institution would be in a better position for the emerging

global knowledge economy? And which maritime institutions would have produced more students ready for today's complexities and opportunities? In 1998 MAAP was established and its services started in 1999, the same year that IAMU began its operation in 1999 with the objective of preparing member institutions with students to participate in the global knowledge economy. MAAP also ranked number 1 in the PRC examinations for the past six years both for BSMT and BSMarE course. MAAP also takes pride in the many of the world's brightest MAAP graduates that were hired by big shipping companies with some of MAAP graduates already President of a company. MAAP graduates also enjoy the exemption from taking the Japanese examination for international and non-domestic seafarers granted by its Ministry of Land Infrastructure, Transportation, and Tourism (MLITT). MAAP became a member institution of IAMU or International Association of Maritime Universities in 2016. MAAP as member of IAMU, was successfully identified as one of the best MET in the Philippines in the areas of facilities, teaching, training quality and international cooperation (2017 IAMU PIMET Report and 2017 PAESP report.

Today, MET policymakers face the same kind of choices: to look far ahead seeking emerging educational opportunities or just make moderate innovations that appear creative.

Indeed, if we don't know that something is possible, then we will not try to make it happen. What are some of the future global MET developments and directions in the Philippines given the challenges? What might we do today to take advantage of the emerging global MET possibilities? Execution of new ideas can sometimes turn out differently than expected. Nevertheless, it is also wise to reflect on what could make them turn positively or negatively.

The maritime skills to survive and thrive in this 20th century have transitioned from that of a knowledge-based economy to a competency-based economy. Moreover, the emergence of technology to our daily lives, events, and phenomena across the globe resulted in rethinking how best to prepare students for an education system born out of global maritime era influences.

The recent global developments in MET with MARINA and MAAP participation in the various initiatives in the year 2017 to date are analysed

On APEC hosted by KIMFT Korea on Enhancing Global Capacity of Seafarers

MAAP and MARINA participated in the Oct 19-20, 2017 APEC Seminar with the theme " *Enhancing the Global Capacity of Seafarers in the APEC Region"*, hosted by the Korea Institute of Maritime and Fisheries Technology (KIMFT) and by Ministry of Oceans and Fisheries /Republic of Korea, in Busan, the Republic of Korea. There were 96 participants composed of 66 Males and 29 females. MAAP thru its External Relations Director represented Philippines as one of the 11 speakers from 8 APEC economies. There were fifteen countries represented: 3 from China, 4 from Taipei, 2 from Indonesia, 1 from Japan, 2 from Malaysia, 57 from Korea, 1 from Russia, 1 from Thailand, 9 from the Philippines, 1 from USA, 11 from Denmark, 1 from Finland, 1 from Germany, 1 from Italy and 2 from UK. The Philippines were represented by four from MARINA led by its Administrator, and one each from MAAP, PAMTCI and IMAREST/NI Philippine Chapter. After discussions of the future direction of seafarers training and education in the APEC region, with a specific focus on enhancing seafarers' global capabilities and promoting their successful entry into the global shipping industry, the major outcomes of the meetings were noted:

1. **Identified key competencies of seafarers**, focusing more on soft skills ; cross-cultural awareness; English abilities required for native and non-native speakers to foster a harmonious on board working environment; a global leadership mind-set and attitude that will ultimately lead to seafarers' increased employability in the global shipping market, and the pursuit of continuous career development on-board and onshore;

Challenge is that despite the critical importance of soft skills in current and future MET, participating economies strongly backed the idea that proper training infrastructure, specialists and a systematic and well-designed curriculum with training materials should be established first. From this perspective, cooperation and support for the development of relevant capacity-building cross-border courses within APEC should be considered as the top priority to resolve the common concerns

2. **Established an improved training and education system,** actively utilizing the existing MET infrastructure within APEC economies and furthering the development of programmes and courses that can be mutually shared by and beneficial to the economies that need them;

Challenge is that there is no specialized organizing body within APEC for promoting solid connections and encouraging practical exchanges for the education and training of seafarers. Therefore, there must be efforts to actively consider the process of establishing a responsible organizing body, with the resulting suggestions being delivered to APEC.

3. Developed a lifelong learning system by establishing a common platform to effectively attain the educational welfare of the seafarers in the APEC region by enlarging the scope at a global level of available education

programmes that have been requested by cadets, seafarers, shipping companies and the maritime administrations of individual economies;

Challenge is that there have been scattered on-going efforts in various Asian Pacific regions to enhance the capacity of the local and global shipping industries by realizing seafarers' educational welfare.

4. To execute future actions, includes developing seminars into a more formalized and regularized workshop in which more active and in-depth discussions on a wide range of issues can be dealt with periodically and actual outcomes can be reflected in the future strategies of APEC, as well as establishing an organizing body that covers the topics mentioned above in the APEC region for the mutual prosperity and development of the shipping industry through systematic and coherent approaches to MET.

Challengeis that a uniformed approach that can attain resource effectiveness regarding workforce, funding and time has not yet been implemented.

To provide the necessary global-level lifelong learning programmes that APEC economy will be able to mutually develop and share, further discussions on this topic will be conducted as once again, KIMFT is initiating a 3-day 2nd meeting "*Strategic Planning among APEC economies"* on **February 27 to March 1, 2018 i**n their new KIMFT merchant training ship in Pusan Korea and the same shall be participated by MARINA and MAAP. The initiative of KIMFT Korea is commendable for the ASIAN APEC Economies.

Given the above outcomes, it is deemed essential to analyze the different kind of competencies provided in the meeting and to group them accordingly, to put the ideas in order. Skills may be organized into three stages to acquire global competency which may be conceptualized as interdependent and overlapping.

Together, they form a set of global knowledge and skills, but this does not mean that every part of the set is decidedly global. For example, the basic first group of skills includes general education subjects like English, Math, History, and Science. Although these subjects in and of themselves may not be global, they function as necessary building blocks that support the development of other skills. They also serve as platforms for teaching global interdependence, cultural diversity, and international issues.

Global competency is characterized not just by skills and knowledge, but also by dispositions or attitude. Education may be seen primarily as a site for the transmission of information, facts, and experience, but it is also an essential institution for socialization. (Reimers 2010) had captured the same definition to wit "Global *competencies are also the attitudinal and ethical dispositions that make it possible to interact peacefully, respectfully and productively with fellow human beings from diverse geographies.*

In enhancing the global competency, three distinct groups of knowledge, skills, and attitudes have been identified: *Empirically based knowledge and skills such as basic competency and numeracy, science, and technology skills, Higher-order cognitive and metacognitive skills such as critical thinking and creative problem solving and Global dispositions, perspectives, and attitudes.*

1. Stage 1: Empirically Based Knowledge and Skills

Broadly defined, these are the skills and sets of knowledge that are empirical and practical. One could think of these as "information students need to know." School subjects within the traditional disciplines (*math, science, language arts, history, etc.)* fall into this category, along with a few additional "*21st-century skills."* This stage includes the following sets of knowledge and skills: *Native language literacy, Non-native language literacy, Numeracy and quantitative skills, Science; Geography, history, and politics, Social studies, Economics, Digital literacy-* or CORE SUBJECTS which is based on national standards for learning in the disciplines

A mastery of the knowledge and skills included in this stage is essential for the globally competent student for a few distinct reasons. First, core subjects such as *algebra, English language arts, and history* are foundational to other types of knowledge.

Once the three "Rs"(reading, writing and arithmetic) have become relatively fluent, students are ready to master the primary subject matters or disciplines of their culture. These core subjects serve as an entryway to the later acquisition of higher-order cognition.

In the case of first language literacy, language is the tool that underpins the acquisition of most forms of human knowledge and skills. But other fundamental disciplinary skills play a similar role. For example, arithmetic admitted that computers could do basic math for us; however, having necessary math skills such as addition and multiplication is needed if one is to learn algebra. Knowing algebra is, in turn, an essential foundation for a whole host of other vital skills like making computers compute things we want them and this requires algebraic skills. Take a computer spread sheet for example. The computer does all the computations automatically. However, you have to provide the macros that tell what calculations to do, and that is algebraic thinking. Furthermore, a mastery of core subjects is essential from a human capital perspective because while the20th century employers want employees who can be creative, collaborative and able to solve complex problems, they will still look at those skills only after they confirm that prospective employees have mastered the 'three Rs."

A second reason the skills and knowledge are essential is that they provide a springboard for teaching and learning about global issues.

APEC meeting identified that second language literacy and digital literacy are intrinsically tied to global competency. It is true that English may be "*the first worldwide lingua franca,"* but there is also growing consensus that even native English speakers must step out of their linguistic comfort zone and engage more thoroughly and thoughtfully in second language acquisition. Learning the second language offers many benefits in addition to its economic advantages. It serves as a locus of cross-cultural education wherein students can begin to explore alternative ways of thinking, believing, and understanding. The students may be able to understand the experience of communicating in another language and may acquire new skills needed in globalizing the maritime arena.

2. HIGHER-ORDER COGNITIVE, METACOGNITIVE, AND INTERPERSONAL SKILLS

These are competencies that allow students to access, manage, interpret, and apply knowledge. It also includes needed interpersonal work skills in maritime that are marked by connectivity and collaboration. Skills like *"what students need to be able to do."* The following list is not comprehensive but includes the most commonly cited higher-order skills found in the literature and most 21st-century skills frameworks: *Critical thinking, Problem-solving, Creativity, Innovation, Information literacy, Communication, Collaboration, Flexibility and adaptability, Lifelong, self-driven learning.* These skills are interrelated and overlapping and should not be thought of as discrete subjects. Also, they complement rather than stand apart from the knowledge and skills. Information literacy can be defined as the combined abilities to locate, critically examine, evaluate, interpret, synthesize, prioritize, and apply information.

3. GLOBAL DISPOSITIONS, PERSPECTIVES, AND ATTITUDES

These competencies are not so many skills or specific sets of knowledge as they are behaviours, mind-sets, values, and sensibilities. These soft skills may include being curious to learn about the world and its people; being aware of one's own and others' cultural, political, geographical, or socioeconomic perspectives, being appreciative of nuance and complexity and being knowledgeable of and willing to act in ways that acknowledge global interconnectedness. Other soft skills include a sense of personal agency and belief in the capacity to affect outcomes and make a contribution; the sense of responsibility to others and concern for fairness, justice, and progress on a global scale.

It is vital to understand that these dispositions cannot come from schooling alone; education is an essential space for shaping such attitudes. Attaining a global consciousness will help students to become competent as well as responsible workers and citizens in an interdependent world.

On the IAMU-PAESP Project in the Philippines

In addition to the recent involvement of MARINA and MAAP with APEC Korea, is its engagement with the IAMU-PAESP project. MARINA signed Memorandum of Agreement (MOA) with IAMU. They had conducted several joint activities in the Philippines aimed *to provide MET institutions in the Philippine with academic advice and suggestions to improve MET; to organize educational workshops together with academic member universities and MET schools in the Philippines, and to have the opportunity to share and confirm outcomes of the activities with parties concerned.*

For this Peer-assisted Self -Evaluation Scheme Project in the Philippines or PAES-P project, MARINA and MAAP partners with IAMU co-member institutions represented by University of Rijeka Faculty of Maritime Study, Croatia; Chalmers University of Technology Department of Mechanics and Maritime Sciences Sweden and Swendborg International Maritime Academy (SIMAC) Denmark. On October 27, 2017, hosted by MAAP, these three institutions facilitated and moderated the MARINA-IAMU seminar-workshop on "*STCW 2017- Quality of Education at the Maritime Higher Educational Institutions (MHEIs)"* to selected HEIS in the Philippines nationwide.

Of equally important for Philippine MET comparative assessments, demonstrate that other co-IAMU MET institutions from Europe are on top when it comes to preparing their students thru provision of quality MET.

This dynamism must inspire innovative solutions to improve the Philippine MET system. However, because of demographic, geographic, cultural, linguistic, economic, and political variables differ from country to country; we cannot merely copy systems from Europe that outrank the Philippines.

List of actions must be developed to support a balance between competitive and collaborative transformation efforts. While many challenges exist, including cultural, economic, and political considerations, with the appropriate framework, organizations such as IAMU can support the Philippine MET systems under its MOA with the MARINA to maintain relevancy amid a shifting paradigm.

Moreover, organizations such as IAMU can support access and equity to provide more students with more excellent opportunities to learn and then contribute to their national well-being.

In 2017, as IAMU member MAAP's two students were invited and sponsored by IAMU to participate in the July 2017 Student forum held at IMO headquarters in London which is part of globalization advocacy of IAMU.

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Further, there were 9 Areas that the IAMU-PAES-P project evaluated at MAAP in 2017. The nine areas include *Organization and Management; Students, Program, Education and Process; Academic Staff and support Personnel; Professional Training and Internships; Facilities and Resources; Program objectives and stakeholders involvement and Continuing Education* and had suggested future developments in MET under each area not only to MET institutions but also to MARINA.

As this paper had explored **Future MET developments in the Philippines**, there is a need for the adoption of **global skills in MET curriculum, assessments, pedagogy, and andragogy**. Hence, while we may not know what the MET and global maritime arena will look like in 2100, students who will benefit from this reform movement globally will be prepared to excel and succeed.

This paper examines, summarizes, and offers solutions to what may be the biggest challenge facing the Philippine MET in the coming decades.

The Philippines must possess maritime professionals or seafarers who demonstrate sufficient levels of global competency - the **right knowledge, skills, aptitudes, and dispositions** necessary to navigate and excel in a highly fluid, globalized, and increasingly competitive environment.

This paper also presents the role of MET in enabling Filipino students with the skills, aptitudes, and dispositions required to be efficient and competitive in the current and the future globally interconnected and interdependent world system.

Each letter in the word FUTURE **MET DEVELOPMENT IN THE PHILIPPINES**, is used to describe the needed action or roles in MET by all concerned in 3Cs (communication, collaboration, and cooperation) with global counterparts for global MET developments in the Philippines.

FUTURE

1. F- Formation of the MET research network.

The network must consist of a wide range of interested parties from all areas within the waterborne sector that possesses the zest and energy to improve MET through a comprehensive programme of research and development, projects, and initiatives. Partners may include progressive companies, universities, social partners, associations, awarding bodies, accrediting institutions, licensing authorities, government agencies, learned societies, conferences, and individuals.

If we want Philippine MET to prosper, a robust maritime Research and Development centre must be active. It is worth reporting that MARINA partners with MAAP for two MARINA proposed projects and had the kick-off meeting was held on Feb 1, 2017, at MAAP campus

2. U – Underscoring or Emphasizing Global access to fast Internet connection as one of the future global MET development.

If the Philippines would like to be at par with global counterpart, then fast communication and interconnectivity is a must. Knowledge is power and so are immediate connections.

3. T- Tone or harmonization of the efforts of industrial, educational, and governmental maritime organizations in the Philippines to safeguard the well-being and competitiveness of the maritime industry. Through the creation of joint partnerships involving universities, research canters, businesses, and stakeholders from all areas of the maritime transport sector, we can work to ensure that all maritime industrial sectors (such as ship operators, shipbuilders, and support industries) are appropriately represented. By providing a platform from which various organizations within the industry can be heard in academia and the government agency etc. , then voices can be heard, valuable ideas and contributions can be harnessed and transformed into strategies that will give the Philippines a new competitive edge in the global shipping market

If we want the Philippines to be globally competitive, international linkage and cooperation must be reliable and workable. MARINA partners with IAMU, Global MET, IMAREST, and NI. The partnerships are sealed thru a signed MOU.

- IAMU for the PAES-P project
- Global MET for the TKF funded competency standards
- IMAREST And NI for the Continuing professional development of seafarers

4. U-Underlining or Highlighting strict monitoring of the IMO standards for the training and certification of seafarers being strictly enforced (STCW) by MARINA because studies have shown that majority of accidents at sea and in ports reported were mainly due to either disregard for rules or inadequate training and assessment.

MET Development is basically for Safety of life at Sea or SOLAS. Number one cause of accidents at is Human errors and therefore a well-developed organized MET is required to ensure competent seafarers at sea.

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5. R - Revolution or Innovation in MET, underpinned by appropriate research and development activities, and provide a platform from which concerns and interests regarding education and training in the MET industry can be communicated and acted upon.

- GlobalMET in partnership with MARINA will conduct its initial meeting on Feb 24, 2017, for the TKF funded project on competency standards for Seafarers.

6. E - Encouraging good young people (male and female) into seafaring profession to address foreseen shortage of officers

- AMOSUP /MAAP/WIMAPHIL /MARINA GAD Etc.

MET

7. M-Manning vs. Automation Vs. Safety

With the advent of the future use of technology like robotics, automation and the like, the maritime labour market might undergo significant changes due to the forces of globalization. Outsourcing jobs that were once performed by seafarers to computer scientist or Information technologists with the digital work.
Technologies are replacing duties once performed by human workers or by the seafarers. The Philippines workforce needs to be equipped with more workers capable of "expert thinking or solving problems to mitigate the outward push of jobs through outsourcing and digital work,

8. E- Exerting effort beyond STCW and Integrating MET for career at sea and on shore

3 D printing – training students to manufacturing spare parts on board the vessel thru the use of 3D printers is an added skill

9. T-Train *the Trainers*for capability building and domino effect

Students are being confronted with so many diverse information that they must learn to navigate efficiently. Global competency curricula need to include lessons that train students to do just that.

DEVELOPMENTS

10. D-Developing online tools and improving simulator practice

The Use of simulations and/.or Use of global on-line simulations and public communications to reinforce pursuit of knowledge.

11. E- E-Learning /E-Teaching

Since the information era is so heavily defined by new technologies and the changing shape of communication and commerce impacted by those technologies, students must acquire the skills to work with existing technologies as well as the desire and the capacity to learn new technologies as they are developed.

12. V-Various Initiatives will be pro-actively accomplished

Learning and education can be integrated into movies, games, and music to incorporate knowledge and leisure. In this way, a vast number of students can be reached, who in the "normal" education system is lost (MAAP is doing this even in MLC course).
Portable artificial intelligence device, Artificial intelligence-based software, and devices would recreate, interpret, and analyze and enhance enormously issues, facts, etc. not yet understood.

13. E- Equal access to MET Information and Data

The right to equal access to MET information becomes one of the globally recognized human rights. Knowledge must be documented and modularized so that every student could download them when needed. The management should bring together only the contents of all essential groups in one module that any consumers may order. This exercise will also encourage academicians and trainers to write books or modules in MET.

14. L- Literacy { Basic Language, Numeracy, and Digital Literacy)

Considering that Seafaring is the first international workforce,

14.1. Basic literacy or empirical knowledge and skills needed to be globally competitive

- Second language literacy offers many benefits and economic advantages. It also serves as a means wherein students can explore alternative ways of thinking, believing, and understanding.
- Digital literacy is part of almost every global education framework. Both teachers and students are using the computer as it serves as equipment to receive, organize, store, analyze and interpret information. Competency in the use of a computer is emerging as a fundamental skill complementary to other competencies such as reading, writing, mathematics, and reasoning.
- Information literacy is defined as the combined abilities to locate, critically examine, evaluate, interpret, synthesize, prioritize, and apply information. In this 20th century, the most valued mind will be the synthesizing mind. Synthesizing mind is a mind that integrates a wide range of information; decide what is relevant and useful; and then incorporate this information together in ways

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that make sense to oneself and, ultimately, to other persons as well,"

14.2. Higher-Order Cognitive, Metacognitive, and Interpersonal Skills
14.3. Global Dispositions, Perspectives, and Attitudes

15. O- Opportunity to develop at least two languages beneficial for the development of the person, including other benefits related to the early recognition of different cultures.

16. P- Positive disposition to continue learning throughout life about global affairs, can serve students better than many facts taught in boring ways

The ability and the motivation to enhance one's learning throughout a lifetime are other essential components of global competency. A necessary characteristic of the knowledge economy is that information is abundant and in a continual state of change; therefore, it is critical that learning extends beyond the years of formal education: Contextualized from an economic perspective, "Lifelong learning is crucial to preparing workers to compete in the global economy."

17. M- Mobility of Seafarers

18. E- Equal standard of MET

The Philippine government must guarantee inclusion of all of society first and especially in the educational system- to each member of the country. Then an equal standard of maritime education can be guaranteed to everybody. The Philippines are quite far away from many e-tools, technology and nanotechnology instruments that are very useful and can correctly incorporate into the educational item.

19. N-National programs for improving *collective intelligence*

The shift to a collective intelligence appears to be already underway, as evidenced by mass online collaboration, open source software, knowledge creation communities, and social sharing of learning resource (e.g., Wikipedia, YouTube, Facebook, LINKEDIN, Nautical Institute, IMAREST, GlobalMET, AMEA, IAMU) often without evident individual financial compensation or incentives.
Develop new models for collective knowledge and intellectual developments, a step ahead of cyber culture and towards a global brain and further development of human consciousness.
Organized individual learning is considered less critical than tapping the capacity of groups and communities (and whole societies) to take in, evaluate, effectively use, and creatively transcend the existing knowledge relevant to a given situation, creating new, potentially more powerful learning in the process. The results of such group and community "collective intelligence" will be broadly available to all individuals and groups, which makes individual "education" as obsolete.

20. **T -Teaching***of morals, routine measurement of characteristics other than intelligence (e.g., emotional intelligence) will be commonplace.*

21. S -Safety at Sea zero collisions reduced accidents/ Soft skills

IN

22. I -Innovate*solutions to problems faced by the maritime industry*

23. N-Networking with ASIAN counterparts and global counterparts for benchmarking

Time and time again, the single most crucial factor shown to impact student outcomes is quality teaching Teachers cannot explain what they do not know. National commitments are needed now, to prepare teachers to promote international knowledge and skills. With adequate support, teachers would willingly take on the challenge of "globalizing" their lessons and, in so doing, would themselves reflect the kind of innovation, flexibility, and openness to developing a global consciousness that is at the heart of future global competency MET.

THE

24. T -Training in rational scientific thinking as part of primary education

New outcomes of teacher/student relationship could create new educational systems based on a new kind of learning cooperation

25. H -Harmonization of standards within maritime sector (Globalmet TKF funded project in partnership with MARINA – kick-off meeting on Feb 24)

26. E -Emphasis on the need to learn how to learn. Not merely the acquisition of new facts and inputs, but the capacity to discard the unnecessary and to transform the useful information into useful and productive realities.

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27. P -Promote good practice in maritime education and training

Some educators advocate for a comprehensive shift towards "problem-based learning". Teachers are encouraged to design the whole lesson around problem-based learning scenarios that provide major concepts to be solved, understood and mastered" so that maritime students are no longer passive recipients of knowledge; but decision makers."

28. H-: Homogenization of higher maritime education degree programs in the Philippines

29. I -Identify key competencies for the waterborne sector and each type of vessels.

30. L- Limitless non-profit organization offering global education programs will be developed

31. I Identify the education and training needs of the maritime industry

Continuous evaluation of individual learning processes designed to prevent people from growing unstable and becoming mentally bored.

32. P- Provision of optimal national funding for research and development

33. P- platform be maintained where interests and concerns regarding the maritime industry can be raised and action taken

Assessment and accountability should remain important objectives in a global competency system, but the methods used may need refinement and expansion regarding approach and impact

34. I Identify areas where research and development is needed

35. N- Non-formal and Informal MET as a Platform for Global Education

Competencies can be developed in both the formal curriculum of instruction and informal curriculum like after-school projects, in peer-based projects, or in summer programs. Along the same lines, international study, work, volunteer, and shipboard training experiences have long been seen as pedagogically enriching opportunities for students and considered the most valuable educational experience any student can receive. While travel-based cultural exchange may not be an ideal option for all students, the new technologies are making cultural exchange accessible to everyone with a computer and an Internet connection

One of many organizations engaging in this work is AMEA with some of its member institutions is an advocated of the "Connect Program" where it brings together students from Africa, Europe, and Asia. The Connect Program participants use customized video conferencing technology to connect directly with their peers from around the world and to engage in discussionsof variousMET issues."

36. E - Efforts to internationalize public school curricula

37. S -Support programmes to make the shipping industry more competitive

4. CONCLUDING REMARKS ON THE FUTURE DEVELOPMENT OF MET

Whatever future MET developments are approaching in the coming decade, one thing is sure: the maritime world is marked by fast-paced, far-reaching change on a global scale. MET Educators see this as a challenge, while at the same time as a significant opportunity exists. Enthusiastic MET teachers are encouraged to design a mode of learning for a world in Hyper Transformation.

We need to prepare future seafarers not for a single, predefined maritime career until retirement, but for a life of accelerating unpredictable velocity. We are also responsible for transmitting the cumulative wisdom of the past, the fruit of the most exceptional minds and hearts that preceded us, and to impart the maritime qualities that must be cultivated or nurtured.

Efficiently functioning effectively in a world of "*hyper Transformation*" will require knowledge, skills, dispositions and attitudes that are markedly different from those needed a century or even a half-century ago. MET must provide baseline knowledge about math, science, language, and literature as it always has done. But beyond that, it must nourish maritime students' abilities to think, create, communicate, and problem solves, as well as sustains their inherent capacity for tolerance, understanding, and appreciation of multiple perspectives.

Armed with the multi-various global knowledge, skills, and attitudes, students will be capable of facing yet the unknown challenges. We must invent or develop a future MET that enhances the human well- being. Considering economic and other challenges facing the Philippines today, we must prepare for future challenges and must understand the compelling case this paper presents for the adoption of a global MET Model. As stated earlier, with problems come opportunities.

The challenge that Philippine policymakers and educators will face is in managing the unsynchronized local systems in a national and global paradigm. Therefore, this paper had explored ways and means of

framing global MET with each component. This approach creates a term of reference on which future programs, projects, or services can be developed to inspire future Global MET development in the Philippines.

5. REFERENCES

1. Barrell, J. (2010). Problem-based learning: The foundation for 21st century skills. In J.Bellanca& R. Brandt (Eds.), 21st century skills: Rethinking how students learn (pp. 33–49). Bloomington, IN: Solution Tree Press.

2. Baylon, Angelica M (2018) Post-Activity Report on 2017 sit APEC Seminar with the theme "Enhancing the Global Capacity of Seafarers in the APEC Region" hosted by the Korea Institute of Maritime and Fisheries Technology (KIMFT) and by Ministry of Oceans and Fisheries /Republic of Korea, in Bussan, the Republic of Korea

3. Baylon, Angelica M (2018) PAESP Project Implementation Benefits in the Philippines pp. 1-14 – unpublished paper presented on Feb 22, 2 2018 IAMU-MARINA MET Conference towards Globally Competitive Filipino Seafarers

4. Reimers, F. (2009). 'Global competency' is imperative for global success. The Chronicle of Higher Education, 55(21), A29.

5. Reimers, F. (2010)."Educating for Global Competency."In J. Cohen & M. Malin (Eds.), International perspectives on the goals of universal basic and secondary education (pp.
183–202). New York: Routledge Press.

6. Sarah Balistreri, F. Tony Di Giacomo, IvanleyNoisette, and Thomas Ptak (2012) Global Education: Connections, Concepts, and Careers. Research in Review 2012-4 retrieved on February 19, 2018 from
https://archive.org/stream/ERIC_ED562681/ERIC_ED562681_djvu.txt

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THE NEED FOR TVET QUALITY ASSURANCE SYSTEM AND QUALIFICATION STANDARDS (TEACHER-TRAINER-ASSESSOR) IN THE MARITIME INDUSTRY: THE MAAP EXPERIENCE

Angelica M. Baylon, PhD and Vadm Eduardo Ma R Santos, AFP (Ret)**

** Director for MAAP External Relations /Presenter
Maritime Academy of Asia and the Pacific, Mariveles Bataan Philippines
ambaylon@maap.edu.ph or ambaylon@gmail.com

***Abstract*:** This paper provides a brief overview of the Maritime Industry with focus on the seafarers being a number one choice in the global maritime arena as evidenced by the number of deployment of seafarers. A brief overview on the educational and training system in the Philippines with the concerned agencies (TESDA, DepEd, CHED, and MARINA) and their various initiatives have been analyzed primarily on the latest trend in MET namely: 2016 nationwide implementation of K to 12, OBE implementation and the Philippines Qualification Framework. **MAAP as a MET provider** and full supporter of the government initiatives is spearheading programs, projects, and activities aimed at ensuring a continuous supply of quality seafarers in the global maritime industry which this paper would like to share. This paper emphasized the need for a TVET quality assurance and a TVET Trainer/Assessors Qualification Standards in the Maritime Industry to ensure the success of the programs because the continuous training of human resources is the key to success. Technical-Vocational Livelihood (TVL) Maritime specialization and a Pre-baccalaureate Maritime specialization are being offered to Senior Maritime High Schools which must be handled by qualified and certified TVL maritime teachers. The TVET policy framework and TVET qualification levels have been analyzed. This is timely as this may serve as a reference by MARINA in expanding them to come up with general MET teachers' standards by incorporating the needed competencies (outcomes) and performance criteria for each qualification level. The paper ends with conclusions, recommendations, and projected implications/impact of quality assurance and qualification standards in the Maritime Industry thru innovations in TVET for socio-economic development

Key words: TVET, Quality assurance, Qualification levels, or standards, Assessment.

1. BACKGROUND AND RATIONALE

1.1. The MAAP, the Maritime Industry, and Seafarers Deployment

According to POEA, since 1987 to date, the Philippine is the world's leading supplier of seafarers and is the manning capital of the world. Filipino seafarers account for more than 30% of the world's seafarers. The International Chamber of Shipping (ICS) reported over 50,000 merchant ships registered in over 150 nations and manned by over a million seafarers of virtually every nationality **(1).** Also, in the Deloitte survey of companies and practitioners, it was reported that the Philippines supply more officers to the world fleet than any other country. Explicitly, the report stated that only the Philippines remains the largest market for crewing, advantaged by the fact that these people communicate very well in English. The maritime profession is desirable in the Philippines due to numerous factors including the country's geographical position consisting of approximately 7,100 islands, high unemployment rate, and population growth rate. Over the years, there has been a consistent growth in the number of Overseas Filipino Workers (OFWs), supported by increasing globalization and Filipino workers preference for a job abroad because of higher wages and better employment opportunities. More ratings are employed as traditionally; the distribution of workers is composed of about 65% ratings and 35% officers. However, even if there is a massive demand for rating workers, there is currently an oversupply of rating seafarers in the Philippines, as other countries are also supplying this category. At the same time, officer positions require

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long-term investments from the workers, regarding time and education, due to higher licensure and training requirements.

It is for this reason that on January 14, 1998, the Associated Marine Officers and Seamen's Union of the Philippines (AMOSUP) established the Maritime Academy of Asia and The Pacific (MAAP) to ensure a continuous supply of high breed graduates as future offices of the new seafaring generation. The actual school operation started in June 1999. Located on a 103 –hectare land in Kamaya point Barangay Alas-asin, MAAP is situated in proximity to the scenic coastal waters in Mariveles Bataan, overlooking the Manila Bay and Corregidor Island. The geographical location of MAAP is fitting for a maritime school that offers three maritime programs: the Bachelor of Science in Marine Transportation (BSMT), Bachelor of Science in Marine Engineering (BSMARE) and the Bachelor of Science in Marine Transportation and Marine Engineering (BSMTE) or Dual Course. MAAP offers full scholarship grants to qualified applicants selected nationwide through competitive qualifying entrance examinations. Other benefits include free board and lodging, insurance, leadership training and exposures, fleet training, discipline and extra-curricular activities that enhance student's mental, emotional, social and physical development, the use of state of the art equipment and facilities, and modern instructional methods utilized by world-class institutions. It undertakes grants from sponsors represented by reputable shipping companies who provide midshipmen with immediately available job opportunities aboard sponsoring company vessels**.**

The AMOSUP Seamen's Training Center (ASTC) which is the first and oldest training center for seafarers in the Philippines established in 1972 in Intramuros, Manila was transferred to its present site in Kamaya Pt., Brgy, Alas-asin, Mariveles Bataan in 1999 at the MAAP campus, in order for it to avail of all the MAAP facilities and equipment. ASTC is one of the best-equipped training centers in the country today. It uses state of the art equipment such as a Full Mission Bridge Simulator with ECDIS and AIS, Full Mission Engine Room Simulator, dedicated ARPA and Radar Simulators, Desk Top Engine Simulator with Liquid Cargo Handling Capability for crude oil, chemical products, LNG & LPG and a chemical product tanker simulator. Recently, it acquired a Full Mission Membrane LPG Simulator. It also has a Sea Survival Complex located near the shoreline in Sitio Marina facing Corregidor Island where courses in Survival Techniques, Free Fall Lifeboat, Davit Launched Enclosed Lifeboat and Proficiency in Survival Craft, and Rescue Boat (PSCRB) are held. Also, it also has facilities to conduct various offshore courses such as basic Offshore Safety Induction and Emergency Training (BOSIET), Further Offshore Emergency Training (FOET). Helicopter Underwater Escape Training (HUET), etc. ASTC has seven fully air-conditioned classrooms that can accommodate 24 students each; fully air-conditioned dormitory that can provide 120 trainees at any one time; and an Officer's Lounge equipped with billiard table, and television with karaoke system. After classroom hours, the students can use MAAP athletic facilities such as the swimming pool and the gymnasium where they can play basketball, volleyball, badminton, and futsal. They could also avail of the MAAP library. Under an equipment sharing scheme with the other departments of MAAP, ASTC students can make use of actual bridge equipment with operational functioning radars, ECDIS, AIS steering equipment, weather facsimile. GMDSS and other radio communication equipment with a separate fully air-conditioned engine control room, two main engines and two auxiliary engines with are all operational to include its associated systems such as air starting, lube oil, and water cooling. ASTC is accredited by Maritime Industry Authority (MARINA) to conduct 14 IMO Model Courses and as an assessment center for the Assessment for the issuance of Certificate of Competency (COC) as required by MARINA. Likewise, ASTC is recognized by the MARINA (Board of Examiners for Deck Officers and Board of Examiner of Engine Officer) as an assessment center for practical component of the Deck and Engine Licensure Examinations (Ship Simulator and Bridge teamwork and Engine Room Simulator courses. The Training Center offers 26 fundamental to advanced courses. **(2)**

MAAP fully support all government initiatives in maintaining the Philippine status as the number one choice for qualified seafarers in the global maritime industry.

1. First, to **ensure a continuous supply of qualified seafarers in the maritime industry**, MAAP partnered with GlobalMET to provide training for MET teachers responsible for producing qualified seafarers. This was done to ensure Philippine stand as the manning capital of the world and to contribute its share in addressing the global studies and reports on skills gaps. The Fisher report (2013) found gaps or deficiencies in the STCW Convention and the manner in which MET was delivered across borders **(3).** Skills have become the bottleneck of economic growth in any country, which means that trainees are not equipped with the necessary skills that employers need. This issue of **insufficient skills** is also evidenced in the research done by GlobalMET through the Asian Development Bank. Hence, since 2014, hosted by MAAP in its campus, GlobalMET provided continuing professional development to its member countries. One of the activities was the CPD held in Manila for its members and interested persons, in the MET industry. The CPD delivered standard competencies for personnel in

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"*standards-based"* curriculum development, teaching, training, instruction, and assessments of maritime personnel following the STCW Convention 1978 as amended. In the pursuance of excellence in MET, National Standards and International Standards have together been identified with the critical elements and descriptors (criterion-referenced) incorporated into the standards following national requirements for outcomes-based Education (OBE) and competency-based education, training and assessments (CBETA). These standards will now become the standards by which every MET institution will practice under the supervision of the MARINA. Courses of training and certification will be accredited through the authority of MARINA **(4).** Further, after the IAMU-MARINA International Conference at Midas Hotel on **February 25, 2018,** an initial meeting was facilitated by GlobalMET (Capt. Richard Teo) with MARINA, MAAP, PAMI, PAMTCI, NMP and CHED representatives on the need for the Philippines to come up with a MET Teachers Standards. It was agreed that PAMI, PAMTCI, CHED, and NMP should be developers with MARINA and MAAP as evaluators of the intended proposed Teacher Standards. On **June 25, 2018**, GlobalMET (**Dr. Capt Richard Teo**) made a follow-up on the inputs. Due to time constraints in the preparation of draft for MET Teachers Standard in August 2018, this would be developed instead by an independent group led by MARINA (**Ms. Presca Lee**) and by MAAP (**Dr. Angelica Baylon)**, in consultation with various maritime organizations (PAMI, PAMTCI, NMP and CHED) for their comments. The GlobalMET (**Dr. Capt Richard Teo and VADM Eduardo Ma R Santos, AFP (Ret))** shall serve as evaluators - validators and be responsible for its submission to the International Maritime Organization. On **June 26, 2018**, **Capt Richard Teo** and **Dr. Angelica Baylon** with **Mr. Pedro Garduque Cortez** called at Colombo Plan Staff College (CPSC) in Pasig and met with its **CPSC Director-General Dr. Ramhari Lamichhane**. International accreditation may also be attained through the **Asia Pacific Accreditation Commission (APACC).**

2. Second, to **ensure employment of the youth with adequate experiences** that meet company requirements, and more specifically with relevant employability skills and qualifications required in the maritime labor market, MAAP partnered with INM Korea for the pilot students in K to 12 maritime High School in support to the Philippines nationwide implementation of K to 12. This is a welcome development in the maritime industry particularly in reforming the TVET provision to provide necessary skills, particularly to youth, to increase their employability in the maritime world **(5).** MAAP President submitted the proposed maritime curriculum to DEPED and also had witnessed along with Ankla representative the signing of MOU between MARINA Administrator and DEPED Secretary in **March 2016** as shown in **Figure 1.**

Figure 1 MOU Signing between DEPED and MARINA

MAAP also supported national maritime high schools in the province of Bataan and signed MOU with them. MAAP also developed and shared in **November 2016**, the MAAP-GlobalMET inputs on Maritime Senior High School Track: Content Delivery and Assessment applying the OBE and CBETA concepts in line with STCW **(6).** With the maritime K to 12 implementations, more youth shall be provided certifications to work on board local and international vessels.

Accordingly, the government developed the quality assurance system that includes the standardization of skills and training programs as well as an assessment/certification system **(7).** The industry establishes standards, and TVET programs are designed to meet these standards. By mandatory registration, providers are required to comply with the rules instituted by the government. Then, graduates are assessed based upon these standards and their certifications indicate their acquisition of competency-based skills that employers need. In this way, the TVET system is expected to become more responsive to the needs of the maritime labor market.

1.2 The Philippine Educational and Training System

The education system in the Philippines is composed of three sub-sectors: primary education (elementary and secondary levels); post-secondary technical-vocational education and training, and tertiary education in community colleges, universities, and specialized colleges, which are managed by the Department of Education **(DepEd);** the Technical Education and Skills Development Authority **(TESDA);** and the Commission on of Higher Education **(CHED),** respectively.

The Commission on Higher Education **(CHED),** in accordance with the pertinent provisions of Republic Act #7722 otherwise known as Higher Education Act of 1994, is mandated to set the minimum standards for Higher Education programs without abridgement of

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curriculum freedom of universities and colleges except for minimum requirements and specific professional courses as may be stipulated by various licensing entities. CHED had revised policies, standards and guidelines for the Bachelor of Science in Marine Transportation and Bachelor of Science in Marine Engineering Programs **(8).** The **Policy-Standard to Enhance Quality Assurance (QA) in Philippine Higher Education** is through an **Outcomes-Based and Typology-Based** as shown in **Figure 2**.

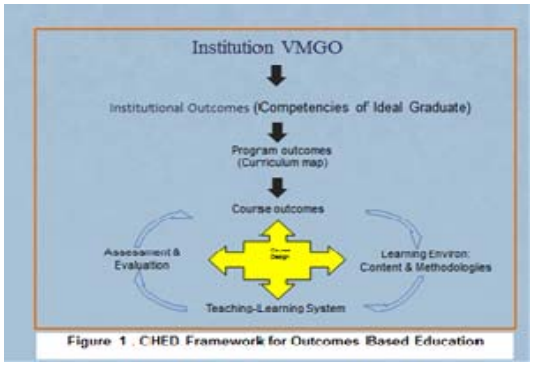

Figure 2 CHED Framework for OBE

The Technical Education and Skills Development Authority (**TESDA)** provides national leadership for the TVET system by implementing competency-based curriculum standards, training regulations, and assessment and certification processes to ensure a high-quality TVET development and delivery throughout the country. Hence, TESDA initiated a **TVET qualification assurance and qualifications standards for the teachers-trainees –assessors** to ensure continuous development of the Filipino maritime workforce with world-class competence and positive work values.

According to Republic Act (RA) No. 10533 or the Enhanced Basic Education Act of 2013, the Department of Education **(DepEd)** started the nationwide implementation of the Senior High School (SHS) Program with Grade 11 in School Year 2016-2017 followed by Grade 12 in School Year 2017-2018. The first batch of K to 12 graduates will be from the Sr. HS students in **SY 2017-2018.** The **DepEd** acknowledges and sees the increasing demand for seafarers in the international and local maritime industry; hence, in 2017, it has collaborated with MARINA to offer maritime specializations in Senior High School.

Under Republic Act No. 10635, the **MARINA** serves as the single Maritime Administration responsible for the implementation and enforcement of the 1978 International Convention on Standards of Training, Certification, and Watchkeeping (STCW), for Seafarers, as amended and international agreements or covenants related to it **(9).** The monitoring of the SHS maritime specializations is being conducted jointly by the DepEd and MARINA. Two Senior High School (SHS) Maritime Specializations were developed, a **Technical-Vocational Livelihood (TVL) Maritime specialization** and a Pre-baccalaureate Maritime specialization. The 1978 STCW Convention, as amended, was used as the basis for developing the curriculum for the TVL Maritime Specialization.

With the Philippines's recent shift to **K-12 compulsory education**, TVET education is integrated into senior maritime high school to produce high school maritime graduates with employability skills. The government's education department accredited **56 schools** throughout the country to entirely offer Maritime Senior High Schools curriculum that shall be responsible in preparing students for Maritime degree.

Those students, who do not choose to enter higher maritime education after high school, often select **TVET (TVL Maritime specialization**). However, they have to take the assessment for Certification of Ratings Forming Part of a Watch (Deck and Engine) to qualify them for career opportunities in the maritime industry upon graduation and evaluation. A National Certificate (NC) from TESDA is a well- recognized as national employment credentials but is not applied or transferable to higher education. Technical and Vocational Education and Training (TVET) in the postsecondary education sector, provides noncredit, technical middle-level skills training to produce skilled workers required for them to be recruited in both local and international maritime workforce.

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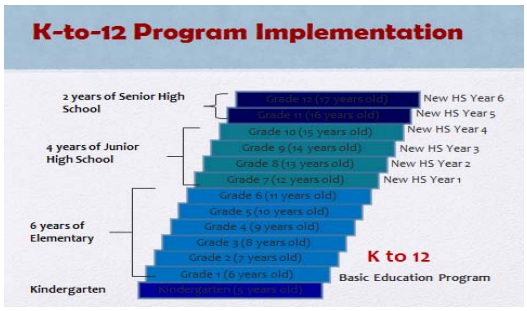

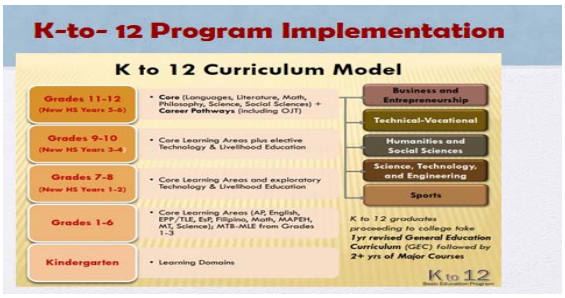

Figure 1 K to 12 Program Implementation

Under **Executive Order (EO) No. 75** signed by President Aquino on **April 30, 2012,** MARINA under the Department of Transportation and Communication (DOTC) is designated, as the Single Maritime Administration in the Philippines responsible for the oversight in the implementation of the 1978 Standards of Training, Certification and Watchkeeping (STCW) Convention **(10).**

MARINA now manages the **training aspect of the maritime industry formerly being handled by TESD**A. After the implementation of EO No. 75, MARINA Advisory No. 2013-10 series of 2013 was issued to all shipping companies, seafarers, manning agencies, and MARINA Regional Offices. The subject of which is the assumption by MARINA of **TESDA functions in the conduct of assessment and certification of seafarers in the rating category.** Hence, **TESDA's assessment and certification functions for Deck and Engine Ratings** were transferred to MARINA.

Likewise on March **13, 2014, thru Republic Act 10635**, MARINA assumed all powers and functions of the Professional Regulation Commission (PRC), the Commission on Higher Education **(CHED), TESDA**, the Department of Health **(DOH)** and the National Telecommunications Commission (**NTC**). MARINA is the lead agency responsible for the issuance, validation, verification, correction, revocation or cancellation of certificates of competency, endorsement, proficiency and documentary evidence required of all seafarers and all such other matters on the implementation of the STCW Convention **(11)**.

Such move was in response to retaining the Philippines in the White List. The White List distinguishes the nations that have displayed and established a plan of full. The primary purpose of the Convention is to promote the safety of life and property at sea and the protection of the marine environment by establishing in universal agreement international standards of training, certification, and Watchkeeping for seafarers. - International Maritime Organization **(12)**

2. ON QUALITY ASSURANCE AND QUALIFICATION LEVELS OR STANDARDS

2.1 Philippines TVET Trainers Assessors Qualification Program (NITAQP)

The Framework consists of four levels corresponding to the different roles assumed by trainers. These are Trainer Qualification Level I for **Trainer/Assessors;** Trainer Qualification Level II for **Training Designers/Developers**; Trainer Qualification Level III for **Training Supervisors and Mentors**; and, Training Level IV for **Master Trainer.**

The TVET Trainers- Assessors QUALIFICATION LEVELS (<u>that need to be expanded by MARINA</u>)

Qualification Levels	Trainer Qualification I: Trainer/Assessor	Trainer Qualification II: Training Designer/ Developer	Trainer Qualification III: Training Mentor	Trainer Qualification IV: Master Trainer
Definition	Conducts technical training and competency assessments	Designs and develops curriculum, courses and instructional materials	Supervises develops and mentors professional trainers	Extends the body of knowledge in the field of technical vocational education and training.
Entry Requirements	• BS Graduate or	• BS Graduate or	• BS Graduate or	• MS Graduate or

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	Equivalent • Certified in NC Level that will be handled	Equivalent • Certified in the NC Level that will be handled • With a portfolio of relevant actual work outputs	Equivalent • Endorsed in the highest available NC Level in the Training Regulation • With a collection of relevant actual work outputs	Equivalent • Certified highest available NC Level in the Training Regulation • With a portfolio of relevant actual work outputs
Basic Competency Requirements ***For example :*** ***The following competencies must be included*** **1. Apply employability skills in MET teaching roles** **2. Lead and manage Effective Communications** **3. Apply OBE and CBETA in MET in an adult learning environment**	1. Communication 2. Apply math and science principles in technical training 3. Apply environmental tenets and advocate conservation 4. Utilize and apply IT and digital innovations in conducting and delivery of Training 5. Lead and Work in teams 6. Apply work ethics, values, and quality principles 7. Work effectively in vocational education and training 8. Foster and promote a learning culture 9. Ensure a healthy and safe learning environment 10. Maintain and enhance professional practice 11. Appreciate cost-benefits of technical training 12. Understand and analyze global labor markets			
Core Competency Requirements	1. Plan and deliver Training Sessions 2. Facilitate learning Sessions 3. Supervise Work-Based Learning 4. Conduct Competency Assessment 5. Maintain Training Facilities 6. Utilize electronic /digital media in facilitating training	1. Facilitate Development of competency standards 2. Conduct Training Needs Analysis 3. Develop training curriculum 4. Develop learning materials 5. Develop assessment tools 6. Design and Develop maintenance system of training facilities 7. Develop Learning Materials for teaching and learning including e-learning and digital /synthetic learning	1. Facilitate development and review of training policies and procedures 2. Develop and execute training plans 3. Prepare and manage training budgets 4. Nurture and capacitate trainers/ assessors 5. Evaluate trainers/assessors performance 6. Lead and Coordinate training/ assessment evaluation 7. Facilitate assessment moderation 8. Lead and	1. Institutionalize TVET systems and processes institutions/enterprises 2. Conduct research on TVET 3. Promote, advocate and strengthen industry and TVET linkages 4. Provide professional development to TVET experts

			coordinate training/assessment 9. Lead and manage validation	
Trainer's Curriculum	Course on Training Methodologies and Assessment	Course on Training Design and Development	Course on Supervision and Development of Trainers	Continuing Professional Education

Source: TESDA (2006)

Those being certified in **Levels I and II must be specialists in the areas of competencies** they will facilitate while those being approved in **Levels III and IV must be both specialists and generalists.** The trainer curriculum specified in this program is an enabler and is intended to facilitate trainer development through the various qualification levels. Taking the different courses under the curriculum is not a strict requirement as the trainer may acquire the required competencies through other means like formal and non-formal training, exposure or experiences because learning is a lifelong process.

While there is an implied progression in the qualification levels, any trainer who feels competent and qualified for a particular level may, without necessarily being certified in the previous levels, apply for assessment and certification for that level, provided that the level's entry requirements for accreditation have been satisfied (**13).** Formal education has its equivalence concerning both non-formal education and personal experiences, which can be measured and validated regarding acquired competencies. The educational requirement as an entry requirement for certification may be waived through demonstration of the following equivalent competencies:

- Bachelor's Degree: Oral and written English communication; Quantitative and Qualitative Analysis and Verbal Reasoning.
- Master Degree: Leadership and Research Project.

2.2 Why are quality and qualification standards needed in the Maritime Industry?

The maritime Industry is composed of human resources or people. People connected in an organization or institutions as its workplace must continuously learn and be trained. Learning outcomes are therefore measurable and can be assessed against established standards. The ability to achieve consistent learning outcomes is indicative of training effectiveness **(14).** The workplace and environmental need must all be aligned with the workers' capability, and performance needs to accomplish the overall organizational needs and objectives.

Facilitators of adult learners must be well-versed in the appropriate **(Knowles andragogy 1968**) learning concepts, principles and theories to be able to apply the proper methodologies that will be effective in various learning situations and learner profile and to ensure consistent delivery of learning outcomes that enable performance improvements **(15).**

The training cycle consists of: *training needs analysis*; *training design and development*; *training delivery* (training administration, facilitation, and continuous assessments); and, *training programme evaluation*. All these training functions, including the management of these functions, contribute to training effectiveness. Trainers need to perform various roles and be competent in the capacity of such positions. Their employability skills (Mayer 1992 and Allen 2008) are the keys to successful training delivery **(16).**

There are **three domains of learning**: cognitive, affective and psychomotor skills (Anderson and Krathwohl - Bloom Taxonomy revised 2001-2002) **(17).** To be effective, the learning interventions must consider these three domains as the goals of the training process and as the basis for assessing learning outcomes. Trainers must be a specialist in the area of skill being facilitated to ensure students acquisition of competencies effectively. However, as the trainer assumes broader responsibilities, mainly through the exercise of management responsibilities, there is a need for the said trainer to be a specialist and a generalist at the same time. An individual does not always facilitate learning. Team teaching enables holistic development through the pooled expertise of two or more facilitators. Team teaching likewise allows trainer development as the junior trainers learn from the more senior trainers. The delivery of training should adhere to the design of the curriculum.

For example **Trainers Methodology Level I:** The Trainers Methodology Level I consists of competencies

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a TVL Maritime Specialization trainer or assessor must achieve, such as plan training sessions, facilitate learning sessions, supervise work-based learning, conduct competency assessment, maintain training facilities and utilize electronic media in promoting training. A person who has achieved this qualification is competent to be a TVET Trainer / Technical Trainer, Training Facilitator / Coordinator and Competency Assessor.

- Plan Training Session – this covers competence required to plan a training session, including identification of learner's requirements, preparation of session plan and instructional materials, and an organization of learning, teaching and assessment resources. This self-paced course is part of the cluster Trainers Methodology I - Deliver Training Session. **(18)**
- Facilitate Learning Session- this covers competence required to deliver Competency-Based Training Session, including preparation of training session, the conduct of pre-assessment, training session facilitation, conduct competency assessment and review delivery of training session. This self-paced course is part of the cluster Trainers Methodology I - Deliver Training Session.
- Utilize Electronic Media in Facilitating Training - this covers competence required in advance training environment using electronic media in facilitating training, including operation and maintenance of the equipment. This self-paced course is part of the cluster Trainers Methodology I - Deliver Training Session.

TESDA is responsible for **post-secondary TVET** that provides mid-level workforce in the Philippines. Its role is to provide an overall direction and policies of the TVET system, particularly in the area of setting standards and development for TVET systems. Additionally, TESDA retains both the **registry of certified workers and accredited assessment centers**. It is composed of the Board and the Secretariat. The TESDA Board is the highest TVET policy-making body composed of representatives from both the government and the industry. The Secretariat is a technical and administrative support arm. TESDA ensures that all TVET programs meet the national standards through its mandatory TVET program registration. TESDA also enforces a necessary assessment on all TVET graduates and confers certificates to all trainees who pass the evaluation. The following programs with training regulations may be looked into as reference for maritime instructors by MARINA.

- Trainer's Methodology Level 1 – 90-page training regulations
- Trainer's Methodology Level 2 – 94-page training regulations

Trainer's Methodology Level 1 (In-company trainer) – 158-page training regulations

2.3 The Quality Assurance Policy Framework

The **policy framework for the quality assurance system in the Philippines** includes four components: the *Philippine National Qualifications Framework* (PNQF), *Training Regulations* (TRs), the *Unified TVET Programs Registration and Accreditation System* (UTPRAS), and the *Assessment and Certification System.*

(a)The Philippine National Qualifications Framework (PNQF)

Qualification pertains to the package of competencies describing a particular function or job role existing in an economic sector. PQF was presented by CHED, TESDA, DEPED, and PRC and approved by NEDA, in 2012, is a national policy which defines the levels of educational qualifications and sets the standards for qualification outcomes. PQF is competency-based/outcomes-based; labor market is driven and assessment-based qualification recognition PQF supports the development & maintenance of pathways and equivalencies which provide access to qualifications and assist people to move quickly and readily between the different E & T sectors & between these sectors & the labor market & to align the PQF with international qualifications framework. **Figure 3** shows the PQF that integrates primary education (grade 11 and 12), TVET and HE into one consistent quality assured instrument fir classifying qualifications. The PQF call for an 8 –level qualification description that would give students the option to finish courses with NC 1, NCII, NCIII, NC IV or graduate with a diploma degree, bachelor post-baccalaureate and masters or doctorate.

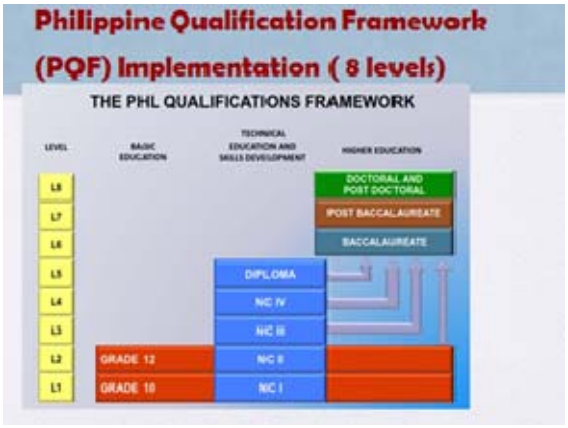

Figure 3 The Philippine National Qualifications Framework

This is an example of an educational paradigm and shifts program structures (specialized senior high school maritime track; associate degrees; junior colleges/feeder HEIs and dual training certifications). PNQF integrates all levels of formal education from the high school diploma, certificates, to doctoral degrees. All qualifications included in the PNQF are assured,

meaning that criteria fall well within the parameter of adequate skill standards and quality teaching. The Philippine National Qualifications are given to graduates who pass the assessment. Benefits of the PQF Implementation are as follows:

- For the person: lifelong learning allowing the person to start at the level that suits him and then build-up his qualifications as his needs and interests develop and change over time with the certificates and licenses recognized by the government
- For employers: standards and criteria are consistent to job requirements/demand and provide a shared understanding of standards, qualifications & levels
- For MET providers: transparency in training provision, conformance to standards & preciseness of accountability for learning outcomes; common knowledge of policies & guidelines
- For the authorities: standards, taxonomy, and typology of qualifications as bases for granting approvals to providers and stakeholders and; harmonized qualifications in MET across Phil.

(b) Training Regulations (TRs)

TESDA-promulgated document serves as a basis for which the competency-based curriculum and instructional materials and competency assessment tools are developed. This document represents a specific qualification. It defines the competency standards for a national requirement and how much skill can be gained, assessed and be given recognition. It would be interesting to note the exact number of training regulations that were promulgated by the TESDA Board (TESDA), MARINA, DEPED, Maritime organizations for maritime. As of **August 30, 2018**, the following training regulations (TRs) are found on the website. However, the certification and assessment powers were transferred from TESDA to MARINA in 2014 hence only three training regulations were left for TESDA's management- Ship's Catering NC I with 49-page TR; Ship's Catering NC II with 132-page TR, and Marine Electricity NC II.

The rest are of the TRs are under the responsibility of MARINA to assessed and certify.

- Able Seafarer for Deck NC II
- (STCW 11-5) – 72-page TR
- Able Seafarer for Engine NC II (STCW II_5) – 73-page TR
- Rating forming part of a Navigational Watch NC II (STCW 11-4)- 72-page TR
- Rating forming part of an Engineering Watch NC II (STCW 111-4)- 723-page TR

TRs are being developed in consultation with industry leaders and promulgated by the TESDA Board and MARINA. The TRs consist of the competency standards, training standards, and assessment and certification arrangements. They serve as the bases for the development of curriculum, instructional materials, and competency assessment packages for competency-based programs **(19).** TRs also prescribe which programs are qualified and registered. The development of TRs is based on four components of training delivery: curriculum; trainer qualification; tools and available equipment; and training facilities **(20).**

(c) The Unified TVET Programs Registration and Accreditation System (UTPRAS)

The Unified TVET Programs Registration and Accreditation System (UTPRAS) is a regulatory mechanism in which TESDA assures TVET programs. All providers offering TVET programs are mandated to comply with the set of standards for TVET provision. This process involves:

- **Compulsory registration of programs** in compliance with the standards prescribed in TR and a competency-based system. For mandatory registration, it signifies agreement of the TVET program in curriculum design, trainer qualification, facilities, and tools and equipment. The competency-based registration system prescribes the requirement of compliance with the minimum standards provided in the TRs. Compliance audits are conducted regularly by the field offices.
- **Voluntary accreditation.**

It would be interesting to note the number of registered TESDA Assessment Centers for Maritime. On the other hand, voluntary accreditation refers to the process of assessing and upgrading the quality of TVET programs through self-evaluation and external assessment by a TESDA-recognized accrediting body. The system provides multi-level accreditation status, public recognition, and conferment to ensure that a TVET program will meet and exceed the minimum requirements of program registration. It would also be interesting to note the number of institutions who voluntarily subjected itself for voluntary accreditation.

In maritime, **56 secondary schools have been recognized by DEPED and MARINA** to offer Senior maritime High Schools with TVL Maritime Specializations. Also interesting to note the exact number of maritime training centers recognized or accredited by TESDA as **TESDA Accredited Assessment Centers.** TESDA authorizes the MAAP-ASTC Training Center for all the short training courses that the ASTC offers. For Ships' Catering NC III (Ships' Cooks), there are 25 maritime training centers authorized by TESDA as Assessment Centers with MAAP-ASTC included. **CHED and MARINA** are responsible for accrediting maritime schools.

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(d) Assessment and Certification System

The Assessment and Certification System is the process of evaluating the TVET graduates to determine if they have acquired the level of competence to perform jobs in the workplace. It provides evidence of whether compliance and competency have met standards and have been achieved.

The assessment and certification system involves the accreditation of assessors, the development of assessment tools, the qualification of TVET trainers as assessors, and the recognition/ accreditation of National Assessment Boards. All programs with TRs are provided with competency assessment tools. Regarding issuing certificates, the qualifications are aligned with specific skill levels as defined in the PNQF, which includes **four certificate levels for TVET**—National Certificate Levels I, II, III, and IV, as shown in **Figure 4.**

PQF Implementation

Level 1 National Certification I

KNOWLEDGE, SKILLS & VALUES	APPLICATION	DEGREE OF INDEPENDENCE
Knowledge and skills that are manual or concrete or practical and/or operational in focus	Applied in Activities that are set in a limited range of highly familiar and predictable contexts; involve straightforward; routine issues which are addressed by following set rules, guidelines & procedures	In conditions where there is very close support, supervision and guidance; minimum judgment or discretion is needed

PQF Implementation

Level 2 National Certification II

KNOWLEDGE, SKILLS & VALUES	APPLICATION	DEGREE OF INDEPENDENCE
Knowledge and skills those are manual, practical and/or operational in focus with a variety of options.	Applied in activities that are set in a range of familiar & predictable contexts; involve routine issues which are identified & addressed by selecting from and following a number of set rules, guidelines or procedures.	In conditions where there is substantial support, guidance or supervision; limited judgment or discretion is needed.

PQF Implementation

Level 3 National Certification III

KNOWLEDGE, SKILLS & VALUES	APPLICATION	DEGREE OF INDEPENDENCE
Knowledge and skills that are a ***balance of theoretical and/or technical and practical***	Applied in activities that are set in contexts with some unfamiliar or unpredictable aspects; involve routine and non-routine issues which are identified and addressed by interpreting and/or applying established guidelines or procedures with some variations	Application at this level may involve individual responsibility or autonomy, and/or may involve some responsibility for others. Participation in teams including team or group coordination may be involved.

PQF Implementation

Level 4 National Certification IV

KNOWLEDGE, SKILLS & VALUES	APPLICATION	DEGREE OF INDEPENDENCE
Knowledge and skills that are mainly theoretical and/or abstract with significant depth in one or more areas; contributing to technical solutions of a non-routine or contingency nature; evaluation & analysis of current practices and the development of new criteria and procedures	Applied in activities that are set in range of contexts, most of which involve a number of unfamiliar and/or unpredictable aspects; involve largely non-routine issues which are addressed using guidelines or procedures which require interpretation and/or adaptation.	Work involves some leadership and guidance when organizing activities of self & others

Figure 4 The PQF Implementation for Level 1-4 National Certifications (NC1- NC4)

It would be interesting to note the statistics or exact numbers for these if any. It would be interesting to get the precise statistics for maritime issued with NC 11 both for able seafarer (Deck or Engine) and Rating watch keeping (Deck or Engine), be it TESDA or MARINA database and their employability status with the K to 12 implementations.

3. CONCLUDING REMARKS

In conclusion, the ultimate goal of the quality assurance system is to increase the relevance of provision, which in turn, enhances the **employability skills** and **increases the employment of the youth** in the maritime arena. To implement the assessment successfully, there should be well-trained assessors.

Training and accrediting assessors in the Maritime Industry is a must in the Philippines**.** With the TVP maritime specialization trainers, they need to be equipped with the skills to conduct assessments of their trainees' competencies, but training trainers as assessors are indeed required.

To enhance employability skills and increases the youth employment in the maritime labor market, it is emphasized in this paper the need for the TVET in developing the quality assurance system. TESDA in the Philippines had introduced the components and the procedure of assessment in the policy framework successfully. The **Philippines National TVET Trainers and Assessors Qualification Program** should be implemented in the maritime industry to ensure qualified and certified TVL maritime specialists and generalist. TVL maritime specialization trainers must at least be a TQ1 qualified to assess trainees.

- Since the K to 12 implementations started in 2016 nationwide, it would be interesting to note that from 2016 to date, how many TVL maritime trainers have been certified with at least a Trainer Qualification 1 (TQ1). From there, the level of the TVET trainers may be raised from TQ1 to TQ2 and higher as a positive indicator of Maritime Teachers-Trainers-Assessors development program in the Philippines.

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- The policy also explicitly prescribes that assessment tools should accompany the TRs at the implementation level. It would be interesting to know if all TRs have assessment tools.

With these functions transferred to MARINA, however at the service delivery level in the maritime industry, there seems still a need to increase assessment tools/ packages, number of maritime assessors, and provide information on the test schedules. Also, well-trained skilled assessors require training and an accrediting system. Trainers should also be trained as assessors because in many cases, assessments are conducted at training institutions. If these supportive mechanisms at the service delivery level are not completed, then, even if the policy framework on evaluation is well- designed, outcomes will not be favorable. MAAP as a MET provider shall continuously support and initiate TVET programs, projects, and activities in partnership with both local and foreign counterparts for socio-economic development

4. RECOMMENDATIONS

1. A Need for MARINA /TESDA to Qualify and Certify Maritime Teachers/Trainers/Assessors

Teachers are trainers and assessors. Assessors are also teachers/trainers. There is a need to qualify and certify the instructors or teachers responsible in handling the **TVL maritime specializations** to professionalize the teacher responsible in enabling a learner or a group of learners to develop maritime competencies in performing a particular trade or technical work. An **NC certification** would qualify him/her to assume various roles namely: as a training facilitator, competency assessor, training designer, and developer and training supervisor. In line with the TESDA/ MARINA role in awarding NC to trainers/ assessors which include maritime workforce

- The competency standards of TVET maritime Trainers given different functions and qualification levels must be identified.
- A structure that will ensure the systematic and purposive development of TVET Trainers must be established
- The competence of TVET maritime Trainers at different roles and levels of technical training must also be demonstrated and certified.

2. A Need for MARINA to expand the Philippine TVET Trainers Assessors Qualification Program to be used in the Maritime Industry for MET Teacher Standards or Qualifications

Given the number of Maritime Technical Training Institutions, TVET maritime Trainers and the diversity of maritime coverage and maritime qualifications, the 2006 Philippines TVET Trainers Assessors Qualification Program (NITAQP), may be used in the maritime industry to ensure consistent delivery of quality training services for the maritime TVL courses

However, there is a need to expand the **TVET Trainers /Assessors Qualification Program** to show the makeup of the qualifications with the requisite competencies (outcomes), and with performance criteria for each level. Each unit of competency must be identified, described; explaining the volume of knowledge and skills required for performing the various competencies under varying conditions (attitude-behavior). The TVET format can be further expanded to show how the Trainer 4 levels qualifications are packaged to enable delivery and assessment. TVET follows OBE ad CBETA and criteria must be of standard units of competences. Spady's work updated **(21)** and Blooms updated (Anderson and Krathwohl - Bloom's Taxonomy Revised - The Second Principle) will be used in **expanding the TVET Trainers/Assessors Qualification Program for Maritime by MARINA.**

Important Notes:

- The augmentation of the MET **TVET Trainers/Assessors Qualification Program for Maritime by MARINA** supersedes the outdated IMO Model Course 6.09 and associated programmes.

- These **IMO model courses do not meet the requirements for adult learning, OBE, Competency-Based Education and Assessments required by the STCW convention**. Most of all they do not achieve the standards-based approach to attaining competencies as outcomes of learning in TVET.

3. A Need for MARINA to provide that quality assurance and qualification standards of MET Providers in the Maritime Industry

The service delivery level should be strengthened. The provider and assessment centers should be supervised and assessed on their compliance with the provision of TVET programs and conducting assessment/certification within the guidelines.

The Quality or competency of trainers which is the key to delivering TVET programs should be improved. Various accredited training organizations like **GlobalMET**, Colombo **Plan Staff College, NMP, TESDA, and other APACC accredited training providers** may assist MARINA

The Assessment centers should also be monitored to ensure that assessment packages are well prepared, and assessors are well trained.

The **Competency-based standards** must be designed with the maritime industry's input, so trainees could obtain skills that were required by employers.

Programs should be accredited within the guidelines prescribed in TRs, and providers should also be

registered. This is where **the Asia Pacific Accreditation and Certification Commission (APACC)** could come in to assist.

4. The Need for a MET QA system, with the following in place:

- Philippine Quality Training Framework (PQTF) must contain the **Risk-based component** in support of the PQF. Risk Assessment Requirements, an instrument that sets out details of the financial viability risk assessment of registered and applicant training organizations. Data Provision Requirements, a tool that sets out the requirements for providers about the submission of data to TESDA upon request and to submit quality indicator data annually.
- Continuing (periodic surveillance) maintenance of registration. Audit training and certification for MET personnel and regulators must be issued to ensure standards are held on par.
- Purpose of the Standards: to describe the requirements that an organization must meet to be an accredited MET provider; to ensure that training delivered meets industry requirements (as set out in training packages and accredited courses) and has integrity for employment and further study; and to ensure that MET providers operate ethically and consider the needs of both MET students and the maritime industry.
- The structure of the Standards. Each Standard must consist of the Standard itself, which provides a broad statement about the required outcomes of that Standard; a context statement, which includes background information to aid understanding, but is not part of the Standard itself and does not describe any compliance requirements ; and that one or more clauses, which represent the outcomes a provider is required to achieve to comply with that Standard (for a MET Provider to comply with the Standard, it must fully comply with all of the clauses in the Standard).

5. A need to monitor and track TVET and MARINA statistics

As the latest TVET statistics report is from the year 2014-2016, it would be imperative to monitor the statistics pertaining the training successes and situations in the MET, maritime sector including the nationwide implementation of the K to 12 programs in 2016 to date for, all NC that would be issued by TESDA and MARINA and to monitor the projected implications of quality assurance and qualification standards in the maritime industry.

Once accomplished by all concerned government agencies in the Philippines, these would also be an innovation in TVET for Socio-Economic Development.

PROJECTED IMPLICATIONS AND IMPACT OF TVET QUALITY ASSURANCE AND QUALIFICATION STANDARDS IN THE MARITIME INDUSTRY

1. **Increase in the skills Certification Issued** - to improve the recognition of certifications/qualifications among employers, the participation of employers in both designing and implementing quality assurance mechanisms should be emphasized. The identification of certifications among employers is also a critical factor in increasing the certification rate.

2. **Increase Relevance Programs** -The assumption is that certified trainees (TVL maritime specialization) who complete employer-designed competency-based programs can enter the labor market more efficiently.

3. **Increase in Employment rate**- It is also important to note if the employers value certification by hiring only workers with the necessary maritime accreditation. Certifications inform employers that trainees have acquired skills in line with competency-based qualifications and can perform their jobs successfully.

4. **Increase in Passing Rate/Outcomes result** - It would be interesting to note the outcomes of the employment rate of those who graduated from TVL Maritime specialization.

5. **Increase in Employers recognition** - The policy framework on quality assurance is rightfully designed to aim at increasing the employment rate; however, without employers' acceptance, the desired level cannot be achieved. Therefore, when implementing a particular policy, the acceptability and recognition of the system among stakeholders become a critical contributing factor to its success.

5. REFERENCES

1. ICS | Shipping and World Trade at http://www.ics-shipping.org/shipping-facts/shipping-and-world-trade retrieved in July 2018
2. AMOSUP Seamen's Training Center at http://amosup.org/union-programs/educational-training/amosup-seamens-training-center/ retrieved in July 2018
3. Annual Report 2013 - GF Georg Fischer at http://annual-report.georgfischer.com/app/uploads/sites/2/2017/02/AR_2013_en.pdf retrieved on July 28, 2018

4. Agenda - CrewConnect Global Main Conference Day 1 at https://maritime.knect365.com/crew-connect-global/agenda/2retrieved in August 2018
5. Master Thesis-TVET | Vocational Education | Tourism https://www.scribd.com/document/363346462/Master-Thesis-TVET retrieved in August 2018
6.Maritime Track SHS: Content Delivery and Assessment at http://patef-update.org/resources/NC2016/Part2/6-Acad6.DrBaylon.pdf retrieved on Aug 2018
7. TVET quality assurance system in the Philippines at http://www.voced.edu.au/content/ngv%3A59992 retrieved in August 2018
8. Republic Act No. 10635 | Regulatory Compliance at https://www.scribd.com/document/242896539/Republic-Act-No-10635 retrieved in August 2018
9. 2018 CHED Memorandum Orders – CHED at http://ched.gov.ph/2018-ched-memorandum-orders/ retrieved in August 2018
10. Maritime Industry Authority averts delisting at http://maritime-connector.com/news/general/maritime-industry-authority-averts-delisting-of-philippines-from-imo-list/ retrieved in August 2018
11. Republic Act No. 10635 | Regulatory Compliance at https://www.scribd.com/document/242896539/Republic-Act-No-10635 retrieved in August 2018
12. International Convention on Standards of Training at http://www.admiraltylawguide.com/conven/stcw1978.html retrieved in August 2018
13. The Philippine Maritime Industry Through the Years – TESDA at http://tesda.gov.ph/Uploads/File/planning2017/LMIR/MARITIME%20LMIR%20March%2017%20with%20cover%202017.pdf retrieved in August 2018
14. National TVET Trainers Assessors Qualification Program at https://tm1.gnomio.com/mod/resource/view.php?id=251 retrieved in August 2018
15. Andragogy –Adult Learning Theory (Knowles) at https://www.learning-theories.com/andragogy-adult-learning-theory-knowles.html retrieved in August 2018
16. Employability skills and opportunities for accreditation of part-time at workfile:///C:/Users/ERO/Downloads/http---www.aphref.aph.gov.au-house-committee-edt-schoolandwork-report-chapter4.pdf retrieved in August 2018
17. Anderson and Krathwohl – Bloom's Taxonomy Revised Understanding the New Version of Bloom's Taxonomy ©Leslie Owen at https://thesecondprinciple.com/teaching-essentials/beyond-bloom-cognitive-taxonomy-revised/retrieved in August 2018
18. Home: Deliver Training Session (COC1) at https://www.tesda.gov.ph/course/index.php?categoryid=34 retrieved in August 2018
19. Competency-based Curriculum –TESDA at https://www.tesda.gov.ph/Downloadables/CBC%20Rating%20Forming%20Part%20of%20a%20Navigational%20Watch%20NC%20II%20(II-4).pdf retrieved in August 2018
20. The Philippine Technical Vocational Education and Training at https://docplayer.net/1620850-The-Philippine-technical-vocational-education-and-training-tvet-system.html retrieved on August 2018
21. William G. Spady Outcomes Based Education: Critical Issues and Answers at https://files.eric.ed.gov/fulltext/ED380910.pdf retrieved in August 2018

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OPTIMIZING ACTIVITIES IN A CONTAINER TERMINAL BY DEVELOPING THE OPERATIONAL PROCEDURES OF THE MANAGEMENT SYSTEM

Robert Alexandru, Dăineanu

[1]Constanta Maritime University, Faculty of Naval Electro-Mechanics, 104 Mircea cel Batran Street, 900663, Constanta, Romania, e-mail address: decanat@cmu-edu.eu
[21]Constanta "Ovidius" University, Faculty of Natural Sciences, 132, Mamaia Street, 900721, Constanta, Romania, e-mail address: rectorat2@univ-ovidius.ro

Abstract: Maritime transport is the sector of the international economy that ensures the transport of people and goods in space. In other words, maritime transport within the global transport system is the economic activity through which trade is made between two points (one being the expedition and the other the destination) situated on land but separated from water. Maritime transport is considered - and rightly so - one of the most important international activities, the study of some aspects related to this field also involves the study of the world economy. That is why we can say that this type of transport is very sensitive to the events recorded globally. The operational equipment used in the container terminal is the main means of cargo handling both from the ship to the terminal and vice versa as well as within the storage / transport terminal. Of particular importance are the equipment targeted for indoor traffic. Port facilities involve costly investments but are imperative for efficient operation without overloading or neglecting the technical endowment of operators, as happened in some countries that have built new operating capabilities when the old ones were already very crowded or on the contrary, as long as they did not have the optimal load. All means of exploitation must be carefully calculated and should not lead to high economic costs for operators who have incorrectly operated or poorly maintained port facilities. The cost of these installations is generally not invoiced to the infrastructure user, and it is mainly borne from self-financing.

Key words: container terminal, maritime transport, operational equipment, port facilities, world economy.

1. INTRODUCTION

Shipping accounts for about 75-80% of the world's total freight traffic. Economics and external economic relations rely mainly on maritime transport.

The economic role of maritime transport is to ensure the commodity circuit, nationally and internationally, in a safe and timely manner, with economic efficiency and in accordance with the conventions, laws and clauses in force.

Maritime transport is a catalyst for economic development, being a cheap, cost-effective source of transport even for the transport of ordinary products, due to prices much lower than those of other means of transport.

The economic development of society has taken place concurrently with that of transport, including maritime, between the development of economic relations and international transport, and there is a close interdependence: on the one hand, the increase in the economic exchanges between states determines the increase in the transport requirements, its development; on the other hand, the development of transport (by improving the means of transport, ports, airports, railways, main pipelines, the emergence of new transport routes facilitating freight exchanges and reducing transport costs) has an active influence on development international commodity exchanges.

Freight transport is carried out in accordance with a whole range of international conventions in the field of transport. The multilateral character makes this area a distinct one, given that it is regulated separately, and it is also closely related to the other branches of law. Modern maritime trade is a vast and complex economic activity, both as a volume of commodities in annual traffic and as a material value, plus the huge, high-tech investments represented by ships as a means of transport and transport modern ports.

Much of the international trade between countries on the same continent or between geographically united continents is done in the inland waters of the riparian countries and maritime transport is essential for trade between countries on different continents or between countries on the same continent but at long distances

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between them. At present, more than 80% of international trade is carried out with the aid of shipping, mainly maritime transport, which remains the cheapest type of transport, and is at the same time an indispensable factor for securing international trade.

The main phases of the development of a port from the traditional harbor to the modern modern harbor are shown in Figure 1.

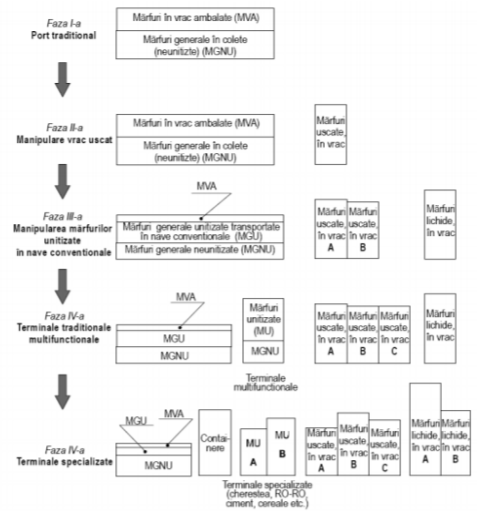

Figure 1 The development phases of a port [1]

- Phase I. Traditional harbors
- Phase II. Development of solid bulk terminals.
- Phase III. The emergence of unified goods and bulk cargo terminals.
- Phase IV. Development of multifunctional terminals.
- Phase Five. The emergence of specialized terminals.

2. GENERAL NOTES ON THE ORGANIZATION OF A MARITIME TRANSPORT RATE

Container transport has become competitive and profit margins have become very low. In such an environment, the pressure is very high due to costs. Port tariffs and fees form only part of the total costs of transporters. The tendency is to place more emphasis on port charges and fees than on the costs of reorganization services and time, because it is easier to determine the impact of tariffs and port fees on carriers than the impact of time services and reorganization. The reorganization of a line service network can be defined as the probability that one or more links will fail, according to a set of operating variable standards. A downtime or poor performance of a link will add extra costs to lost time, additional operating costs, or other costs as a result of delays or diversions. Reorganization affects the degree of stability of service quality a system offers. In the concept of navigation services, vulnerability can be defined as the inability to provide the appropriate services. Thus, the reorganization focuses on the possibility of maintaining the link, the possibility of degrading or destroying a link.

2.2 Transfer flow

The transfer stream represents all the physical operations of handling the goods when they are loaded and unloaded, the transport itself, trained by a complex of technical and execution factors that must ensure the flow of supply / distribution in conditions of increased economic efficiency.

a) Transport under FCL conditions(Full Container Load)

"Gate-to-Gate" transport service.

The goods are loaded into containers, then the container is transported on different means of transport: rail, road, sea transport and thus arrive at the consignee.

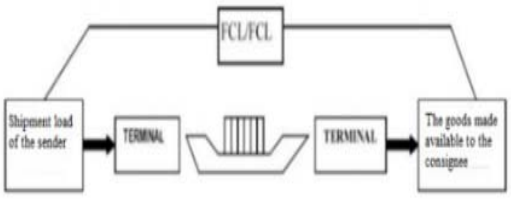

Figure 2 FCL transfer flow [2]

b) Transport under LCL conditions(Less Container Load)

It is the transfer service from cheu to cheu. This is the partially offered service, when charterers do not have enough goods to fill a container. The goods are brought to the CFS (Storage area or grouping), which is in or near the loading terminal, is loaded into containers, transported to the discharge bridge and delivered to the recipient in the CFS at the unloading port.

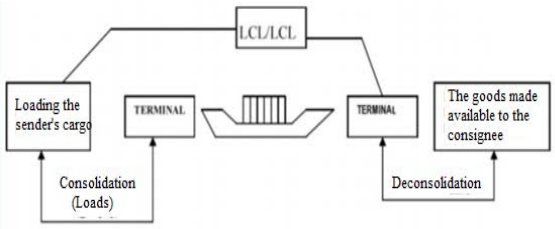

Figure 3 Transport under LCL conditions [3]

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c) Transport under FCL / LCL conditions

The FCL / LCL condition is met when the charter wishes to ship the merchandise to several recipients at the same time and in the same container. In this cay he may benefit from FCL on shipment and LCL conditions at destination, where the cargo is distributed to recipients.

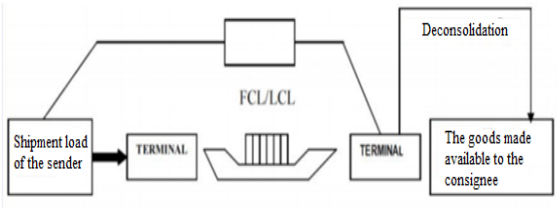

Figure 4 Transport under FCL / LCL conditions [4]

d) Transport under LCL / FCL conditions

The LCL / FCL condition is encountered when the charterer has to receive from different suppliers and prefer a LCL delivery. The merchandise will be loaded into one or more containers. From this point, the cargo will be transported under FCL conditions.

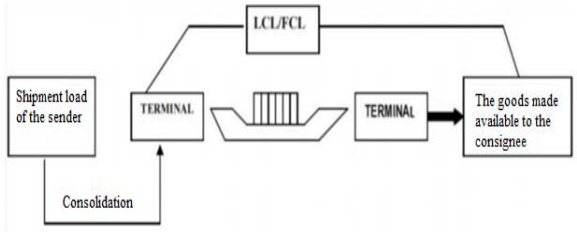

Figure 5 Transport under LCL/FCL [5]

3. OPERATIONAL EQUIPMENT IN A CONTAINER TERMINAL

Port facilities involve costly investments but are imperative for efficient operation without overloading or neglecting the technical endowment of operators, as happened in some countries that have built new operating capabilities when the old ones were already very crowded or on the contrary, as long as they did not have the optimal load. All means of exploitation must be carefully calculated and should not lead to high economic costs for operators who have incorrectly operated or poorly maintained port facilities. The cost of these installations is generally not invoiced to the infrastructure user, and it is mainly borne from self-financing. The basic infrastructure is subsidized directly or indirectly by the State, as in the example of France, where the state takes over 80% of the cost of maintaining the quays. The current trend is to lower these subsidies, leading to the disappearance of direct state aid in many countries, the burden of sustaining investments remaining on the national or international economic and investment environment.

The port facilities are composed of:

• outdoor fittings: access channel, waveguard, avantgarde;

The access roadway is a straight path consisting of a succession of straight zones which make a minimum angle of 300 between them. Its length is given by the size of the largest ship that has the right to enter the port, this value being imperative if the track is in the wind area. In order to avoid the risk of failure, the depth is 10-15% higher than the draft of the largest ship, below which the movements of the ship can be interrupted by waves exceeding 3. Also, an access rail intended to be used of 250,000-tonne oil tanks must have 350 m wide and a depth of 22-23 m.

Avanportul. It allows ships to stay waiting for tugs to assist in operating the dock. For ships arriving and maneuvering, the avoidance circle must have a diameter equal to 2-3 times the length of the largest ship. The avant-garde waves should not exceed 1.5 m and should preferably be limited to one meter.

The dykes that protect the waveguide are made to withstand very high waves:

-Vertical ditches consist of a large wall made of large concrete blocks (over 100 tons of weight) fixed and aligned with vertical pillars of slightly reinforced concrete or reinforced concrete cavities. This wall is formed on a massive sprain. Its dimensions must ensure stability

-The dikes in the slope are made of small embankments covered with large-scale stones, a shell of large natural or artificial cliffs (concrete) capable of withstanding the great efforts of blasphemy and waves. The upper part is made up of a massive concrete structure placed on the level in the sea to avoid its corrosion caused by waves.

-Mixed ditches are built up by combining the two above-mentioned types, being designed to withstand very large waves.

• Indoor arrangements: pools, operating berths and dry areas.

3.1 Key equipment

Quay machines performing ship loading / unloading operations in technology processes directly affect how port traffic flows. The classical tools used for ship operation are generally of two types:

MOBILE CRANES are intended for work in a specialized port terminal. They have a great utility in the container terminal for loading and unloading ships as well as for handling heavy containers in the surfaces intended for them in the port terminal. The maximum range is 30 tonnes for a 40-foot container plus 10 tonnes for the spredel, so a total of at least 40 tonnes. The maximum action range for a port container of 1,500 TEU is approx.

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31 m, and for the handling of 13 rows of containers (Panamax distance), a 32.5 m (32.5 m).

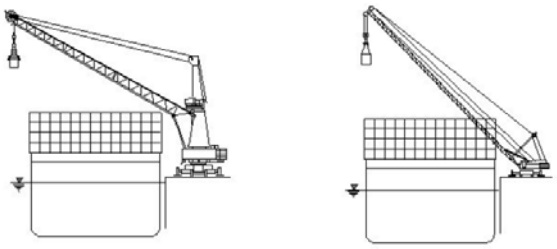

Figure 6 Mobile cranes [6]

PORTERS are descending bridge-type machinery moving along runways located along the quay along the operating front, Figure 2.9. The keepers perform three main movements: lifting, turning, swinging the swing arm. They must have openings covering 2-3 rail tracks, at least one road bundle, and a temporary storage area of the containers.

The main features of the Portainere are: 40 tons minimum load, 32.5 m maximum radius of action, 25 m lifting height, 25 m width, 15 m width, 12 m height.

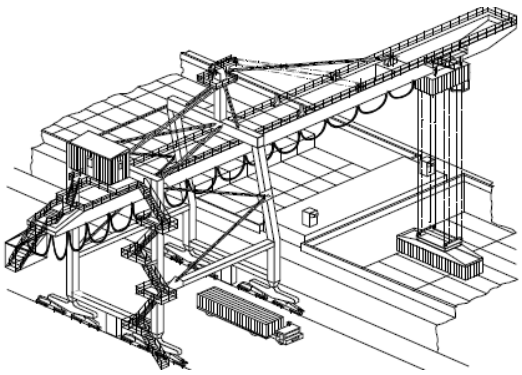

Figure 7 Portainers [7]

3.2 Terminal operation machines

Three types of trailer are used to move the containers inside the terminals:

Low platform trailers - long distances, low speed due to small wheel sizes are a disadvantage, but they have the advantage of being stacked when empty.

Trailers with normal height - are similar to road trailers, but are more robust, with no suspension or external connections.

Hydraulic lifting trailers have the advantages of the other two types but do not need a loader. Hydraulic lifting system ensures that the load is lifted from the ground but can not be used for stacking. These types of trailers are towed by a vehicle fitted with coupling devices.

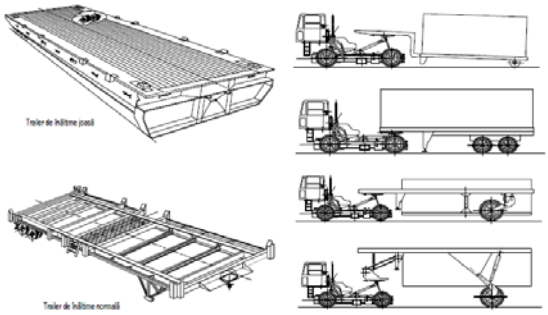

Figure 8 Trailers [8]

The Reach Stacker crane can perform the same operations as front forklift trucks, providing the necessary flexibility.

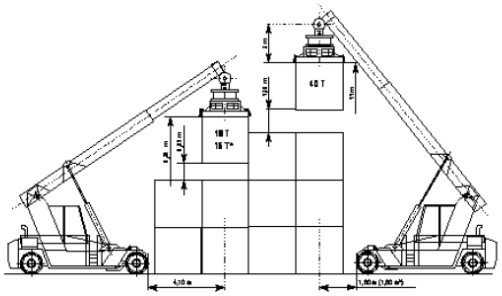

Figure 9 The Reach Stacker [9]

The Goat Container Conveyor (Straddle Carrier-Rider) is omnipresent in the container terminals. It offers high flexibility, but the acquisition and maintenance costs are very high. Its stacking capabilities range from a row-one column to three rows-three columns, one row-two columns being the most common.

Horsemen are fast and safe handling of containers in the terminal, which work more efficiently in agglomerated spaces when the loads need to be moved, lifted and stacked at high heights or when selectively extracted from the ground. The level of selectivity makes possible a faster cycle of vehicles in the case of inland transport, minimizes the need for additional lifting for access to the required container and enables a much higher storage density of the loads. These factors are essential when reliable services are to be provided on a highly competitive market.

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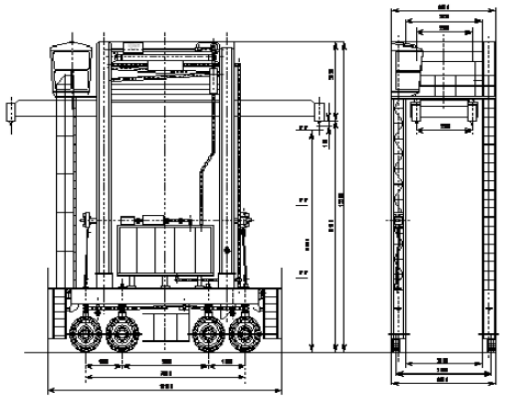

Figure 10 Straddle Carrier-Rider [10]

Transtainers are ramp-mounted conveyor bridges (RMGs) or tire-borne transporters (RTGs), which are highly specialized machines with large stacking capabilities and well-suited to high-order operations.

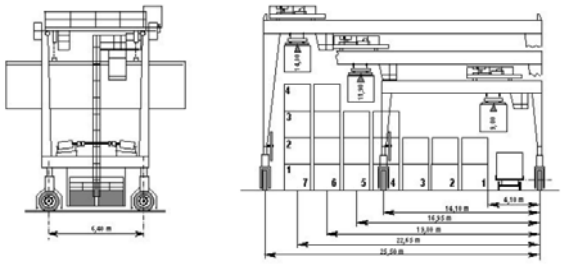

Figure 11 Transtainers [11]

The transport variant from the quay to the inside of the terminal with the existing equipment is limited to the take-over of containers under the portainer with tractors with a single trailer. The main reason why two or three trailers can not be trailed to a tractor is because the trailers used in the terminal have four or eight wheels on the rear. Without wheels and front, they have a support point and so they can not get up. As the terminals are equipped with a large number of high capacity tractors and trailers, the proposed variant can provide sufficient resources to correlate the intrinsic capacity of the goods handling subsystem with the inland transport subsystem.

Transport from storage to stacking is done with tire tread (RTG). Another option would be to use a telescopic boom, which has a maximum stacking capacity of three rows: first 45 tons, 30.5 tons second, and 15 tons third. For the stacking container, the two front-loader for 9-tonne empty containers will be used.

4. OPERATIONAL PROCEDURES IN THE CONTAINER TERMINAL

Inside the terminal there are strict rules on vehicle traffic and pedestrian traffic. So the purpose of this procedure is to include all aspects of the Labor Standards and to identify all the risks associated with moving mobile equipment and pedestrian traffic.

Pedestrian traffic is restricted to the terminal's operational areas, except for the following:

- The operator Dan
- Circulation Movement Operator (Daineanu Robert Alexandru)
- Dispatch
- Ship Planner
- Chief of Container Area Container Transport Department
- Chief of Transports Department
- Chief of Transportation Workshop

Visitors wishing to transit through the terminal's operational areas are required to use terminal vehicles specifically designed for passenger transport. Any unauthorized person found in the operational areas of the terminal will be escorted to the secondary gateway for further security clearance from the security firm.

We need the following protective equipment to enter the terminal:

- Helmet
- Reflective vest

Reflective equipment

- VHF communication system
- Terminal equipment equipped with lights and audible warning systems

4.1 Procedure for trafficking protocol

The purpose of this procedure is to reduce or eliminate the risks of accidents within the container terminal.

The goal is clear: to define the responsibilities and the way in which the traffic of mobile equipment, but also of all the vehicles using the access ways of the terminal, unfolds.

Devices targeted by the traffic protocol:

• ITV
• RTG
• RMG
• CHE
• RS
• Shuttle Bus
• Terminal Bus
• Forklift

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• External trucks
• The means of transport of the authorities
• Authorized cars and utensils, belonging to contractors, agents and visitors

Parking areas

• ITVs will park in the area between the Cantina and the Workshop;
• Trailers will park in the "E" area;
• RTGs will be parked on the ends of the lines in the areas designated by Yard Foreman or the Operations Supervisor to be connected to the electricity network for as long as it does not operate
• RMGs will park at the ends of the Rail area at the two anchor points;
• The RS and ECH will be parked in the area between the Workshop and the PECO Station; during mass-pause, ECH-type machinery will be parked in the RR area adjacent to the leaky container area; during the mass pause, RS-type equipment will be parked in berth, ie in the lid area, in the place indicated by the Operations Supervisor;
• The shuttle bus, for as long as it is operational, awaits your orders in the parking lot in front of the Cantina;
• The terminal bus, while it is operational, will wait for the orders in the parking lot in front of the Cantina;
• The Forklift will be parked when not in use, and when it is operational, it will be parked only on the lid area, ie in the location indicated by the Operations Supervisor;
• The external trucks have two parking areas next to MAIN GATE, designed to lock / unlock ladder systems or any other container loading / unloading operations; during the waiting period of operation in the container storage area, they will be stationed outside the access routes for traffic in the terminal and the runways of the RTGs.
• The means of transport of the authorities throughout the visit will park in the areas indicated by Yard Foreman or the Operations Supervisor so as not to interfere with the proper conduct of the operating activities or internal safety and security regulations at work;

Speed limitations

• Circulation on the access roads inside the truck terminal and external, the means of transport of the authorities and the equipment intended for operation will be done at a maximum speed of 30 km / h;
• Also, the operational areas where the speed limit is maximum 30 km / h are the following:
a. operating areas under bridges;
b. operating areas mobile cranes;
c. RTG operating areas;
d. RMG operating areas;
e. empty container storage areas;
f. Container storage areas full;
g. roundabout;
h. all intersection areas within the terminal (no longer applicable, falls under the previous paragraph, concerning traffic on access roads);

4.2 Working procedures handling containers in a specialized terminal

Handling BB

The procedure aims to establish the working and accountability of staff and customers for handling / transporting BBs to the ship, car and train.

This procedure aims at identifying / controlling the risks associated with BB manipulation, appropriate training of the personnel involved in this activity, and defining the processes to be undertaken.

BB Operation Planning

The planning of the BB handling operations will be prepared by the CRANE BOOKING SUPERVISOR, it will prepare a detailed report stating the following information:

-coordinators handling BB operation;

-the ship's name on which the BB is loaded;

- date and time of commencement of handling operations;

- the date in which the BB handling operations will be carried out;

- BB's;

-WB weight;

-position of center of gravity;

- quotation marks / quotation mode;

-working connecting devices and lifting devices required for BB handling;

- privileged tools for mounting tools and hoists on cranes;

-Boat / landing position of the BB;

-free transport (registration number) / drivers to ensure the transport of the BB as appropriate (Name / Surname / No contact);

-the way in which the BB will be bitten;

-the bitter materials used to loosen the BB;

-the data of the persons performing SURVEY as appropriate (Name / Surname / Contact number)

RSVTI qualified / authorized personnel for the periodic inspection of linking devices and devices are required to perform periodic checks and to notify in writing any defects / damage discovered and to dismantle the connecting elements and lifting devices.

ISCIR qualified / authorized personnel are required to perform the equipment check before operating the BB handling operations and to notify in writing any defects /

damage discovered and to withdraw from use of these machines.

When a breakdown or damage to equipment is discovered, the coupling elements and lifting devices will be brought to the attention of the Chief Transport Officer. Uncovered lifting gear and damage to equipment or damage will be withdrawn from service and will be properly marked (date / time when the fault / fault / person who carried out the inspection / the person who removed the lifting equipment / equipment was discovered) .

The physical verification of the BB will be done by the Chief of the Transport Section together with the Ship Operator/Movement Operator - the Operator Coordinator from the indicated point of operation to carry out the BB handling operations.

The physical verification of the BB before handling is to identify the points of quotation, bit, center of gravity of the piece where it is marked, the size of the BB, all of which must coincide with the information contained in the report, any discrepancy the report submitted by CRANE BOOKING SUPERVISOR will terminate the activity and report these discrepancies to the CRANE BOOKING SUPERVISOR.

The BB will be dismantled only after the BB has been physically verified and the data has been confirmed. Verification of specialized means of transport consists of:

-verifying documents (RCA / ITP Insurance);

-verification of the means of transport (no number of items);

-the physical inspection of the specialized means of transport, it must be suitable for the transport of the BB, to ensure the minimum amorage necessary for the displacement with the load in the TERMINAL premises;

5. CONCLUSIONS

Maritime transport has always been of great economic, social and strategic importance. He still plays the leading role in international transport, and is an effective way for economic exchanges of material goods. It is also the cheapest mode of transport and holds the largest volume of goods transported (90-95% of internationally transported goods, the percentage varying from region to region).

Protecting the human factor is the most important aspect, and this is evidenced by the application of a policy that emphasizes the human being.

6. ACKNOWLEDGEMENTS

The authors thank for this work that was supported by the Constanta Maritime University,
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The purpose of the presented paper is to emphasize the importance and protection of human life first and foremost. This is possible due to the implementation of safety procedures that are continually updated, depending on the needs. It is necessary not only to protect employees and visitors who have strict regulation and equipment. Trafficking and container handling procedures are necessary to avoid tragedy (loss of life). Through these procedures we have been hoped to minimize human losses and ensure a safe working environment.

7. REFERENCES

[1] Alexa, C., Pencea, R., Transporturi, expediții,asigurări, Lito ASE, București,1985
[2] BEIZADEA, H., POPA,C., NISTOR,F., MARINESCU,C. Management portuar/Beizadea Haralmbie, Cătălin C. Popa., Nistor Filip, Marinescu Călin, Constanța : Editura Academiei Navale „Mircea cel Bătrân", 2013
[3] Bătrînca, Gh., Expediții maritime internaționale , Constanța, Nautica,2007
[4] Căpăţînă, B. Ştefănescu, Tratat de drept al comerţului internaţional, vol. 2, Editura Academiei, Bucureşti 1987
[5] Caraiani, Gheorghe.,Georgescu, Constantin, Transporturi și expediții internațional,Universitară,2012
[6] Dragoş-Alexandru Sitaru, Dreptul comerţului internaţional. Tratat, Partea generală, Ed. Lumina Lex, Bucureşti, 2004;
[7] Dumitru Mazilu, Dreptul comerţului internaţional. Partea specială, ediţia a V-a, Ed. Lumina Lex, Bucureşti, 2008;
[8] Hotărârea Parlamentului nr.86-XIV din 10.07.1998 pentru ratificarea Protocolului adiţional la Convenţia despre regimul navigaţiei pe Dunăre, publicată în Monitorul Oficial al Republicii Moldova nr.71 din 30.07.1998;
[9] Lege nr. 91 din 06.2014 privind semnătura electronică şi documentul electronic.
[10] Mircea N. Costin, Sergiu Deleanu, Dreptul comerţului internaţional, vol. II, Partea specială, Ed. Lumina Lex, Bucureşti, 2004;
[11] Procedură de lucru a biroului Expediții din companiei Constanța South Container Terminal
[12] Procedura de sănătate și siguranță în muncă al companiei CSCT Legea 86/2006 – Legea privind Codul vamal al României.

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OPTIMIZATION OF TECHNOLOGICAL PROCESSES IN CONTAINER MARITIME TRANSPORT

Robert Alexandru Dăineanu

[1]Constanta Maritime University, Faculty of Naval Electro-Mechanics, 104 Mircea cel Batran Street, 900663, Constanta, Romania, e-mail address: decanat@cmu-edu.eu
[21]Constanta "Ovidius" University, Faculty of Natural Sciences, 132, Mamaia Street, 900721, Constanta, Romania, e-mail address: rectorat2@univ-ovidius.ro

Abstract: The radiation scanning system is an innovative solution for scanning containers and freight wagons in a container terminal. The proposed solution will offer increased capacity for effective and continuous monitoring of real-time inspection and adjudication. it will also allow for the full legitimacy and full security of imports and exports, while at the same time applying the exact taxes and duties on all goods. The radiation scanning system equipment consists of a dual-energy rail scanner of the wagons and a dual energy portal (bi-directional portal to the container side - automatic container scanning. The portal is capable of detecting hidden threats and smuggling in densely packed trucks, freight containers and tanks, the portal is ideal for scanning operations at large sea ports, border crossing points and security points. With a compact footprint that allows installation in areas with limited space, the system can scan up to 200 trucks per hour. When it works, the system offers material discrimination, the coloring of orange organic objects and blue metal objects. As vehicles pass through the portal, high-quality images appear in real-time on a high-resolution monitor, allowing for immediate processing and analysis. Once the cabin and driver have passed through the system, the sub-system "informs" the X-ray source when the front edge of a container reaches the beam plane - and in milliseconds, the X-ray beam is on. The radiation inspection system is based on the lifecycle perspective, a perspective that relates, among other things, to the environmental requirements of the material supply chain, product life cycle controls, from the purchase of materials to product treatment end of its life cycle and waste disposal.

Key words: dual energy portal, dual-energy rail scanner of the wagons, radiation scanning system, security points, X-ray source.

1. INTRODUCTION

The X-ray scanner is a remote-robotic, remote-robotic inspection system installed on a fixed portal platform used to identify illicit trafficking in people and goods (drugs, prohibited chemicals and smuggling - cigarettes, weapons, fuel and alcohol) / customs and other strategic areas. The system identifies potential threats and is intended solely for the use of trained, trained personnel.

The system is equipped with a linear particle accelerator, being assigned to provide a high-resolution radiographic image and to allow materials to be discriminated by using high-energy photons. The system is based on a dedicated multispectral radiation generator, combined with an original approach to the use of attenuation coefficients for photon absorption effects - photoelectric generation and pairs (electron - positron).

The radiation scanning system equipment consists of a dual-energy rail scanner of the wagons and a dual energy portal (bi-directional portal to the container side - automatic container scanning.

In addition, this system is ready to provide two specialized military container containers, one for the datacenter and one for the remote analysis center, or to deploy and deploy all hardware and software components within certain office areas.

This proposed system will be used to inspect 100% of all import and export containers.

The technology behind the Portal allows the beam of the high energy X-ray source (HE) to penetrate the dense load, while reducing the amount of scattered radiation.

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Figure 1 Ports Inspection System of Load [1]

A container location subsystem provides safety operations by using the technology to avoid cabin scanning. Once the cabin and driver have passed through the system, the sub-system "informs" the X-ray source when the front edge of a container reaches the beam plane - and in milliseconds, the X-ray beam is on.

When it works, the system offers material discrimination, the coloring of orange organic objects and blue metal objects. As vehicles pass through the portal, high-quality images appear in real-time on a high-resolution monitor, allowing for immediate processing and analysis.

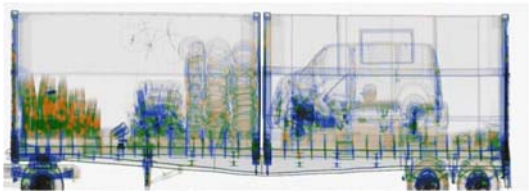

Figure 2 Picture of the Dual Energy Portal [2]

2. APPLICATION FIELD

The proposed solution is a combination of: interleaved high-energy pulse X-ray scanning with maximum remote energy, special filtration and collimation, multi-band detection and dedicated processing algorithms.

The scanner provides a radiographic image analyzed by a trained operator. The operator uses dedicated software specifically for both system and scanning control, as well as image analysis.

Regarding the remote operation of the fixed portal X-ray inspection system, it should be stressed that the portal will be designed in accordance with the applied principle as a fundamental requirement for radiological protection, the main aim being to reduce the radiation exposure of operators and population . In this system, it is designed and built to be permanently operated remotely by an operator located outside the exclusion zone where the scanning process is performed, thus offering the maximum possible physical protection.

2.1 Overview

The system has a service life of 17 years if it is maintained according to the manufacturer's recommendations. To achieve this, all components of the Mobile X-ray Scan System are manufactured in accordance with the following technical requirements:

- Modular design that allows easy maintenance or replacement
- Robust construction of the most exposed mechanical components
- Good quality materials
- Corrosive protection
- Non-toxic materials and substances, in line with EU environmental standards
- Materials and substances which do not endanger the pathogen and which increase the risk of developing bacteria, microbes, mold, communicable diseases in line with EU environmental standards.

The radiation inspection system is based on the lifecycle perspective, a perspective that relates, among other things, to the environmental requirements of the material supply chain, product life cycle controls, from the purchase of materials to product treatment end of its life cycle and waste disposal.

In this regard, all components of the mobile X-ray scanning system are made in accordance with the directives of the European Parliament and the Council and of the European Union Regulation.

2.2 Description of the equipment

The scanning system mainly consists of a robotic port scanning unit (PSU), which will scan goods by remote control (see Figure 3) and a fixed control and control center. The scanner provides a radiographic image of the containers or cargo loaded in all types of trucks. By measuring the amount of transmitted photons emitted by the double high energy accelerator. For reasons of radiation safety, the driver's cab is not scanned.

All functions and controls are automated, being remotely controlled, outside the exclusion area where the scanning process takes place, through the software control software and wireless communications.

The main components of the scanning system are:

-Mechanical structure
- The imaging system
- Signaling and lighting system
- Video surveillance system
- Communication system
- The automation cabinet
- Safety system
- Power supply system
- Software system
- Ventilation and air conditioning system
- Fixed command and control center
- Traffic management system

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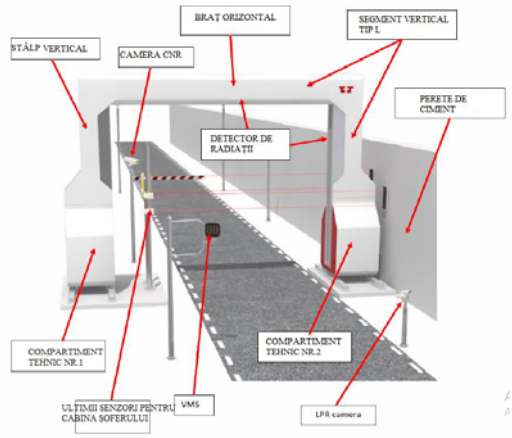

Figure 3 PSU description [3]

Each main component of the scanning system is described below:

a) Mechanical structure

The scanning frame is made up of: the structure of the radiation detector holder (scanning arm), the mechanical support of the irradiation head and the radiofrequency unit, the technical compartment carcasses.

The scanning frame is a downside "U" frame representing the physical support of the scanning tunnel. The internal dimensions (height and width) of the scan frame are the dimensions of the scanning tunnel.

Horizontal side of the boom (type "I") - Horizontal segment of the scanning arm, linking the pillar arm segment to the "L" vertical segment. This boom segment provides support for some of the detection modules.

Frame - is the first segment of the scan arm that makes the connection between the technical compartment no. 1 and the horizontal branch segment "I" of the structure. A technical compartment is installed around the base of the pillar arm segment. 1 . Both the pillar arm segment and the technical compartment no. 1, are installed on a fixed metal platform with adjustable legs.

Vertical arm segment ("L" type) - scan arm segment, with a horizontal part and a vertical part that supports the majority of the radiation detection modules. The vertical boom segment is fixed to the ground through the technical compartment no. 2 . Both the vertical boom segment and the technical compartment no. 2, are installed on a fixed metal platform with adjustable legs.

Figure 4 The scanning process [4]

b) The imaging system

The imaging system is designed to generate X-ray radiation and detect the radiation transmitted to the inspected vehicle.

The imaging system is a "dual energy system" that has the ability to detect the nature of the scanned material (a feature called "material discrimination") by evaluating the equivalent Z number.

The imaging system consists of:

- high energy interfering energy source, composed of:
  - irradiation head and radio frequency unit
  - modulator
  - Thermal control unit
  - remote control console
- Colimator;
- Laser alignment
- Radiation detectors
- how to acquire data
- Sync mode

c) Signaling and lighting system

- Signaling component containing visual and acoustic warning devices that warns the status of the scanning system at certain times or events by means of warning lights and sound.
- Lighting component that contains the lighting installations required for proper operation
  - flashing blue light:

♣ Operation of large vehicle detection sensors. The collision hazard is also signaled by a warning message displayed on the operator screen, a message that, together with video surveillance images and incident-related sound recordings, is recorded and saved in the database.

  - flashing red light and acoustic signaling:

♣ danger of exposure to radiation during X-ray emission

  - Intermittent yellow olumin:

♣ Moving the truck through the scanning frame

a) Video surveillance system

The video surveillance system is based on cameras mounted on the scanning arm (network video recorder)

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with a minimum storage capacity of 30 days. Fixed rooms are positioned to provide the best viewing angle for the operator. A speed-dome camera helps the operator to view the angles that are not covered by the fixed cameras. Video surveillance is divided into two subsystems:

A Subsystem for Operational Tasks for the following purposes:

- to help the operator operate remotely
- help the operator to supervise the scanning process, always observing the target position

A subsystem for automatic recognition of registration numbers and container numbers assigned to recognize the truck registration plate number and the container registration numbers. Recognized numbers are correlated with the radiographic target image and are saved together with this image in the database.

b) Communication system

The portal scan unit communicates through Wi-Fi emission reception devices. The link is used by distributed software modules that send and receive information about states, system variables, and radiographic data. The communication link is ensured and optimized for low delays so that the data is transferred in real time.

c) Automation cabinet

The automation cabinet provides power connections and signals with detectors and all other electrical and electronic components mounted on the mechanical structure (projectors, signal lights, mercury, sensors, ESD buttons, LPR cameras, video surveillance cameras, alignment laser, sensors) .

d) Safety system

The safety system consists of all devices and means which prevent:

- operators and passers-by are exposed to ionizing radiation;
- injury to any person by moving the mobile machine platform.
- damage to scanning system components or scanned target vehicle

e) Power source

The main components of the power supply system are:

- Electricity generator
- Control and control cabinet containing:

♣ power generator control panel

♣ Switches for switching the power supply from the power generator to the local power supply

- the electrical cabinet
- electrical cables

All power system components are installed inside the technical compartment no. 2 .

Power supply is provided by an electrical cabinet installed on the power supply unit containing fuses, voltage surge arresters, relays and other protection devices.

Electrical wiring connects the control cabinet with all electrical and electronically controlled elements / sensor:

- radiation detectors
- Lighting and optical components
- barriers and traffic lights
- surveillance cameras
- sensors and lamps

f) The software system

During scanning, the image is displayed by the real-time viewer on the operator screen. When the scanning sequence ends, the image is analyzed either on the first image or by applying image processing filters (sharpening, edge detection, pseudo color, negative, embossing, suspect area, gamma correction).

An important feature of the imaging system is material discrimination. The information about the nature of the scanned material (atomic equivalent Z of elements) is displayed on the screen using a color map:

- Orange: organic (plastic, sugar, explosive, drug)
- Green: Inorganic / light metals (salt, aluminum)
- Blue: Metals (steel, copper)
- Purple: Heavy metals (lead, tungsten, uranium)

3. OPERATING SYSTEM

The radiation scanning system is based on a remote controlled portal scanning unit (PSU), which will be used to scan goods loaded into cars and X-rays, as well as a fixed control and control center.

Scanning takes place in the exclusion area by moving the vehicle to be scanned at low speed through the scan frame. This mode is optimized to get the best performance. To perform this scan mode, dedicated radar and scan mode sensors are used as follows:

- Radar for motion mode
- Cab Sensors Termination - Laser Sensors that detect the cabs that are radiographs.

Figure 5 Procesul de scanare [5]

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The scanning process consists of the following operational steps:

• Prepare the scanning area

The scanning area will be organized in accordance with the beneficiary's operating requests (customs authorities). The exclusion area that actually includes the scanning area will be set within the customization zone, access to people and equipment being restricted according to the personalized internal procedures.

• Starting the system

If the device is operating in scan mode, the operator starts the power supply unit by connecting the power generator or power supply from the local power supply via a 100 m long cable. Then, the operator opens the software application on the workstation.

• Authentication and launch of the process control application The software control application has three levels of security access (Operator, Administrator, and Service), and the actions to be performed are limited to specific levels.

The operator can only start the software control application using an authentication authorization password. Once authentication is successful, all operations performed by the operator are recorded in a "black box" of the software. The software also performs a self-test that verifies that communication and all hardware and software components are working correctly.

• Approaching vehicles

The access of the vehicle to be scanned is allowed in the exclusion zone by the traffic barriers. The driver is trained to approach the traffic light: red light for "STOP" and green for "GO". In order to comply with the speed limit, the driver must follow the directions from the drivers' speed indicators.

• Vehicle scanning

The operator allows the truck to enter the scanning area by opening the entrance barrier gate and deactivating perimeter protection. The driver of the vehicle to be scanned passes the vehicle through the scan frame and performs the appropriate speed corrections based on the measured and allowed speed that is displayed in real time. Vehicle speed is displayed on the VMS.

Prior to inserting the x-ray target into the scanning frame, the control application automatically checks the active status and starts calibrating the image system. Calibration consists in obtaining the signal from the image detectors without radiation (dark signal) and with radiation (air signal) and lasts for a maximum of 10 seconds. The signal to be acquired is used for building all subsequent radiographic images. Radiographs can be easily affected by changes in environmental conditions (eg temperature). The user is instructed to periodically calibrate.

• Analysis of images

The atomic number discrimination imaging system provides non-invasive scanning of target radiographs by scanning them with a beam of radiation that moves along a target at a constant speed. The vehicle penetration range is detected by a complex detection system supported in the plane of the vertical beam by a support structure for detector images. The data concentration module converts the detected radiation into the signal electrical system is processed by a complex electronic system and is transmitted together with the data on the operation of all the PSU subsystems via Wi-Fi devices located outside the exclusion area where radiography is performed.

The software system controls the entire process and displays the radiographic data on the operator screen. The operator analyzes the radiographic images using various software tools (distance and angle measurements, text annotations, zoom, contrast / brightness, material discrimination display, image filters - sharpening, edge detection, pseudo color, negative). Using the X-ray, the image operator could get a conclusion on the exam result.

3.1 System components

The solution I'm using uses a Linear Accelerator. For this project we chose the latest technological developments in the field provided by Siemens.

As an essential part of providing the best possible imaging performance, the ensemble plays an important role in minimizing the radiation dose received by the drivers of the vehicles carrying the containers through the scan frame. In combination with the solution I'm implementing, the Portal offers the industry's lowest dose for maximum operating reliability.

It also uses double interstellar impulses very quickly to achieve optimal separation of the desired materials.

Radar detectors receive the radiation emitted by the Linear Accelerator after it passes through the target object /container and converts the ionizing particles into electron signals that are processed accordingly to obtain the displayed radiography.

Typical container scanning is performed while the target container is stationary, and the scanner (either a luggage compartment or mobile unit) is moving slowly along a reduced speed. This allows a sufficient number of pulses to reach the detectors every second to obtain the desired image resolution.

Figure 6 Standard grayscale radiography without applied filters [6]

The image analysis screen displays container X-ray with intuitive image enhancement buttons such as zoom (continuous and step-by-step), color reversal, dynamic range adjustment, pseudo-color, etc. Filters can be applied to the entire radiograph or to a particular section. A very useful feature is the display of organic and inorganic material in the image, which greatly improves the operator's ability to interpret the content correctly.

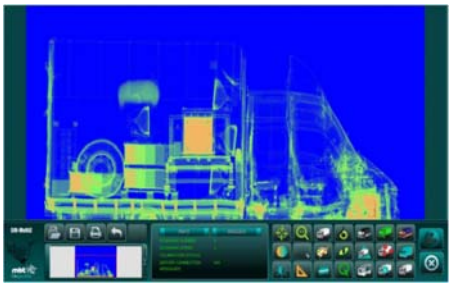

Figure 7 Pseudo-color image (blue-yellow) [7]

To achieve the desired site size, we recommend using the concrete walls to minimize the overall footprint of the system. The chart with the main components of the system exemplifies the configuration of the proposed site.

The automatic exclusion zone protection system automatically shuts down the radiation in the event of an authorized perimeter violation being detected during the scanning process.

To ensure full protection against direct exposure of drivers, a special cab detection system ensures that the radiation is activated only after the cab has passed safely through the scan frame.

3.2 Implementation

The training module is configured for seven days and covers both the operation of the equipment and smuggling techniques.

Day 1 - Introduction to ionizing radiation
Day 2 - Introduction to Ionizing Radiation (continued)
Day 3 – Contraband
Day 4 - Internal Security
Day 5 - General aspects of imaging
Day 6 - Scanner Control Room
Day 7 - Basics of image analysis

4. CONCLUSIONS

The proposal to launch, design and implement a radiation scanning inspection system, as well as the provision of port facility equipment for operating support and image analysis, based on an agreement, aims to meet the requirements and objectives of scanning and trading the trade.

The ownership, maintenance, operation and support of automatic scanning equipment will be customer responsibility as well as image analysis. In addition, it is facilitated to provide civilian and engineering work to facilitate the operation and inspection of shipping containers.

Sistemul de inspecție cu radiații prezintă numeroase beneficii pentru port și, în cele din urmă, către Serviciile Vamale ale României la Portul Constanța, fără costurile inițiale mari asociate în mod obișnuit cu un proiect de această amploare.

6. ACKNOWLEDGEMENTS

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ERASMUS PROJECT KA205-048177/YOUTH-60/19.09.2018- Get together-practical tools for youth engagement'.

7. REFERENCES

[1] Beizadea, H., Popa, C., Nistor, F., Marinescu, C. Management portuar/Beizadea
[2] Containerisation International. A chilling performance, August 1994;
[3] Nicolae F. - Instalaţii navale şi portuare de operare. Editura Academiei Navale "Mircea cel Batran", Constanta, curs disponibil pe platforma Elearning adl.anmb. 2010, 2011
[4] Nicolae F. - Instalaţii navale şi portuare de operare.Ed. Academiei Navale "Mircea cel Bătrân", 2015.
[5] Oranescu O. – Exploatarea navelor şi porturilor;
[6] Popa, C., Beizadea, H., Nistor, F., Marinescu, C., Management portuar, Editura Academiei Navale "Mircea cel Batran", Constanta, 2013
[7] Procedura de sănătate și siguranță în muncă al companiei CSCT Legea 86/2006 – Legea privind Codul vamal al României
[8]www.containerhandbuch.de/chb_e/stra/index.html
[9]http://www.dpworld.ro/ro
[10]www.dpworld.ro/ro/media/prezentare-terminal
[11]https://www.google.com
[12]www.globalsecurity.org/military/library/policy/army/fm/55-17/ch13.htm;
[13]www.globalsecurity.org/military/library/policy/army/fm/55-17/ch15.htm;
[14]www.globalsecurity.org/military/library/policy/army/fm/55-60/ch62.htm;
[15]www.hardrockcontainers.com/aboutus.htm;
[16]www.solentwaters.co.uk

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THEORETICAL STUDY FOR AIR-LIFT PUMP SYSTEM. APPLICATION'S PROPOSAL – OFF-SHORE LIGHT FISHING

Dumitru DINU[1], Andrei Alexandru SCUPI[2]

[1]Constanta Maritime University, Faculty of Naval Electro-Mechanics, 104 Mircea cel Batran Street, 900663, Constanta, Romania, e-mail dumitru.dinu@cmu-edu.eu
[2]Constanta Maritime University, Faculty of Naval Electro-Mechanics, 104 Mircea cel Batran Street, 900663, Constanta, Romania, e-mail andrei.scupi@cmu-edu.eu (10 pt)

Abstract: In the Black Sea, electrical light can attract, in certain periods, the following fish species: sprat, pontic anchovy, Azov anchovy, saurel, common grey mullet, tinker, etc. In the paper we do not present the results of the researches regarding the attraction modalities of this species by electrical light, but the system which the fish, concentrated near the light source, can be brought on board. One of the systems which can be used is air-lift pump. Air-lift pump system is an installation based on principle of communicating vessels filled with no miscible liquids. Compressed air, introduced on the base of an underwater conduit, forms with the water a heterogeneous mixture gas-liquid with a lower density than the liquid. We present below an original approach regarding this problem. After a theoretical study, the authors propose a system which could be used for fishing and for bringing the fish on board of fishing vessels.

Key words : air-lift, continuity equation, gas-liquid mixture, light fishing.

1. INTRODUCTION

Light is used to attract both fish and members of their food chain. Lights can be attached to ship or to another marine structure above water or underwater. We'll discuss about underwater light attractor to concentrate fish and lift him on board using an air lift.

Fishing light must be intensive and emit in a colour compatible with fish vision: blue or green. Due to the colour absorption, the submersible light is more efficient than surface light.

In the Black Sea, electrical light can attract, in certain periods, the following fish species: sprat, pontic anchovy, Azov anchovy, saurel, common grey mullet, tinker, etc.

One of the systems which can be used for bringing on board the fish, concentrated near the light source, is the air lift.

Air-lift is an installation based on principle of communicating vessels filled with no miscible liquids. Compressed air, introduced on the base of an underwater conduit, forms with the water a heterogeneous mixture gas-liquid with a lower density than the liquid. The heterogeneous mixture lifts on the conduit until a height h given by the formula:

$$h = h_1 \frac{\gamma_{water} - \gamma_{mix}}{\gamma_{mix}}, \quad (1)$$

where:
h – the discharge height;
h_1 – the working depth;
γ_{water}, γ_{mix} – specific gravity of the water and of the mixture, respectively.

The relation issues from the equalization of the pressure at the depth h [1]:

$$\gamma_{water} h_1 = \gamma_{mix}(h + h_1). \quad (2)$$

We can dimension the installation to permit the mixture to come on board ship.

2. THEORETICAL STUDY

The air flow must be established taking into account two considerations: the height h of the water upper the sea level and the velocity v_1 of the water at the entrance in the tube.

Equalizing the flows we'll obtain the continuity equation:

$$\gamma_{mix}(Q_{air} + Q_{water}) = \gamma_{air} Q_{air} + \gamma_{water} Q_{water}, \quad (3)$$

In fact there is a problem of a three phase system: gas – air, liquid – water and solid – fish. We

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approximate the density of the fish equal with the water density.

From equations (2) and (3) we can obtain, for a section S of the air-lift conduit, a known working depth h_1 and an imposed discharging height h, the necessary air flow:

$$Q_{water} = S\sqrt{2gh}, \quad (4)$$

$$\gamma_{mix} = \gamma_{water}\frac{h_1}{h_1 + h}. \quad (5)$$

The formula (3) becomes:

$$\gamma_{water}\frac{h_1}{h_1+h}(Q_{air} + S\sqrt{2gh}) = \gamma_{air}Q_{air} + \gamma_{water}S\sqrt{2gh} \quad (6)$$

Neglecting;

$$\gamma_{air} = \frac{1}{800}\gamma_{water}, \quad (7)$$

it results:

$$Q_{air} = \frac{v_0\sqrt{2gh}\cdot S}{h_1}. \quad (8)$$

Knowing the air pressure provided by the blower p_0 and the exit pressure p at the working depth (between 5 and 30 m sea water column), we can determine the exit velocity of the air to dimensioning the necessary passing section:

$$v = v_0\sqrt{\frac{2}{k-1}\left[1 - \left(\frac{p}{p_0}\right)^{\frac{k-1}{k}}\right]}, \quad (9)$$

where:
v_0 – the sound velocity in the air;
k – adiabatic exponent of the gas (air).
The passing section will be:

$$s = \frac{Q_{air}}{v}. \quad (10)$$

Further the calculus will be made taking into consideration that we need to ensure, in the absorption zone, a velocity of water superior of fish velocity.

Ingersoll-Rand Co relation, experimentally obtained, gives us the compressed air volume necessary to lift a cubic meter of water:

$$V_{air} = 16.3\frac{h}{c\lg\frac{h+10.3}{10.3}\eta}\left[\frac{m^3 N}{m^3_{water}}\right], \quad (11)$$

where c = 245 for h = 2 to 18 m.

$$Q_{aer} = V_{air}Q_{water}. \quad (12)$$

The necesary water flow is obtain using the relation:

$$Q_{water} = v_1 S_1, \quad (13)$$

where:
S_1 = (1.2 – 2) S and
v_1 = the maximum velocity of the fish (for anchovy 1,8 m/s).

Having the air flow and the pressure necessary which must be over γh_1, but lower than $\gamma(h_1 + h_2)$, we can chose the compressor.

Practically, the phenomenon is much more complex, but the above simplified formulas succeed to realise an approximate dimensioning such as, with an appropriate variation, between enough large limits, of the passing section of the air, so of the air flow, to assure a good running of the installation. We'll make the preliminary calculus, having the conduit diameter 100 mm and a maximum working depth 30 m. It results the necessary power of the compressor.

3. SYSTEM DESCRIPTION

We propose the system (Figure 1) having the following components:
1 – mixture chamber;
2 – hose for mixture (air, water, fish);
3 – hose for air;
4 – compressor;
5 – fish-water separator.

The air introduced into the tube 2 reduces the density and, according to the principle of communicating vessel, lifts the mixture on board ship.

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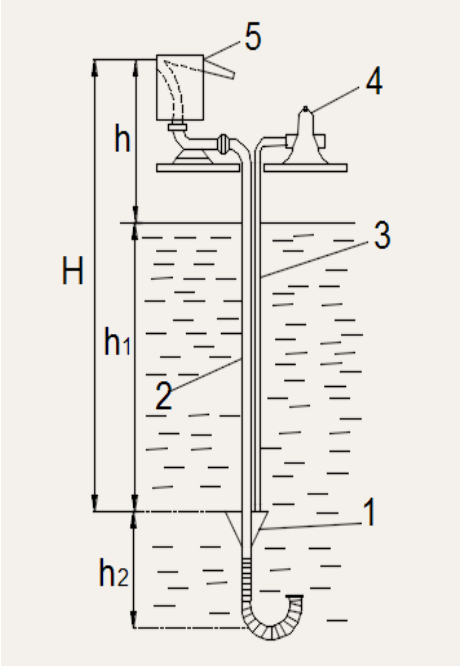

Figure 1 Air-lift schema

Studying the velocity distribution near the absorption, we can establish the maximum distance for attracting the fish. Of course this distance can be variable because the fish species have different velocities.

Putting the light near water absorption of the air lift, the fish, attracted by this light, will be pulling along hose until the separator on board ship (Figure 2).

We presented only the theoretical aspect of the air lift system and the proposal to use it for light fishing. The theoretical model must be followed by numerical approach and, of course, by experimental confirmation.

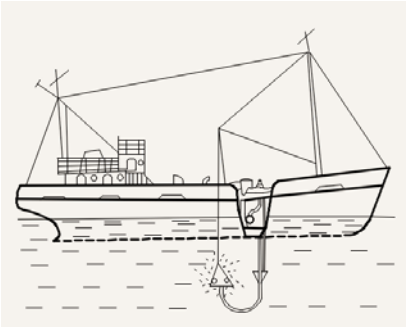

Figure 2 The air-lift mounted on the ship

4. CONCLUSIONS

Air-lift is framed in the category of pumping systems with low efficiency (35-55% comparing to the classical pumping system – about 70%), but without moving parts, ideal for fish transportation in a good state. It is used also for cleaning wrecks covered by sand, for finding diamonds from the sea bottom near the river embouchure, etc. The system can be used much more easily in aquaculture to reap the fish attracted by light and send it onshore.

Using air lift for fishing is a new idea that can be confirmed by experiment. This experiment must take into consideration many factors, such as: density of fish in the area, the velocity of fish, weather conditions (waves, current, etc.). Also it is necessary to design different parts of the installation to better corresponding to the purpose of the fishing: height over the sea level, dimension of the on board lattice to separate the fish end the water, type of lights, etc.

While the air-lift efficiency is relatively low, using this system for light fishing has evident and important advantages:

- the fish isn't damaged;
- low fuel consumption on tone of fish (the ship remains a drift when fishing);
- the fish maintains fresh (the fishing is by night when the temperature is diminished);
- when fishing by trawl the quantity of anchovy is insignificant;
- increasing of work productivity by reducing the working people;
- reducing the physical effort.

We intend to study the velocity distribution near the entrance of the water/fish using the Computational Fluid Dynamics [2] to establish the optimal shape of this and of lights position. As we specified before, this study will allow us to determine the maximum distance for attracting the fish.

Another problem to solve is the optimization of the mixture for good running of the installation without creating a positive buoyancy of the system.

5. REFERENCES

[1] Dinu D. 2010, Mecanica fluidelor pentru navigatori, Editura Nautica.
[2] Scupi A., Dinu D. 2015, *Fluid Mechanics. Numerical Approach,* Ed. Nautica

ISSN (Print): 1844-6116
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NAVAL TRANSPORT AND BLACK SEA POLLUTION

[1]Iurea Neculai, [2]Panaitescu Mariana, [3]Stan Liviu-Constantin, [4]Panaitescu Fănel-Viorel

[1,2,3,4]Constanta Maritime University, Faculty of Naval Electro-Mechanics, 104 Mircea cel Batran Street, 900663, Constanta, Romania,
iureaneculai@yahoo.com, liviustan14@yahoo.com, panaitescumariana1@gmail.com, viopanaitescu@yahoo.ro

Abstract: The paper strives to analyze the proportion of emissions from noxious combustion from a diesel engine and to suggest some methods of minimizing them prior to their discharge into the atmosphere. Even though cargo shipments or military applications on water account for less than 8% of all pollutant emissions emitted in the terrestrial atmosphere, it is not negligible that they also participate in the intense effort of the other components of thinning ozone layer. This state of affairs has a great impact not only on aquatic flora and fauna but also on the health of human life. Today's advanced performance technology, applicable to naval diesel engines equipping marine and river ships, largely addresses this environmental pollution problem, which is particularly sensitive to us all.

Key word: saquatic environment, ship, fuel, diesel engine, shipping, exhaust fumes, pollutants, catalyst, health.

1. NAVIGATION WITH LESS POLLUTION

The Black Sea water is made up of a mixture of sweet waters brought by the Danube and other rivers and saltwater from the Mediterranean Sea. As a result of these different layers of salinity there is a wide variety of fauna both in the deep and the entire Black Sea. The continental plateau is delimited in three areas: the prelitorial area (up to 12 m deep), the coastal area (12-70 m deep) and the sublitoral area (70-230 m deep). The most widespread fish are gray mullet, flounder, sturgeon, mackerel, anchovies, and other rattlesnakes (shark, pike, hatchery etc.).

The Danube transports to the Black Sea a quantity of chemical substances (fertilizers, herbicides, insecticides, etc.) entering the soil, where they do not decompose, and are pushed to its shedding. Another polluter of the sea is oil. It penetrates the sea with the washing of oil tanks in ports such as Midia, Constanta, Mangalia, plus those on the Danube.

Figure 1 Petroleum tank seen from the bow [https://www.marineinsight.com/naval-architecture/oil-tanker-ships/]

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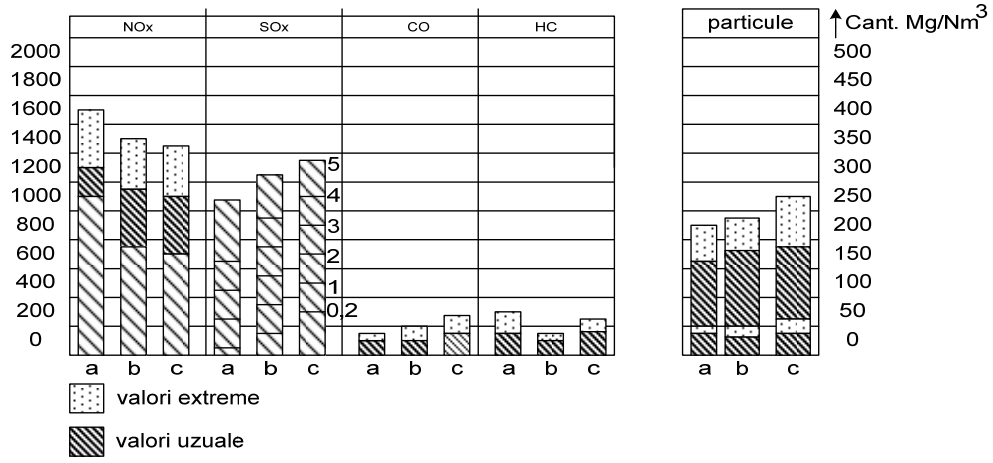
Specialists from over 100 states of the world met in London in 2017 under the aegis of the International Maritime Organization (IMO), a special UN department, adopting a final document stating that by 2030 the percentage of pollutants the atmosphere on board ships should decrease by 40% and 70% by 2050 compared to the current situation. The priority is the CO, CO2, NOx and SOx emissions. However, suspensions of a mechanical or chemical nature are not neglected. The main paths are: strong noxious infrastructure, high performance processing technology and rich resource for development.

Any unmonitored combustion, which runs cyclically and at high temperature, produces to a greater or lesser extent, the qualitative deterioration of the environment [1]. In this respect, there are concerns at global level (especially within the IMO) for the adoption of regulations to limit the emissions of NOx and SOx from exhaust gases by 2050 to 70% and 50% compared to the current level, knowing that the increase in these emissions contributes to a negligible proportion of the Earth's ozone depletion. Consequence? Continuous thinning of the ice cap, desertification, drought, fires, etc.

As a result, research programs have been initiated since the 1990s, starting with the analysis of exhaust emission levels from MT (thermal engines), TG (gas turbines), caldarines or on-board incinerators. An example of this is the statistical situation (see Figure 2) with the previously mentioned emission levels, compiled by New Sulzer Ltd. for three of the engine variants operated at varying loads and speeds by different navigation companies [3].



a) motorul tip RTA b) motorul tip ZA40S c) motorul tip S20

Figure 2 Typical levels of pollutant emissions on Sulzer naval diesel engines [3]

The amount of pollutants (taken as a spatial velocity, the mean of the hourly velocity of the NOx formation velocity and its decomposition rate, where this velocity is taken as a spatial hourly amount and according to the graph, vh ≈ 1050 Nm / h for the " RTA ") from the exhaust gas, according to the experimental data, depends on a number of factors, the most important being [1]:

- parameters of the environment; pressure, temperature, humidity, etc .;
- the type of fuel used; gas oil, fuel oil or gasoline;
- constructive-functional characteristics of the engine;
- its speed and load, etc.

All of these factors must be taken into account when determining ways to reduce emissions of pollutant gases.

Depending on the constructive and functional measures taken, the methods of limiting the noxiousness of the ships and the river can be primary (acting in the sense of improvement of the fuctional processes with a role in the quantitative diminution of the polluting substance), or secondary (they act in the direction of treatment by filtration, of the flue gases before their discharge into the atmosphere).

2. PRIMARY METHODS TO REDUCE THE LEVEL OF POLLUTANT EMISSIONS FROM THE EXHAUST GASES OF THE ENGINES

They are characterized by the highest economic efficiency, and they usually do not require the use of

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additional aggregates or devices. On the whole, it is intended to control combustion by a series of devices specific to each category of pollutant. Thus, the reduction of the amount of nitrogen oxides (NOx) can be ensured by:

 reduction of the maximum firing pressure, which is achieved by reducing the injection rate, thus providing a reduction of about 30%. The method, however, increases the specific fuel consumption, being effective only if this increase does not exceed 5% of the nominal value;

 lowering the maximum combustion temperature, this being achieved by emulsifying the fuel with water (Fig.3); the NOx concentration of the exhaust gas can be reduced by up to 20% in this way without increasing fuel consumption [3];

 reducing the maximum combustion temperature by increasing the amount of intake air, thus reducing NOx by up to 10%;

 Adopt injection laws to reduce the pressure increase rate during burning.

This method is particularly useful for fast and semi-rigid engines (most of them military vessels), which achieves a reduction of up to 25% of NOx emissions. Figure 4 shows how the concentration of NOx pollutant emissions varies according to the speed of a slow-running diesel engine.

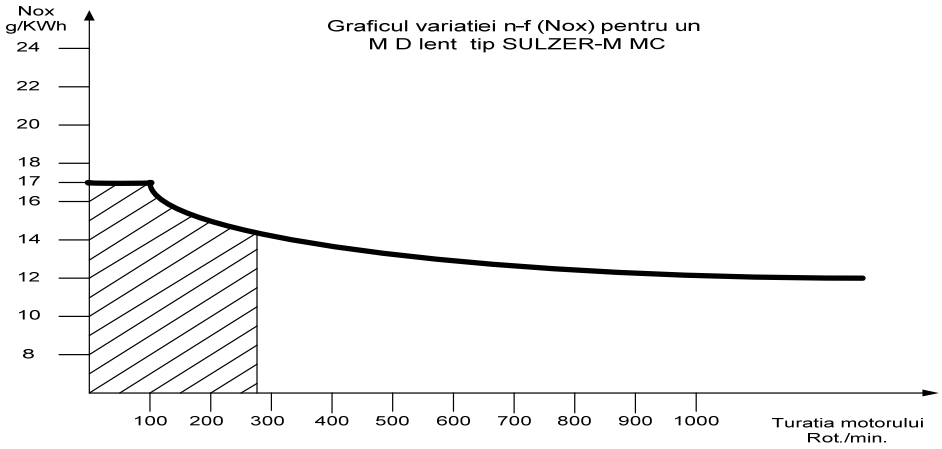

Figure 4 Variation graph n = f (NOx), for a slow diesel engine - "Sulzer" [4]

 Reduction of CO content by recirculation of an exhaust gas fraction (see Figure 5); although significant emission reductions are provided [2], the method leads to a substantial increase in fuel consumption, so that constructive modifications are required which ultimately lead to increased engine deposition.

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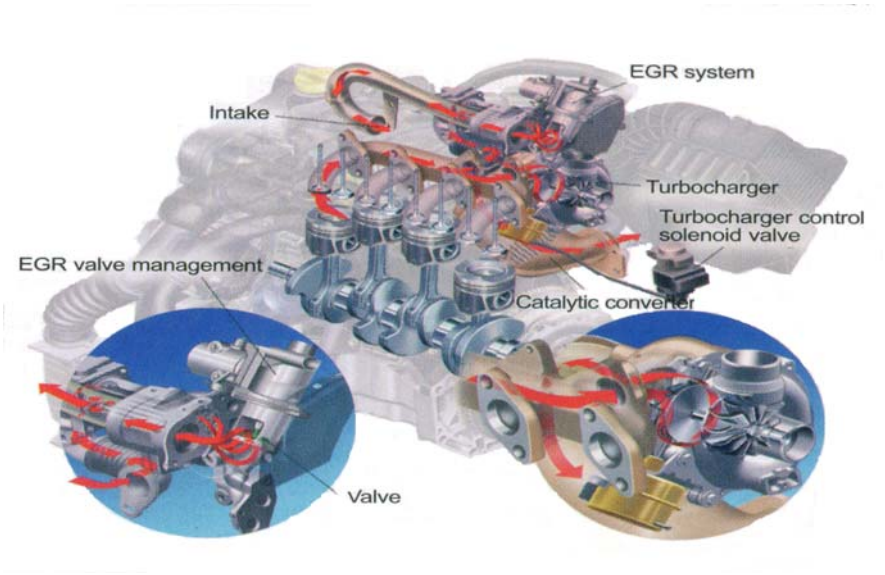

Figure 5 Equipment to reduce CO from exhaust gases in the engine [2]

Sulfur oxides (SOx) in the exhaust gases can be reduced only by reducing the sulfur content of the fuel used, since it is completely oxidized in the combustion process. The IMO requirement for a 60% reduction in the current NOx level requires a reduction in the sulfur content of the fuel from current values of up to 4.5% to only 1.25 to 2.25%. This unquestionably leads to a significant price increase due to the demanding thermopetrochemical process. To reduce particulate emissions, the fuel injection pressure increases, thereby improving the fuel mix quality, resulting in a considerable reduction of SOx particulates in the exhaust gases. In the same direction, action must be taken to ensure both quantitative and qualitative lubrication for the engine, knowing that lubricating oil is another source of toxic emissions. When using diesel, it will be more expensive.

As with sulfur oxides, carbon monoxide in exhaust gases can not be reduced by combustion control. The only way to reduce the COx and CO2 concentration in engine exhaust is to use fuel with a low C / H ratio, which however involves rising fuel prices. Carbon monoxide emissions have negligible values for diesel engines, whereas non-carbonated (HC) emissions are accidental, this being only due to malfunction of the injection system.

3. SECONDARY METHODS FOR REDUCING THE LEVEL OF POLLUTANT EMISSIONS FROM THE EXHAUST GASES OF ENGINES

Subsequent treatment of combustion gases can provide significant reductions of any pollutant component thereof. The significant estimated reduction in nitrogen oxide emissions (see Figure 1) makes primary methods not always have the desired efficiency. Therefore, secondary methods are frequently used, the most practical solution being Selective Catalytic Reduction (SCR). This method (see Figure 6) is based on the fact that NOx can be converted by ammonia (NH3) into nitrogen and water [3]:
a reaction that occurs spontaneously at a temperature of 350 ÷ 4500 C, depending on the value of certain constructive and functional technical sizes.

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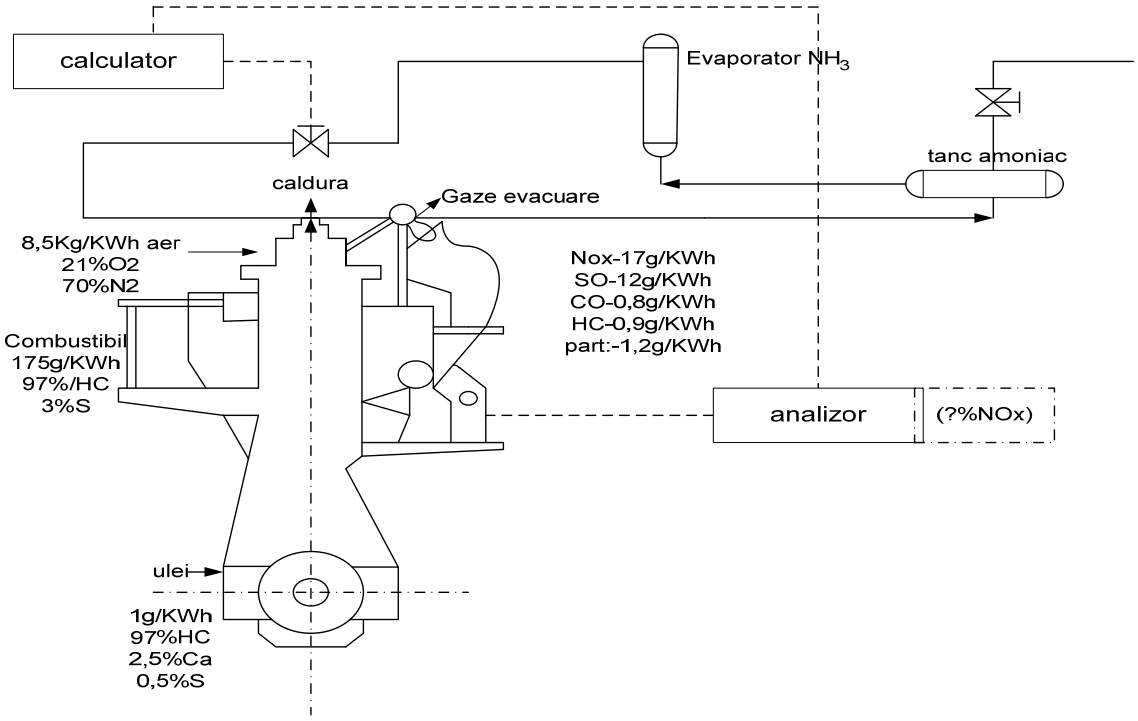

Figure 6 NOx Noise Reduction Equipment Selective Catalytic Reduction Equipments MAN B & W, 6S50MC [3]

The exhaust gas temperature (which is around 500 K) ensures that noxious decomposition reactions are carried out by means of some catalysts (see Figure 7), with possible reductions of up to 85% in NOx emissions. Moreover, companies dedicated to the construction of marine diesel engines (Fiat, MAN B & W, Sulzer, Alco, Gotawerken, etc.) have initiated and run extensive experimental research programs focused on this method [5].

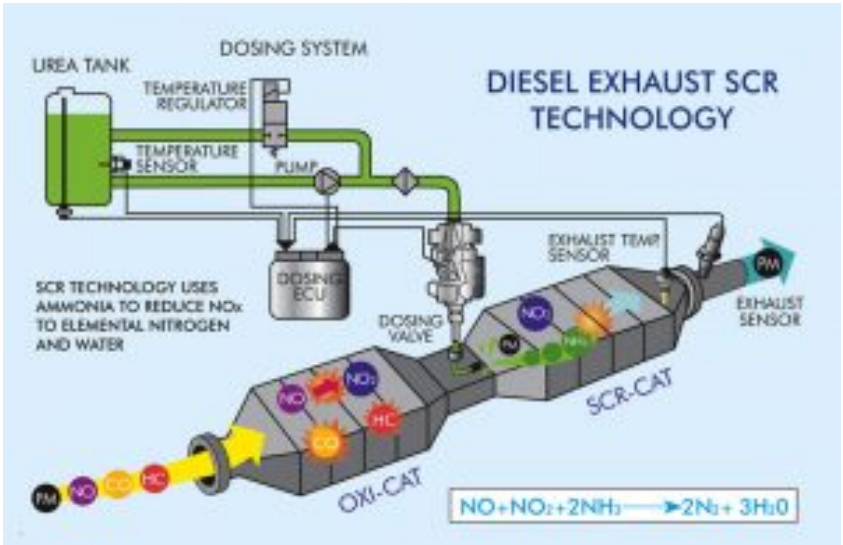

Figure 7 Catalyst [5]

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For the secondary reduction of sulfur oxides, the most effective solution is the so-called "friction-wet"; after the exhaust gas is cooled, the lime is washed (neutralized).

Regarding particle emission, the use of reclamation heaters ensures by recirculation of the flue gases in thermal motors the reduction of up to 50% of the suspension content, or the use of so-called gas cylinders which, by centrifuging the pollutant emissions, performs the particle separation. For the same purpose, there is a constructive solution with electrostatic filters which can provide an almost total ionization reduction of particulate emissions from engine pollutants [1].

4. OTHER SOURCES OF POLLUTION OF THE BLACK SEA

4.1. Naval Accidents

It is quite true that offshore, offshore, rarely collided between two Black Sea vessels. There is really no history (the accident with the "Independence" ship took place in the Bosporus!). However, the 1986 on-shore accident at Chernobyl-Ukraina caused environmental contamination, especially in some areas of the Dnieper and Dniester, rivers that flow into the Black Sea. The haircuts and cramps on their courses have managed to stop a large part of the pollution. As a result of this accident, the level of radioactivity of the Black Sea has doubled compared to the level of radioactivity of the Mediterranean Sea.

4.2. Marine drilling platforms

These mastodont constructions made of metal, concrete and glass and anchored offshore, are designed for drilling, drilling and extracting crude oil and petroleum gas; raw materials in the manufacture of fuels and other chemicals (Figure 8). Crude oil contains thousands of hydrocarbons. They may be: saturated (have no double bonds), unsaturated (have double or triple bonds), or aromatic (have benzene rings).

Figure 8 Overview of a Marine Drilling Platform [7]

The higher the amount of benzene rings or double and triple bonds, the more toxic the oil is. It is frequently found on the beach (depending on how the wind blows and the shape of the seaside), and the Black Sea oil concentration is higher than that of the Mediterranean Sea. This is caused both by the industrial waste dumps in the rivers and the sea by the large processing companies (Figure 9), and by the exploitation of this wealth through drilling platforms that are in alarmingly large numbers on the continental shelf of Romania.

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Figure 9 Wide view of the on-shore platform «Petromidia» [8]

Taking into account the alluviums of the running waters and taking into account the fact that no purification (filtering) takes place before their penetration into the sea, there is no good thing, namely that the pollutants contained in them come to the sea, the receptors being not only the flora and fauna specific to the continental shelf distributed over the three areas listed above.

Figure 10 Sewage treatment plant at the quay [9]

With well thought-out and well-designed projects, both downstream of Tulcea, the Danube and the Great (in the ports of Constanta, Midia, Mangalia) can be built with European money, wastewater treatment plants before their penetration in the Black Sea, of the type shown in Fig. 10 which works very well in Rotterdam before the Rhine discharge into the North Sea [9]. Perhaps you do not know, but most of the cost of a diesel engine does not come to the engine, but to deploying related equipment (more and more expensive as Euro rules tighten).

5. CONCLUSIONS

The application of the listed methods must be carried out in the context of internationally required requirements and engine-constructive features. Additionally, the adoption of one or other of the methods for reducing the concentration of pollutants in exhaust gases should also take into account overall economic efficiency. Thus, the advantage of primary methods (minimum investment) is also accompanied by some unfavorable aspects, such as:

 there can be substantial reduction of some pollutants but not all of them;

reducing a pollutant can lead to the growth of another;

 Specific fuel consumption and thermal loads can also be increased, thus reducing engine safety.

Secondary methods, although providing for significant reductions of pollutants, are characterized by: additional investments needed to provide harm reduction devices (through further treatment), which are of high dimensions; some procedures require extra operation - maintenance.

The use of secondary methods to reduce the amount of pollutant in the exhaust gases of inboard engines shall in no way exclude the primary ones by redesigning and retrofitting these coexisting and operating within the same on-board system .

The adoption of these methods and processes in Romanian naval engines can ensure high economic efficiency; higher energy balance with minimum spending.

The management of ship power installations must be based on an already confirmed principle; "It is always better to prevent marine and river pollution than to treat it!"

6. REFERENCES

[1]. Apostolescu I. ş.a., Arderea carburanţilor în M.A.I., Editura Tehnică, Bucureşti, 1998;
[2]. Bodolan D., Buzbuchi N., Modelarea, predicţia şi controlul emisiilor poluante ale motoarelor navale, Editura Nautica, Constanţa, 2015;
[3]. Calotă S. – Influenţa regimurilor tranzitorii ale motoarelor diesel asupra performanţelor dinamice şi ecologice ale acestora, teză de doctorat, Braşov, 2005;
[4]. Dragalina A., Motoare cu ardere internă, Editura Academiei Navale, Constanţa, vol. 1,2,3, 2000-2003;
[5]. Manea L. ş.a., MAI; Procese şi caracteristici, volumul 1, 2, Editura Matrix, Bucureşti, 2011;
[6]. Uzuneanu Krisztina, Influenţa proprietăţilor amestecului combustibili convenţionali-combustibili neconvenţionali, asupra emisiei de poluanţi, lucrare prezentată la ediţia din 2012 a Colocviului naţional cu participare internaţională „Acvadepol", Constanţa.
[7]https://www.google.com/search?q=Overview+of+a+Marine+Drilling+Platform&tbm=isch&source=iu&ictx=1&fir=yigDwCt_fqmdPM%253A%252CAo_K5dWABHUYnM%252C_&vet=1&usg=AI4_-kQl3ljGsbcf6NcWLMQgeyENh51Okw&sa=X&ved=2ahUKEwjF3qi7-IjiAhUutIsKHQvWBTMQ9QEwAHoECAkQBA#imgrc=yigDwCt_fqmdPM:
[8] https://www.blackseaog.com/wp-content/uploads/sites/17/2019/04/3B_-AESIA_Appendix_2-Critical-Habitat-Assessment-EN.pdf
[9]https://www.google.com/search?q=foto+with+Sewage+treatment+plant+at+the+quay+CONSTANTA&tbm=isch&source=iu&ictx=1&fir=d1doqlJnzE2A1M%253A%252C6I7nwpny-59sIM%252C_&vet=1&usg=AI4_-kQrmIF1aH-Fhprt81o1x1XsU-xM0w&sa=X&ved=2ahUKEwjkgsif-ojiAhXpwosKHSNwBToQ9QEwA3oECAoQCg#imgrc=d1doqlJnzE2A1M:

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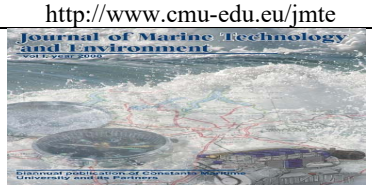

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PROPOSING A QUANTITATIVE ASSESSMENT METHOD FOR SECURITY PERFORMANCE OF PORT FACILITIES

Muammer NURDUHAN [1] & Barış KULEYİN [2]

[1]Dokuz Eylul University, Maritime Faculty, Izmir, Turkey, e-mail address:muammer.nurduhan@deu.edu.tr
[2]Dokuz Eylul University, Maritime Faculty, Izmir, Turkey, e-mail address:baris.kuleyin@deu.edu.tr

Abstract: Port facilities have crucial importance for continuity of national and international trade while considering over 80 % of global trade are carried by sea. However, increase in circulation of goods at ports results in shortages in inspection and security problems. These security concerns reached its top level with the 9/11 terrorist attack. After this event, an urgent need for development in security strategies has taken the uppermost place in the relevant agenda. Considering this prominence, International Ship and Port Security (ISPS) Code issued to detect security threats. While ISPS Code comprises many security requirements, it does not present any quantitative method for measuring the effectiveness of these requirements and conformity of port and ships with the ISPS Code. This study aims to propose an efficient and applicable method that combines AHP and fuzzy logic to minimize subjectiveness of security assessment conducted by Recognised Security Organisation (RSO). The proposed model has been tested in a port facility with a Port Facility Security Officer (PFSO) and 30 security officers by using two questionnaries that developed for this purpose. The results show that this methodology is easy to use and it can be used as a helpful tool for RSOs and PFSOs in assessing port security activities with a crisp value.

Key words: analytical hierarchy process, fuzzy logic, ISPS Code, port security, security performance.

1. INTRODUCTION

80 % of global trade by volume and 70 % of global trade by value are carried by sea [1]. This brings port facilities into prominence from two points. Firstly, continuity of global trade highly depends on port facilities which are crucial nodes of sea transportation. Secondly, due to the ever increasing circulation of high volume goods, inspection and detection of illegal activities gets difficult and it results in threatening countries' social, political and economical security by terrorists and criminal organizations [2]. Securing port facilities is necessary and important to ensure continuity of global trade and avoiding disruption of countries' overall security. This necessity became more clear with 9/11 terrorist attacks. These attacks showed that these kind of terrorist attacks may threaten the maritime industry more than the aviation industry as it has many security gaps. As a response of these threats and security gaps, International Maritime Organization (IMO) published International Ship and Port Security (ISPS) Code and it came into force for ensuring security for ships and ports on 1st July 2004 [3].

The ISPS Code consists of two sections: Part A and Part B. Part A contains security related requirements for governments, port authorities and shipping companies. Part B is a guideline about how to meet these requirements. Briefly, ISPS Code outlines what needs to be done to secure ships and port facilities. However, there are not any standard implementation methods for conducting ISPS Code requirements. Therefore, security practices are conducted in different manner in different countries. Moreover, it has been observed that there is not any integrity in practice between different ports belonging to the same country [4][5]. With this, a question arises: How can we measure the effectiveness of security practices while there are not any standard implementation methods? Besides, security is an abstract concept and it makes it difficult to measure effectiveness of security. Measuring effectiveness of security is actually measuring ability to prevent security incidents which may not happen. Hence, it becomes difficult to assess priorities in security activities and targets [2].

Considering the measurement problem of security effectiveness, quantitative assessment methods are emerging as a necessity. However, when databases are scanned, it can be seen that port security has been dealt with from different perspectives and limited researches have been done to address this issue. Most of the researches are qualitative and address the security

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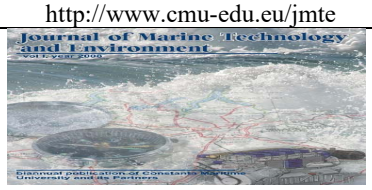

awareness [6], need for providing security [7][8], difficulties in providing port security [4][5][9], effects of ISPS Code on ports security [10] [11] [12] and impacts of security practices on port activities [13] [14]. Quantitative studies are mostly about risk assessments using fuzzy logic, Fault Tree Analysis (FTA) and Failure Mode, Effects, and Criticality Analysis (FMEA) to determine key points, threats and their consequences [15] [16] [17][18]. The other researches are about determining the relation between security practices and port efficiency using system dynamics approach [19], finding optimal treshold values for inspection using decision tree model [20], preventing small vessel attacks using various sensor [21], and developing a model to prevent delays because of rising security inspections [22]. Considering that there is not any study which deals with measuring security performance of port facility, it is important to address this issue and try to set a quantitative model.

In order to solve security assessment problems of port facilities, this study proposes two-staged quantitative model which uses analytical hierarchy process and fuzzy logic. To achive this, ISPS Code requirements have been used for security criteria. The first stage uses analytical hierarchy process and determines the significance level of each ISPS Code requirements. The second stage uses fuzzy logic method, and ISPS Code requirements is considered as linguistic variables for this method. After all, weak and strong security activities and overall security performance have been determined with a crisp value. This model will help Recognised Security Organisations (RSO) to undertake Port Facility Security Assessment (PFSA) in a quantitative manner. Certainly, PFSA also includes non-security matters, but the scope of the model can be extended as required. The model can also be used by Port Facility Security Officer (PFSO) to assisst in preparing Port Facility Security Plan (PFSP). For this purpose, the study has been carried out in a port facility to see the practicability of the model. The theoretical basis, scope and application of the model are explained in the following sections in full detail.

2. METHODOLOGY

The methodology begins with the determination of appropriate solution methods according to the problem. It has been decided that Analytical Hierarchy Process (AHP) and fuzzy logic are the most suitable methods for solving the problem. Since our problem also involves prioritization and ranking, we have choosen AHP method. Fuzzy logic has also been chosen because it allows linguistic variables to be transformed into real numbers. It has been decided to collect the data through a questionnaire. To define assessment criteria, 15 titles prepared for the security of port facilities in the ISPS Code have been simplified, combined and reduced to 9 titles, and the security requirements listed as 97 items have been reduced to 39 items. Each of the 39 items has then been made into a criterion of security and met under the 9 title (see Figure 1). Then, two different questionnaries have been prepared with these criteria to be used in analytical hierarchy process and fuzzy logic. These questionnaires have been evaluated and developed by some relevant experts (faculty members of Dokuz Eylul University and a PFSO) in terms of form, phonetics, comprehensibility, adequacy and suitability. Surveys have been completed by the port security authorities after taking permission from the port facility. The survey for the AHP has been conducted through five experts, the PFSO, the Port Security Officer (PSO) and three assistant security officers, who have information on all parts of the port facility. The questionnaires prepared for the fuzzy logic have been applied to a total of 30 persons including PFSO, PSO, supervisor assistant and security officer.

3. THEORETICAL BASIS OF METHODOLOGY

3.1 Analytical Hierarchy Process

AHP is one of the multi-criteria decision-making approaches using qualitative, quantitative and conflicting factors developed by Saaty. In this method, multi-layered hierarchical structures are created with alternatives, sub-criteria and goals. Data are derived from the construction of binary comparison clusters. These comparisons are used to determine the significance level of the decision for each criterion [23] [24].

AHP implementation steps are as follows [25]:

Step 1: Constructing a hierarchy with alternatives, sub-criteria and goals.

Step 2: Making pairwise comparison using the Saaty Scale.

Step 3: Checking consistency ratio of comparisons and revising the comparison if the ratio is not under 0.1.

Step 4: Determining significance level of each criterion.

Step 5: Assessing the results and making decisions.

3.2 Fuzzy Logic

Fuzzy logic, unlike classical logic, aims to model the vagueness of thought that plays an important role in the ability of people to make rational decisions in an uncertain and deficient environment. This decision making ability is our ability to answer questions by making inferences that are closest to the truth with the experience consisting of unreliable, deficient and inaccurate information [26]. Fuzzy logic is implemented by a series of processes called Fuzzy Inference System (FIS). FIS consists of three steps as described below [27] [28].

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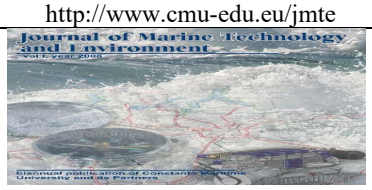

Step 1: Fuzzyfying the inputs: determining a set of fuzzy rules and membership level of each criterion in this set.

Step 2: Combining the fuzzy inputs according to the fuzzy rules by using fuzzy logic operators: determining whether or not the fuzzyfied inputs meet the fuzzy rules and forming fuzzy matrices to perform operations. The union and intersection operations are represented as follows:

Intersection formula;

$\mu_A(x) \wedge \mu_B(x)$ ya da $\mu_A(x,y) \wedge \mu_B(x,y) = \min(\mu_A(x), \mu_B(x)$ ya da $\mu_A(x,y), \mu_B(x,y))$

Union formula;

$\mu_A(x) \vee \mu_B(x)$ ya da $\mu_A(x,y) \vee \mu_B(x,y) = \max \mu_A(x), \mu_B(x)$ ya da $\mu_A(x,y), \mu_B(x,y)$

Step 3: Combining all consequences to get an output distirubiton and defuzzifying output distribution: the most commonly used methods in this step are Mamdani and Sugeno Method [29]. Mamdani method is prefered for this study. Formulas used in this method are as follows:

Considering a function z= f(x, y) where x and y are independent variables, z is the dependent variable, f is unknown, and A_i, B_i and C_i are levels of fuzzy sets, according to the rule *i*: if x is A_i and y is B_i then z is C_i where the integer *i* is ranged from [a,b]. Consequetly,

1) $\alpha_i = \min(\mu_i(x), \mu_i(y))$, for all rules *i*;

2) $\mu_i conseq(z) = \min(\alpha_i$, the level of z corresponding to rule *i*) = min (α_i, ($\mu_i(z)$), for all rules *i*;

3) $\mu conseq(z) = \max_i(\mu_i conseq(z))$.

There are certain strategies in the defuzzification stage, such as Mean of Maximum (MoM), Smallest of Maximum (SoM), Bisector, Center of Maximum (CoM), Center of Area (CoA) and Center of Gravity (CoG), which is used in the study. This method is defined as follows [28]:

$$y = \frac{\sum_i \mu_A(y_i) * y_i}{\sum_i \mu_A(y_i)}$$

4. NUMERICAL ILLUSTRATION OF THE MODEL

The two questionnaries filled by port facility security authorities have been used both for AHP and fuzzy logic.

3.1 Implementation of Analytical Hierarchy Process

This process consists of five steps:

Step 1 – Constructing a hierarchy with alternatives, sub-criteria and goals

In this step, a hierarchical structure consisting of 9 main criteria and 39 sub-criteria related to these chapters has been established. These main criteria and sub-criteria can be seen at the end of the AHP section with their importance level.

Step 2: Making pairwise comparison using the Saaty Scale.

In this step, a total of 10 matrices, 39 for the sub-criteria and 1 for the headings, have been constructed on the basis of the Saaty scale shown in Table 1. One of the generated comparison matrices is shown in Table 2 as an example. The AHP matrix is commonly calculated by scoring rows and columns. However, the matrix to be created in this way can be confusing and hesitatant about scoring, so an evaluation like the one in Table 2 is required. The numerical scoring of the comparisons in Table 2 is shown in Table 3.

Table 1: The Fundemantal Scale

Definition	**Intensity Importance of an Absolute Scale**
Equal importance	1
Moderate importance of one over another	3
Essential or strong importance	5
Very strong importance	7
Extreme importance	9

Source: Saaty, 1990:1

After creating numerical scoring matrix as shown in Table 3, the geometric average of each row is calculated.

1. Row: $(1*1*1*0.2*0.2*0.14*0.33)^{\wedge(1/7)} = 0.409$
2. Row: $(1*1*0.33*0.14*0.14*0.14*0.2)^{\wedge(1/7)} = 0.295$
3. Row: $(1*3*1*0.33*0.33*1*1)^{\wedge(1/7)} = 0.855$
4. Row: $(5*7*3*1*1*3*1)^{\wedge(1/7)} = 2.275$
5. Row: $(5*7*3*1*1*3*1)^{\wedge(1/7)} = 2.275$
6. Row: $(7*7*1*0.33*0.33*1*1)^{\wedge(1/7)} = 1.274$
7. Row: $(3*5*1*1*1*1*1)^{\wedge(1/7)} = 1.472$

The column vector formed by the geometric means above is summed up.

0.409+.295+0.855+0.275+0.275+1.274+1.472=8.854

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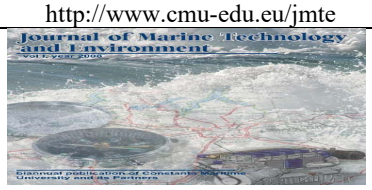

Table 2: Comparison Matrix of Access Control Criteria

Comparison Number	Extremely	Very Strongly	Strongly	Moderately	CRITERIA	Equally	CRITERIA	Moderately	Strongly	Very Strongly	Extremely
1					Preventing Access of Hazardous Material	**X**	Establishing Control Points				
2					Preventing Access of Hazardous Material	**X**	Verifying Identity of Persons				
3					Preventing Access of Hazardous Material		Checking People and Vehicles		**X**		
4					Preventing Access of Hazardous Material		Searching Unaccompanied Baggage		**X**		
5					Preventing Access of Hazardous Material		Ensuring Coordination With Ship			**X**	
6					Preventing Access of Hazardous Material		Facilitating Transfer of Ship Personnel	**X**			
7					Establishing Control Points		Verifying Identity of Persons	**X**			
8					Establishing Control Points		Checking People and Vehicles			**X**	
9					Establishing Control Points		Searching Unaccompanied Baggage			**X**	
10					Establishing Control Points		Ensuring Coordination With Ship			**X**	
11					Establishing Control Points		Facilitating Transfer of Ship Personnel		**X**		
12					Verifying Identity of Persons		Checking People and Vehicles	**X**			
13					Verifying Identity of Persons		Searching Unaccompanied Baggage	**X**			
14					Verifying Identity of Persons	**X**	Ensuring Coordination With Ship				
15					Verifying Identity of Persons	**X**	Facilitating Transfer of Ship Personnel				
16					Checking People and Vehicles	**X**	Searching Unaccompanied Baggage				
17				**X**	Checking People and Vehicles		Ensuring Coordination With Ship				
18					Checking People and Vehicles	**X**	Facilitating Transfer of Ship Personnel				
19				**X**	Searching Unaccompanied Baggage		Ensuring Coordination With Ship				
20					Searching Unaccompanied Baggage	**X**	Facilitating Transfer of Ship Personnel				
21					Ensuring Coordination With Ship	**X**	Facilitating Transfer of Ship Personnel				

Table 3: Numerical Illustration of the Access Control Comparison

	Preventing Access of Hazardous Material	Establishing Control Point	Verifying Identity of Persons	Checking People and Vehicles	Searching Unaccompanied Baggage	Ensuring Coordination with Ship	Facilitating Transfer of Ship Personnel
Preventing Access of Hazardous Material	1	1	1	0.2	0.2	0.14	0.33
Establishing Control Point	1	1	0.33	0.14	0.14	0.14	0.2
Verifying Identity of Persons	1	3	1	0.33	0.33	1	1
Checking People and Vehicles	5	7	3	1	1	3	1
Searching Unaccompanied Baggage	5	7	3	1	1	3	1
Ensuring Coordination with Ship	7	7	1	0.33	0.33	1	1

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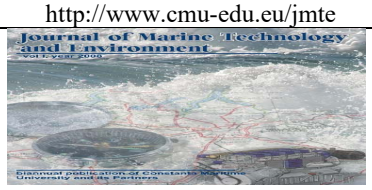

Facilitating Transfer of Ship Personnel	3	5	1	1	1	1	1

After creating numerical scoring matrix as shown in Table 3, the geometric average of each row is calculated.
1. Row: $(1*1*1*0.2*0.2*0.14*0.33)^{\wedge(1/7)} = 0.409$
2. Row: $(1*1*0.33*0.14*0.14*0.14*0.2)^{\wedge(1/7)} = 0.295$
3. Row: $(1*3*1*0.33*0.33*1*1)^{\wedge(1/7)} = 0.855$
4. Row: $(5*7*3*1*1*3*1)^{\wedge(1/7)} = 2.275$
5. Row: $(5*7*3*1*1*3*1)^{\wedge(1/7)} = 2.275$
6. Row: $(7*7*1*0.33*0.33*1*1)^{\wedge(1/7)} = 1.274$
7. Row: $(3*5*1*1*1*1*1)^{\wedge(1/7)} = 1.472$

The column vector formed by the geometric means above is summed up.
0.409+.295+0.855+0.275+0.275+1.274+1.472=8.854

Each element in the column vector created by geometric averages is divided by the sum of the geometric averages. In this way, significance levels are determined. However, these numbers have to be verified by calculating concistency ratio. Subsequent calculations are used to calculate consistency ratio.
0.409/8.854 = 0.046
0.295/8.854 = 0.033
0.855/8.854 = 0.097
2.275/8.854 = 0.257
2.275/8.854 = 0.257
1.274/8.854 = 0.144
1.472/8.854 = 0.166

Table 4: Significance Level of Access Control Criteria

	Preventing Access of Hazardous Material	Establishing Control Point	Verifying Identity of Persons	Checking People and Vehicles	Searching Unaccompanied Baggage	Ensuring Coordination with Ship	Facilitating Transfer of Ship Personnel	**Significance Level**
Preventing Access of Hazardous Material	1	1	1	0.2	0.2	0.14	0.33	**0.046**
Establishing Control Point	1	1	0.33	0.14	0.14	0.14	0.2	**0.033**
Verifying Identity of Persons	1	3	1	0.33	0.33	1	1	**0.097**
Checking People and Vehicles	5	7	3	1	1	3	1	**0.257**
Searching Unaccompanied Baggage	5	7	3	1	1	3	1	**0.257**
Ensuring Coordination with Ship	7	7	1	0.33	0.33	1	1	**0.144**
Facilitating Transfer of Ship Personnel	3	5	1	1	1	1	1	**0.166**
	$\lambda_{max} = 7.447$		**CI = 0.075**		**CR= 0.056**			

Step 3: Checking consistency ratio of comparisons and revising the comparison if the ratio is not under 0.1.

The significance levels determined for each criterion have been multiplied by the corresponding criterion column and the rows have been summed to form a new column vector.

$$0.046\begin{bmatrix}1\\1\\1\\3\\5\\7\\3\end{bmatrix} + 0.033\begin{bmatrix}1\\1\\3\\7\\7\\7\\5\end{bmatrix} + 0.097\begin{bmatrix}1\\0.33\\1\\3\\3\\1\\1\end{bmatrix} + 0.257\begin{bmatrix}0.2\\0.143\\0.33\\1\\1\\0.33\\1\end{bmatrix} +$$

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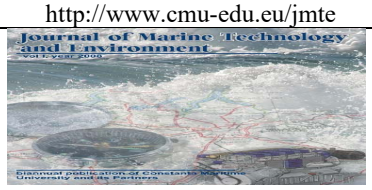

$$0.257\begin{bmatrix}0.2\\0.143\\0.33\\1\\1\\0.33\\1\end{bmatrix}+0.144\begin{bmatrix}0.143\\0.143\\1\\3\\3\\1\\1\end{bmatrix}+0.166\begin{bmatrix}0.33\\0.2\\1\\1\\1\\1\\1\end{bmatrix}=\begin{bmatrix}0.355\\0.239\\0.724\\1.865\\1.865\\1.134\\1.226\end{bmatrix}$$

Each element in the resulting column vector has been divided by significance level.

0.355/0.046 = 7.685
0.239/0.033 = 7.170
0.724/0.097 = 7.500
1.865/0.257 = 7.261
1.865/0.257 = 7.261
1.134/0.144 = 7.884
1.226/0.166 = 7.370

The arithmetic mean of the values has been the largest eigenvalue of the matrix.

$$\lambda_{max} = \frac{7.685 + 7.170 + 7.500 + 7.261 + 7.261 + 7.884 + 7.370}{7} = 7.447$$

Consistency Index has been calculated.

$CI = \frac{\lambda max - n}{n-1} = \frac{7.447-7}{(7-1)} = 0.075$

Consistency Ratio is calculated.

$CR = \frac{CI}{RI} = \frac{0.075}{1.32} = 0.056$

The consistency matrix is consistent since the obtained value is less than 0.1. In this case, significance level of criteria previously calculated are verified.

Step 4: Determining significance level of each criterion.

Since consistency ratio is verified, previous calculated significance level can be shown in Table 4.

Step 5: Assessing the results and making decisions.

Results show that "*Checking Persons and Vehicles*" and "*Searching Unaccompanied Baggage*" have the same score (0.257) and more significant than the other criteria. The less significant criteria (0.033) is determined as "*Establishing Access Points*". The significance levels of the other criteria in the questionnaire have been calculated using the same method and the significance levels are shown in Table 5.

Table 5: Significance Levels of Port Security Performance Criteria

Significance Level of Security Equipment Criteria			**Significance Level of Awareness Criteria**	
Failure Recovery	0.039		Security Drills	0.283
Competency of Security Equipment	0.327		Elaboration of Security Drills	0.036
Intrusion Detection System	0.307		Security Training	0.557
Monitoring System	0.327		Testing Security Personnel	0.124
$\lambda_{max} = 4.008$ CI= 0.003 CR= 0.003			**$\lambda_{max} = 4.181$ CI= 0.060 CR= 0.067**	
Significance Level of Restricted Areas Criteria			**Significance Level of Handling of Cargo Criteria**	
Determining Restricted Areas	0.244		Identifying Cargo	0.25
Verifying Identity of Persons	0.064		Verifying Cargoes' Information	0.25
Using Security Equipment	0.371		Prevent Tampering During Handling Operations	0.25
Providing New Restricted Areas	0.321		Checking of Ship Stores and Bunkers	0.25
$\lambda_{max} = 4.081$ CI= 0.027 CR= 0.030			**$\lambda_{max} = 4.000$ CI= 0.00 CR= 0.000**	
Significance Level of Declarations of Security (DoS) Criteria			**Significance Level of Communication Criteria**	
DoS At Different Level	0.333		Effective Communication	0.111
DoS to Unapproved Security Plan	0.333		Back-up Communication Systems	0.111
DoS to Security Concerns	0.333		Monitoring Port Facility	0.778
$\lambda_{max} = 3.000$ CI= 0.000 CR= 0.000			**$\lambda_{max} = 3.000$ CI= 0.000 CR= 0.000**	
Significance Level of Documentation Criteria			**Significance Level of Main Security Criteria**	
Recording Security Related Incidents	0.056		Security Equipment	0.016
Maintenance Records of Security Equipment	0.099		Awareness	0.025
Internal Audit Reports	0.116		Documentation	0.039
Amendments of PFSP	0.428		Communication	0.026

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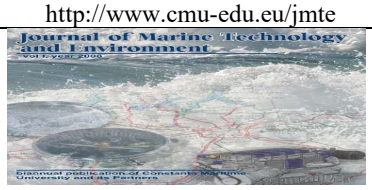

Records of Inspections and Patrols	0.122		Declaration of Security (DoS)	0.196
Protecting Records	0.153		Access Control	0.144
Independent Audit of Port Security	0.026		Restricted Areas	0.216
$\lambda_{max} = 7.717$ CI= 0.120 CR= 0.091			Handling of Cargo	0.120
			Response to Security Incidents	0.218
			$\lambda_{max} = 9.974$ CI= 0.122 CR= 0.084	
Significance Level of Response of Security Incidents Criteria				
Responding to Security Threats		0.785		
Examination of Security Activities		0.149		
Implementation Additional Security Procedures		0.066		
$\lambda_{max} = 3.0803$ CI= 0.040 CR= 0.069				

4.2 Implementation of Fuzzy Logic

Step 1: Fuzzyfying the inputs: determining a set of fuzzy rules and membership level of each criterion in this set.

Significance levels of criteria and titles have been turned into matrices as follows.

A = (0.016 0.025 0.039 0.026 0.196 0.144 0.216 0.120 0.218)

A_1 = (0.039 0.327 0.307 0.327)

A_2 = (0.283 0.036 0.557 0.124)

A_3 = (0.244 0.064 0.371 0.321)

A_4 = (0.25 0.25 0.25 0.25)

A_5 = (0.333 0.333 0.333)

A_6 = (0.111 0.111 0.778)

A_7 = (0.056 0.099 0.116 0.428 0.122 0.153 0.026)

A_8 = (0.785 0.149 0.066)

A_9 = (0.046 0.033 0.097 0.257 0.257 0.144 0.166)

Implementation of fuzzy logic questionnarries has been based on the evalutaion of criteria by scoring them between 1 to 9 (*Very Good = 9, Good = 7, Neither Good or Bad = 5, Bad = 3, Very Poor = 1*). 30 security related port facility personnel have scored these criteria. The results of the questionnarries are shown in Table 6

.

Table 6: Fuzzyfying Questionnaire Scores

		Very Good	Good	Neither Good or Bad	Bad	Very Poor
Security Equipment	Failure Recovery	2 (0.067)	7 (0.23)	13 (0.43)	5 (0.17)	3 (0.1)
	Competency of Security Equipment	2 (0.067)	8 (0.27)	14 (0.47)	6 (0.20)	0 (0.00)
	Intrusion Detection System	1 (0.033)	12 (0.40)	4 (0.13)	11 (0.37)	2 (0.67)
	Monitoring Systems	6 (0.20)	10 (0.33)	8 (0.27)	5 (0.17)	1 (0.33)

The "*Security Equipments*" matrix to be formed according to the above table can be shown as follows:

$$B_1 = \begin{bmatrix} 0.07 & 0.23 & 0.43 & 0.17 & 0.10 \\ 0.07 & 0.27 & 0.47 & 0.20 & 0.00 \\ 0.03 & 0.40 & 0.13 & 0.37 & 0.07 \\ 0.20 & 0.33 & 0.27 & 0.17 & 0.03 \end{bmatrix}$$

Step 2: Combining the fuzzy inputs according to the fuzzy rules by using fuzzy logic operators

The matrix has been unified by using union operator and significance levels of criteria. Union formula and unifying process are as follows:

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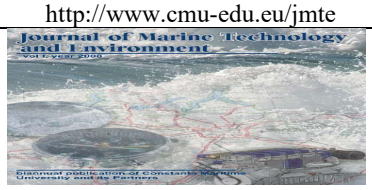


$C_i = A_i * B_i$

$$C_1 = [0.039 \quad 0.327 \quad 0.307 \quad 0.327] \otimes \begin{bmatrix} 0.07 & 0.23 & 0.43 & 0.17 & 0.10 \\ 0.07 & 0.27 & 0.47 & 0.20 & 0.00 \\ 0.03 & 0.40 & 0.13 & 0.37 & 0.07 \\ 0.20 & 0.33 & 0.27 & 0.17 & 0.03 \end{bmatrix}$$

$C_1 =$ ((0.039 ∧ 0.07) ∨ (0.327 ∧ 0.07) ∨ (0.307 ∧ 0.03) ∨ (0.327 ∧ 0.20)
(0.039 ∧ 0.23) ∨ (0.327 ∧ 0.27) ∨ (0.307 ∧ 0.40) ∨ (0.327 ∧ 0.33)
(0.039 ∧ 0.43) ∨ (0.327 ∧ 0.47) ∨ (0.307 ∧ 0.13) ∨ (0.327 ∧ 0.27)
(0.039 ∧ 0.17) ∨ (0.327 ∧ 0.20) ∨ (0.307 ∧ 0.37) ∨ (0.327 ∧ 0.17)
(0.039 ∧ 0.10) ∨ (0.327 ∧ 0.00) ∨ (0.307 ∧ 0.07) ∨ (0.327 ∧ 0.03))

$C_1 =$ ((0.039 ∨ 0.07 ∨ 0.03 ∨ 0.20)
(0.039 ∨ 0.27 ∨ 0.307 ∨ 0.33)
(0.039 ∨ 0.327 ∨ 0.13 ∨ 0.27)
(0.039 ∨ 0.20 ∨ 0.307 ∨ 0.17)
(0.039 ∨ 0.00 ∨ 0.07 ∨ 0.03))

After the unifying process, membership degrees of "*Security Equipments*" are calculated as follows:

C_1 = (0.200 0.330 0.327 0.307 0.070)

The other membership degrees have been calculated in the same manner and are as follows:

Awareness:
C_2 = (0.030 0.270 0.230 0.557 0.070)
Restricted Areas:
C_3 = (0.100 0.270 0.371 0.321 0.170)
Handling of Cargo:
C_4 = (0.070 0.100 0.250 0.250 0.130)
Declaration of Security:
C_5 = (0.030 0.330 0.330 0.330 0.170)
Communication:
C_6 = (0.030 0.070 0.400 0.430 0.130)
Documentation:
C_7 = (0.030 0.170 0.370 0.370 0.153)
Response to Security Incidents:
C_8 = (0.030 0.070 0.170 0.070 0.100)
Access Control:
C_9 = (0.030 0.100 0.257 0.257 0.100)

Step 3: Combining all consequences to get an output distribution and defuzzifying output distribution

A new matrix has been created using the calculated membership degrees.

$$C = \begin{bmatrix} 0.200 & 0.330 & 0.327 & 0.307 & 0.070 \\ 0.030 & 0.270 & 0.230 & 0.557 & 0.070 \\ 0.100 & 0.270 & 0.371 & 0.321 & 0.170 \\ 0.070 & 0.100 & 0.250 & 0.250 & 0.130 \\ 0.030 & 0.330 & 0.330 & 0.330 & 0.170 \\ 0.030 & 0.070 & 0.400 & 0.430 & 0.130 \\ 0.030 & 0.170 & 0.370 & 0.370 & 0.153 \\ 0.030 & 0.070 & 0.170 & 0.070 & 0.100 \\ 0.030 & 0.100 & 0.257 & 0.257 & 0.100 \end{bmatrix}$$

$FFS = A * C$

= [0.016 0.025 0.039 0.026 0.196 0.144 0.216 0.120 0.218] ⊗

$$\begin{bmatrix} 0.200 & 0.330 & 0.327 & 0.307 & 0.070 \\ 0.030 & 0.270 & 0.230 & 0.557 & 0.070 \\ 0.100 & 0.270 & 0.371 & 0.321 & 0.170 \\ 0.070 & 0.100 & 0.250 & 0.250 & 0.130 \\ 0.030 & 0.330 & 0.330 & 0.330 & 0.170 \\ 0.030 & 0.070 & 0.400 & 0.430 & 0.130 \\ 0.030 & 0.170 & 0.370 & 0.370 & 0.153 \\ 0.030 & 0.070 & 0.170 & 0.070 & 0.100 \\ 0.030 & 0.100 & 0.257 & 0.257 & 0.100 \end{bmatrix}$$

= [0.039 0.196 0.218 0.218 0.170]

In the final stage, the final fuzzy scores have been defuzzified by the Centroid Method to obtain the final score which is between 0 to 100. Defuzzification process is as follows:

$$y = \frac{\sum_i \mu_A(y_i) * y_i}{\sum_i \mu_A(y_i)}$$

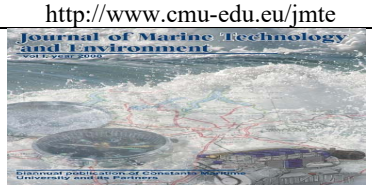
$$NS = \frac{(0.039*100+0.196*80+0.218*60+0.218*40+0.170*20)}{0.039+0.196+0.218+0.218+0.170}$$

$$= \frac{3.9+15.68+13.08+8.72+3.4}{0.841} = 53.25$$

5. RESULTS

The survey has been completed by evaluation of the personnel who worked as a security officer at a port facility by evaluating and scoring the criteria established to measure the security performance of the port facility. The sample of the survey consists of a PFSO, a PSO, two port facility protection and security supervisors, a port facility protection and security group chief and 25 port facility protection and security officers. The average age of the participants is 43.8 years and the work experience is 17.3 years.

As a result of the AHP calculations, the significance levels of the criteria have been determined as shown in Table 4. The security performance of the port facility has



also been measured as 53.25 as a result of the fuzzy logic. This score shows that the security performance of the port facility is "*moderate*".

6. CONCLUSIONS

Port facilities are the nodes that provide the continuity of global trade. The vast majority of global trade is carried by maritime transportation and it results in circulation of high volume of goods. This circulation brings security, operational and administrative problems. When the effects of these problems are taken into consideration, it is seen that the security problem come into prominence because it causes regional, national and international problems.

When researches on port security are examined, it is seen that there is not a quantitative study to show how secure the port facilities are in spite of the ISPS Code and other security initiatives. However, by measuring the security performance at the port facilities, the effectiveness of security applications can be measured, weaknesses in security activities can be identified, deficiencies in the measures can be determined, and the security performance can be motivated by determining the current performance of the port facility.

In order to measure the security performance of port facilities, a measuring method and a measuring instrument must be developed. For this purpose, fuzzy logic method, which is one of the methods to enable the digitization of abstract concepts, has been preferred. A questionnaire has also been used as a measurement tool. Moreover, in order to determine the importance of the criteria in the questionnaire, analytic hierarchy process method which is one of the multi criteria decision making methods has been used. The method and measurement tool used in the research have successfully been applied at a port facility. By using the method, have been determined the priority of port facilities in terms of security and also the level of security performance.

This method can be used by RSO and PFSO in measuring the security performance of port facilities. While RSOs assess conformity of port facilities on behalf of government, it is seen that these assessments are mostly based on subjective observations. To overcome this problem, quantitative methods should be used. PFSOs can use this method to assess security performance to prepare PFSP. Assessment criteria can be expanded appropriately by the RSOs and PFSOs. In this view, assessments will be more objective and scientific.

To conclude, when considering the importance of port facilities and the threats that they are exposed to, the security measures taken and the security activities carried out should be evaluated with an objective approach. Since investing only in security equipment is not enough to secure port facilities, the security performance needs to be measured quantitatively. This model provides the ability to quantitatively measure the security performance of port facilities for RSOs, PFSOs and other security related personnel. Taking into account the expression of "*you can not manage what you can not measure*" which is often mentioned in management science, it is understood that security performance must be measured and measurement also must be done quantitatively to ensure security at port facilities.

7. ACKNOWLEDGEMENT

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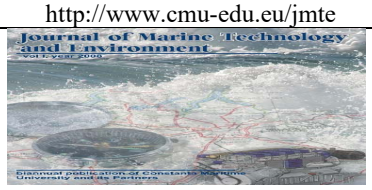
8. REFERENCES

[1] UNCTAD. (2017). *Review of Maritime Transport*. Geneva: United Nations Publications.
[3] Cristopher, K. (2009). *Port Security Management*. New York, NY: CRC Press.
[4] Gunasekaran, P. (2012). Malaysian Port Security: Issues and Challenges. *Australian Journal of Maritime & Ocean Affairs*. 4(2): 56-68.
[5] Sciascia, A. (2013). Monitoring The Border: Indonesian Port Security and The Role of Private Actors. *Contemporary Southeast Asia: A Journal of International and Strategic Affairs*. 35(2): 163-187.
[6] Mileski, J., Mejia, M., & Ferrell, T. (2015). Making Lemonade Out of Lemons: Port Operators' Perception of Their Port Security Regulation Compliance. *WMU Journal of Maritime Affairs*. 14(1): 93-108.
[7] Leonard, T.J., Gallo, P., & Veronneau, S. (2015). Security Challenges in United States Sea Ports: An Overview. *Transportation Security*. 8: 41-49.
[8] Davidson, C. (2008). Dubai: The Security Dimensions of the Region's Premier Free Port. *Middle East Policy*. 15(2): 143-160
[9] Banomyong, R. (2005). The Impact of Port and Trade Security Initiatives on Maritime Supply-Chain Management. *Maritime Policy & Management Journal*. 32(1): 3-13.
[10] McNaught, F. (2005). Effectiveness of the International Ship and Port Facility Security (ISPS) Code in Addressing the Maritime Security Threat. *Geddes Papers*, 89-100.
[11] Okoroji, L., & Ukpere, W. (2011). The Effectiveness of the International Ship and Port Facility Security Code (ISPS) in Nigeria. *African Journal of Business Management*. 5(4): 1426-1430.
[12] Suppiah, R. (2009). International Ship and Port Facility Security (ISPS) Code and Crew Welfare. *Journal of The National Maritime Foundation of India*. 5(1): 57-72.



[13] Bichou, K. (2011). Assessing The Impact of Procedural Security on Container Port Efficiency. *Maritime Economics & Logistic*. 13(1): 1-28.
[14] Chang, C. H., & Thai, V. V. (2016). Do Port Security Quality and Service Quality Influence Customer Satisfaction and Loyalty?. *Maritime Policy & Management*, *43*(6), 720-736.
[15] Yang, Z., Ng, A.K.Y., & Wang, J. (2014). A New Risk Quantification Approach in Port Facility Security Assessment. *Transportation Research*. 59: 72-90.
[16] Greenberg, M. (2011). Risk Analysis and Port Security: Some Contextual Observations and Considerations. *Annals of Operations Research*. 187(1): 121-136.
[17] Kumar, S., & Verruso, J. (2008). Risk Assessment for The Security of Inbound Containers at U.S. Ports: A Failure, Mode, Effects and Criticality Analysis Approach. *Transportation Journal*. 47(4): 26-41.
[18] Ung, S.T., Bonsall, S., Williams, V., & Wang, J. (2008). The Risk Assessment and Management of Port Security Using Fuzzy Modeling. *Marine Technology*. 46(2): 61-73.
[19] Yeo, G.T., Pak, J.Y., & Yang, Z. (2013). Analysis of DinamicEffects on Seaports Adopting Port Security Policy. *Transportation Research Part A: Policy & Practice*. 49:285-301.
[2] Edgerton, M. (2013). *A Practitioner's Guide to Effective Maritime and Port Security*. Hoboken, NJ: John Wiley & Sons.
[20] Concho, A.L., & Ramirez-Marquez, J.E. (2009). An Evolutionary Algorithm for Port- of-Entry Security Optimization Considering Sensor Tresholds. *Reliability Engineering and System Safety*. 95(3): 255-266.
[21] Yan, X., & Nie X. (2016). Optimal Placement of Multiple Types of Detectors Under a Small Vessel Attack Threat to Port Security. *Transportation Research Part E: Logistics and Transportation Review 93,* (2016): 71-94.
[22] Yoon, D., & Gim, J. (2014). A Study of Economic Efficiency in Port Security Inspection. *Journal of Advanced Transportation*. 48(5): 443-453.
[23] Triantaphyllou, E., & Mann, S. H. (1995). Using the Analytic Hierarchy Process for Decision Making in Engineering Applications: Some Challenges. *International Journal of Industrial Engineering: Applications and Practice*. 2(1):35-44.
[24] Brunelli, M. (2014). *Introduction to the Analytic Hierarchy Process*. New York, NY: Springer.
[25] Saaty, T. L. (1990). *Decision Making for Leaders: the Analytic Hierarchy Process for Decisions in a Complex World*. Pitsburg, PA: RWS Publications.
[26] Zadeh, L. A. (1988). Fuzzy logic. *Computer*. 21(4):83-93.
[27] MATLAB. (2018, August 12). Fuzzy Inference System Modelling [Software Guide]. Retrieved from https://www.mathworks.com/help/fuzzy/mamdani-fuzzy-inference-systems.html
[28] Polo, J. (2001). *Development and Testing of a Number of MATLAB Based Fuzzy System Applications* (Project Report). Coventry, UK: University of Warwick.
[29] Tan, L. (2012). *Takagi-Sugeno and Mamdani Fuzzy Control of a Resort Management System* (Master's Thesis). Available from DiVa-Portal Research Publications and Thesis Repository. (Diva Id: diva2:829949)

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ECOTOXICOLOGICAL ASSESSMENT OF TABACARIE LAKE

Mirela-Iuliana Sundri

Constanta Maritime University, Faculty of Naval Electro-Mechanics, 104 Mircea cel Batran Street, 900663, Constanţa, Romania, e-mail: iuliana.sundri@cmu-edu.eu

Abstract: The ecological characteristics of Tabacarie Lake on the Romanian Black Sea coast have undergone changes over time due to the pressure of the anthropic activities in the area. This requires assessment of the aquatic toxicity level. An ecotoxicological assessment of Tabacarie Lake effluent in the Black-Sea was done using 72 h Algaltoxkit biotest. The tests were performed using serial dilutions method, by halving the concentration, on some water samples from Tabacarie Lake. The ecotoxicological endpoints was the growth of green algae *Pseudokirchneriella subcapitata*. The highest inhibition of algal growth, with a value of 17.7%, was recorded in the tests with 100% Tabacarie water concentration, after 24 h measurement. The lowest inhibition was recorded in the test with the lowest concentration of lake water (6.25%). Tests have revealed that at different low concentrations of pollutants, the difference between effects decreases over time and at different high concentrations of pollutants, the difference between effects increases over time.

Key words: Biotest; Black Sea; Ecotoxicological risk assessment; growth inhibition; Tabacarie Lake.

1. INTRODUCTION

Tabacarie Lake, with an area of 84.1 ha and an average depth of 1.5 m, is located in the north-west of Constanta city, Romania, and on the Black Sea coast [1].

The ecological characteristics of Lake Tabacarie have undergone changes over time due to the anthropic activities in the area. Lake Tabacarie is deeper in the north, with a maximum depth of 3.7 m. The south side of the lake has a much smaller depth due to the depositions that have taken place over time as a result of waste spills in the lake.

The pressure of the natural factors specific to the geographical position of the lake but especially the pressure of the anthropogenic factors due to the activities carried out in the immediate vicinity, led to degradation of the lake water and sediment quality. These changes have been highlighted by studies conducted on Tabacarie Lake [2,3,4]. Among the polluting factors that have acted in the past, but whose influence is still felt today, can be mentioned: solid waste spread into the lake, waste water and rainwater discharges, agriculture and animal husbandry activities.

Studies on heavy metal concentrations [3] have shown that in many samples the threshold value at which biological effects may occur could be exceeded. Since in some cases the concentrations of metals in the sediments are 3 to 8 times higher than the natural geochemical background concentrations, it can be normally presumed that anthropogenic intake is important.

Excess water from the lake flows through a channel in the Black-Sea at the point called Pescarie, which is the southern boundary of the beach of Mamaia, with a large number of tourists during the summer. Hence it can be considered that the discharge of Lake Tabacarie water can be a source of pollution for the bathing water in that area.

Due to the synergistic effect of chemical substances, it is difficult to assess the ecotoxicological risk in Tabacarie Lake and in the area of discharge into the sea. For ecotoxicological risk assessment the effect of bio-availability, bioconcentration and biomagnification of pollutants in the trophic network of ecosystem must be considered. Only on the basis of chemical analyzes is it difficult to predict the toxic effects on organisms at different levels of trophic networks in the aquatic environment.

In recent years, bioassays have been used as instruments of real help for assessing the effects of a particular substance [5,6] or all polluting substances in a given environment on organisms [7]. Bioassays provide important data in terms of the acute or chronic effects of pollutants.

The present study provides an assessment of the impact of Lake Tabacarie water quality on aquatic organisms.

2. METHODS

Acute toxicity tests are short-term tests designed to measure the effects of toxic agents on the organisms.

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These tests assess survival over 24 to 96-hour exposure to the toxic substance.

In this study, Algaltoxkit F™, a 72-hour algal growth inhibition biotest using Pseudokirchneriella subcapitata green algae was used [8]. This test, developed by Microbiotest, complies with OECD and ISO standards [9, 10].

To assess water toxicity on test organisms, water samples were taken from the Tabacarie Lake- Black Sea discharge channel.

For testing, the sampled sample was used in concentrations of 100%, 50%, 25%, 12.5% and 6.25% (C1, C2, C3, C4 and C5 respectively). The working method is based on the spectrophotometric measurement of the optical density of the algal cell suspension. The algal concentration differences between the blank sample and the dilution series in the sample of water taken show the degree of water pollution in the lake by inhibiting the growth of the algal population.

Specific growth rates were calculated based on the relationship

$$\mu = (\ln N_2 - \ln N_1) / (t_2 - t_1),$$

where t_1 and t_2 represent the start and end times of the experiment, N_1 and N_2 the cell densities at the initial and end time of the experiment.

Algal inhibition was calculated based on the relationship:

$$I_\mu = 100\ (\mu_c - \mu_t) / \mu_c\ [\%],$$

where Iμ represents specific inhibition, μc and μt the specific increases in the control test and the water test at different dilutions.

For testing algal growth, a special incubator was used at a constant temperature of 20°C. Constant lighting inside incubator was provided by a 10,000 lux white fluorescent lamp.

3. RESULTS

For the different dilutions of the lake water sample, the algal population had a different increase, although initially the test started with the same number of algal cells (Table 1).

Table 1: Algal Concentration (Cells no / mL)

Time (h)	Lake water concentration on test					
	Control 0%	6.25%	12.5%	25%	50%	100%
0	10466	10466	10466	10466	10466	10466
24	20506	20204	19622	19402	18799	18197
48	51265	49429	46777	46322	43105	40249
72	266723	245454	229822	215472	207784	164220

The number of algal cells varies depending on the Tabacarie Lake water concentration, but the differences are not more than 40% compared to the control population. The lowest algal concentration corresponds to the sample with 100% Tabacarie Lake water (fig. 1).

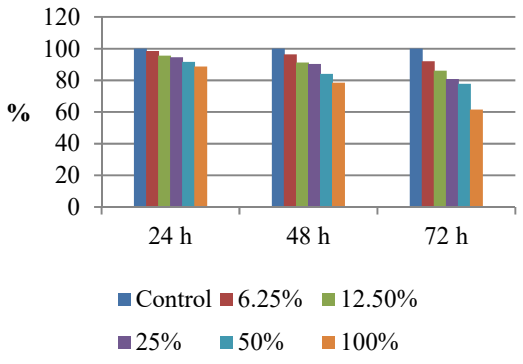

Figure 1 Algal growth relative to the control population

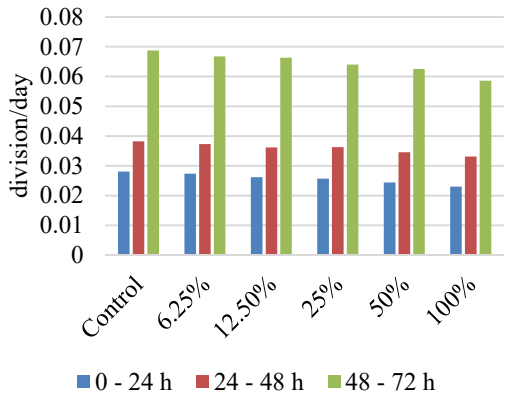

Figure 2 Specific algal growth rates (divisions per day)

Specific growth rates ranged from one day to the next, the highest being on the third test day for all samples, which demonstrates an adaptation of the algal population to environmental conditions, the population

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growth curve being the specific one under the conditions of a discontinuous culture system.

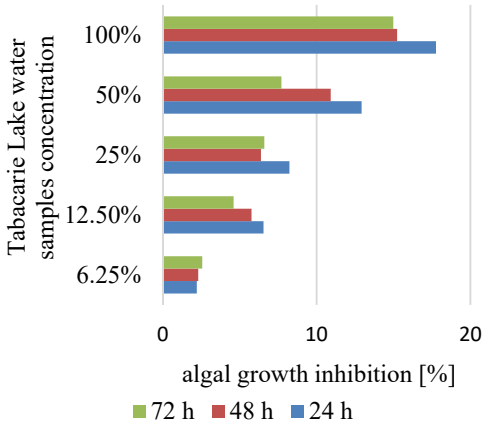

Figure 3 Algal growth inhibition

The highest percentage inhibition of algal cell growth was found for algal populations where the effluent of Tabacarie Lake was in the 100% concentration. In this case, the inhibition values were 17.7% for the first 24 hours, 15.22% for 48 hours and 14.97% for the entire 72-hour test period. For the other effluent concentrations (50%, 25 %, 12.5% and 6.25%) mean growth inhibition over the test period was less than 10% relative to the increase in the control population. The lowest inhibition of algal growth, ranging from 2.2% to 2.5%, was recorded in tests where the lake water concentration was 6.25% (Figure 3).

It is important to know how much the inhibitory effect increases with the increase of Tabacarie water concentration in the test sample. In the test, a serial dilution was used by halving the concentrations, which means that C1 represents twice the concentration of C2, C2 is twice the C3 concentration, and so on. The effect did not follow the same relationship.

Algal inhibition after 24 h and 48 h corresponding to a Tabacarie water concentration of 12.5% C4) was 194% and, respectively, 154% higher than algal inhibition at 6.25% (C5) Tabacarie water concentration. These values represent the largest variation of algal inhibition between two successive concentrations. The smallest difference in algal inhibition between 2 successive concentrations was 10.6% and was recorded after 48 h between algal growth inhibitions in the tests with Tabacarie water at a concentration of 12.5% and 25%. It is noted that between tests with Tabacarie water concentration of 6.25% and 12.5% (C5 and C4 respectively) the inhibition difference decreases over time, reaching after 72 h at 81.2%. Between tests with 50% and 100% Tabacarie water concentration (C2 and C1), the inhibition difference increases from 37.6% after 24 h to 92.7% after 72 h. For the other Tabacarie water concentrations the variation in inhibition degree does not have a clear trend (table 2).

Table 2: The variation of the inhibitory effect on the increase of the pollutant concentration

Time [h]	100*(C4-C5)/C5	100*(C3-C4)/C4	100*(C2-C3)/C3	100*(C1-C2)/C2
24	193.83	25.88	57.09	37.62
48	153.88	10.66	72.35	39.31
72	81.19	43.18	18.87	92.73

It can be assumed that up to a certain increase in the concentration of the pollutant the algal populations adapt so that in time the difference between the inhibitory effects decreases. At high concentrations of the pollutant, as the concentration increases, over time, the difference between the inhibition effects increases. This situation can be attributed to overcoming the threshold for adapting organisms to pollutants.

Given the relatively low algal growth inhibition (below 20%) we can assume that the sample taken from Lake Tabacarie at the point of discharge into the Black Sea (at the entrance to Mamaia Resort) does not have a significant toxic effect on the growth of green algae *Pseudokirchneriella subcapitata*. It has to be taken into account that the study was carried out only with samples of lake water. The sediment toxicity, where much higher concentrations of metals were found, was not tested. A follow-up study on sediment toxicity testing on aquatic organisms will provide comprehensive data on aquatic life quality in Tabacarie Lake and on ecotoxicological risk assessment.

4. CONCLUSIONS

The 72-hour toxicity test on Lake Tabacarie water has allowed us to highlight:

- Ability to rapid assessment of health environment and possible sources of pollution in aquatic areas.
- The water of Tabacarie Lake at the point of discharge into the Black Sea does not have a significant effect on the growth of green algae *Pseudokirchneriella subcapitata*.

- The highest algal growth inhibition value of 17.7% was recorded after 24 hours of lake water toxicity testing.
- At different low concentrations of pollutants, the difference between effects decreases over time.
- At different high concentrations of pollutants, the difference between effects increases over time.

Future studies are required on sediment toxicity in Tabacarie Lake.

5. REFERENCES

[1] *** 2003, *Geografia României -vol. V, Câmpia Română, Dunărea, Podişul Dobrogei, Litoralul Românesc al Mării Negre şi Platforma Continentală*, Editura Academiei Române, Bucureşti. *** http://eca.knmi.nl/.

[2] Breier, A, 1976, *Lacurile de pe ţărmul românesc al Mării Negre. Studiu hidrogeografic*, Edit. Academiei, Bucureşti.

[3] Caraivan G., Secrieru, D., Fulga, Constantina, Păun, F., 2009, *Lacul Tăbăcărie – Model de poluare urbană*, Sesiunea de Comunicări Ştiinţifice GeoEcoMar, Constanţa. http://www.geoecomar.ro/website/publicatii/supliment2009/5.pdf

[4] Păsculescu, C.E., 2011. *Aspects regarding the variability of the levels of Siutghiol and Tăbăcărie lakes*, Present environment and sustainable development, vol. 5, no. 1. http://www.pesd.ro/articole/nr.5/1/08.%20Pasculescu.pdf

[5] Ekelund, N., Häder, D., 2018, *Environmental monitoring using bioassays.* In book: Bioassays, pp.419-437 10.1016/B978-0-12-811861-0.00021-8. https://www.researchgate.net/publication/322182768_Environmental_monitoring_using_bioassays

[6] Azizullah, A, Richter, P, Waheed U., Imran A., 2013 - *Ecotoxicity evaluation of a liquid detergent using the automatic biotest ECOTOX*, Ecotoxicology 22(6) · June 2013

[7] Dokyung, K., Rongxue Cui, Jongmin Moon, Jin Il Kwak, 2018 - *Soil ecotoxicity study of DEHP with respect to multiple soil species*, Chemosphere 216, October 2018.

[8] *** https://www.microbiotests.com /toxkit/ freshwater -algae-toxicity-test-with-algaltoxkit-f/

[9] *** ISO 8692:2012 - Water quality - Fresh water algal growth inhibition test with unicellular green algae https://www.iso.org/standard/54150.html

[10] *** OECD Guidelines for the Testing of Chemicals, Section 2. Test No. 201: Freshwater Alga and Cyanobacteria, Growth Inhibition Test. https://www.oecd-ilibrary.org/environment/test-no-201-alga-growth-inhibition-test_9789264069923-en.

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FLETTNER ROTOR WITH HELIUM

Vasilescu Mihail – Vlad

Constanta Maritime University, Faculty of Naval Electro-Mechanics, 104 Mircea cel Batran Street, 900663, Constanţa, Romania, e-mail vladmihail_2005@yahoo.com

Abstract: The main focus of this article is the presentation of a new type of equipment for obtaining electrical energy using the wind energy, the Flettner Rotor with helium. The main goal is the reduction of environmental pollution and of fossil fuels. I propose to show the principal components of the Flettner Rotor with Helium. The main reason of this article is to try to show an equipment which can be used for reducing of ship pollution and the quantity of fuel used, increasing the energy efficiency, that means, to reduce the price of transportation and a method of saving money for the owners. As a result of my research I discovered that the Flattner Rotor with Helium, is an equipment which can successfully be used on ships, like an alternative source of energy, while passing oceans. In recent years, a lot of money had been invested in the development and research of security measures for eco- energy research equipments for ships. Allot of equipments have been descovered, but a few of them had been emplemented and had success.
Eco energy, the energy generated by equipments from Sun/Moon power and wind power is a free energy, but not a cheap one, it needs special equipment, specialized engineers.

Key words: Wind Energy; Ship; Magnus Effect; Flettner Rotor; Helium; Power.

1. INTRODUCTION

The wind is the fastest energy source in the world and one of the cheapest renewable energy technologies today. The wind is a complete energy source sources.

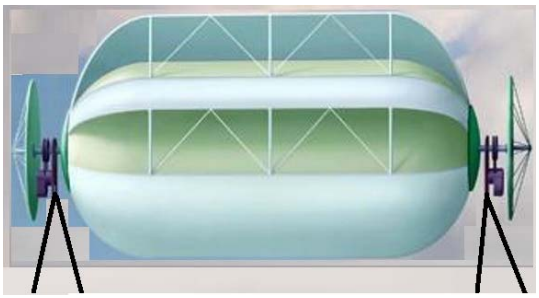

Figure 1 Flettner Rotor with Helium

The Flettner rotor with Helium, is an electric power generator, full of helium which rotates around a horizontal axis and sends power through a cable.

Generated electricity can be used immediately or stored in a battery.

The Flettner rotor with Helium is a device that generates electricity at high altitude. He rotates around a horizontal axis in response to the wind, effectively generating renewable energy, clean electricity at a lower cost than all competing systems.

Generating electricity from wind energy takes place in several stages. The system consists of: 2-3-bladed rotor mounted on a tower, cables and other auxiliary components (converters, inverters, batteries).

Due to high altitudes where is situated the Flettner Rotor, the power generated by it is at least twice the power generated by a classic wind turbine.

2. SYSTEM COMPONENTS

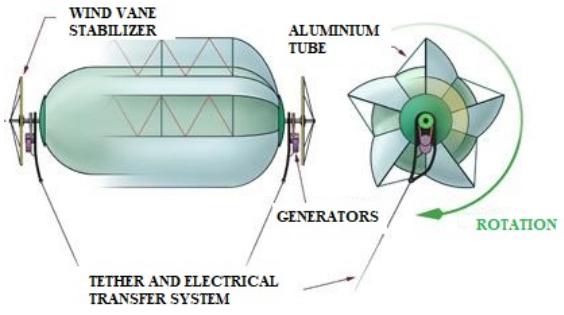

Figure 2 Tether and electrical transfer system

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- Anchor rods: The anchor paramters are designed to anchor the Flettner Rotor with helium of the ship.
- Power transmission cables The power generated by the system at height is sent to the ship by cables. Electricity generated through the cables to a transformer located on the ship, then redirected to the network.
- Helium balloon Due to its filling with a gas lighter than the air-helium, the balloon remains in suspended vertical position. The Helium supports the Flettner Rotor rising to an altitude selected by the operator for a maximum of 300 meters, for the best performance.
- Helium-Helium is the chemical element with atomic number 2 and atomic weight 4.002602, which is represented by He. It is an inert, colorless, odorless monoatomic gas that drives the noble gas group in the periodic table.

Figure 3 Helium

- Rotor blades - The blades are relatively thin, that means they have a higher surface area at volume and they are more affected by the wind. To increase efficiency, they are curved. The blades are made of reinforced polyester with fiberglass because it is a light material. As the blades move, they cause the shaft to be rotated in the body of the turbine to begin rotating. Turbine blades rotate at a speed between 10-50 rotations per minute and are equipped with regulators that shut down the system under dangerous meteorological conditions, to prevent them from coming out of control. The longer they are, thinner and lighter, the turbine blades can increase energy production. Blades current range is from 40-145 meters.
- Turbine - The turbine is located on the horizontal axis and has the ability to convert the mechanical wind energy into electical power.
- Generator- The turbine generator converts mechanical energy into electricity. Turbines generator are different, compared to other generating units that are in the way usually attached to electrical networks. The generator must work with a source of energy that provides variable mechanical power (torque). A generator located 300 meters above the ground level enjoys a strong wind, which is why the Flettner rotor with Helium has such an important role. The generator is positioned at the rear part of the device to ensure stability. This is done with the massive rotor blades, which forms the visible part of a turbine.

2. COOLING

Generators need cooling while working. This is done with air. The encapsulated generator is cooled by large fans.

3.THE OPERATING PRINCIPLE

The wind rotates the turbine blades, which in turn causes the generator to rotate.

The blades change the mechanical energy of the wind into an energy transmitted to the shaft. The shaft is connected to a transmission box that is used to rotate the blades, to rotate the magnets in the generator and produce mechanical energy. This mechanical energy is transmitted to the shaft in the turbine hub causing a torque to develop on the shaft. At the other end of the shaft there is a transmission box that transfers energy to a secondary shaft. Transmission intensification determines a high RPM in the secondary shaft and in the consequently, the torque is reduced. A generator or alternator is mounted on the secondary shaft and transforms the initial mechanical energy supplied by the wind to the turbine. Under a protective cover there is the shaft, the drive unit and the generator.

The generator converts the mechanical energy of the wind into electricity using electromagnetic induction, which involves the use of the opposite charge to a magnet to form the electric current.

The generators have a direct cable outlet at each end of the rotor. Besides the generators at each end of the rotor there are 2 wind stabilizers in shape of conical wheels.

The deviation is caused by the force of Margnus. It is in the direction of rotation of the rotor and results from the pressure differences created during the rotation process. The effect of Magnus is the maximum when the wind direction is perpendicular to the rotation axis of the rotor.

The Magnus effect associated with the rotor rotation ensures extra lifting stabilizes the rotor position. The wind causes the balloon to rotate: The movement is converted into electricity and then is transferred down.
The blades of Flettner Rotor with Helium are a component of the three-dimensional balloon.

The blades capture the wind, making the entire balloon spin. After the generator converts this move into electricity, it is transferred to the ship.

The Flettner rotor with Helium can capture the winds from 183 to 305 meters above the ground. Winds at these higher levels are significantly faster than lower level winds.

Research shows that with each doubling of the height, there is a 12% increase in wind speed, with every

doubling of the wind speed, there is an increase of eight times of the generated power by the Flettner Rotor with Helium.

The wind pushes the rotor blades, turning the kinetic energy into a rotating motion. It rotates a shaft at a low speed, which enters into a transmission box. The transmission, drives a high-speed shaft that passes through the generator case.

A magnetic rotor located on the high-speed shaft produces "electromagnetic induction" through the coils and generates an electric current. The current must be regulated for the power that powers the grid or to be directed into a battery rack for further use.

In order to have as much life as possible, the inflatable turbine is manufactured from an extremely durable fabric used in aeronautics. The outside of the fabric is lined with a special coat for protection against UV and abrasion.

The inner part is covered with a Mylar foil (the silver part seen in the helium balloon) is designed to prevent the helium gas from escaping. Because the Flettner Rotor with Helium is located at such high altitudes, he was specially designed to resist at strong winds.

The Flettner rotor with Helium can operate at speeds greater than 28 m/s. To the other end of the spectrum, the Flettner Rotor turbine with Helium can transform the wind energy in electricity and at wind speeds of 3 m/s.

4. ENERGY BALANCE

From the researches carried out it was found that the Flettner Rotor with Helium, positioned at 300 m altitude can generate about 1000 kW/hour.

Flettner Rotors with Helium, is an environment-friendly, generating electical energy equipment.

5. ACKNOWLEDGEMENTS

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6. REFERENCES

[1] CRAFT T. J., ACOVIDES H., JOHNSON N., and LAUDER B. E., Back to the future: Flettner-Thom rotors for maritime propulsion, Editura Begell House, ,Londra, pag. 1–10 2012.
[2] FAGIANO L, MILANESE M., PIGA D., High Altitude Wind Generation: renewable energy cheaper than oil, EU Conference "Sustainable development: a chalenge for European research". Brussels, Belgium, 2009.
[3] JOHNSON N. D., High-Reynolds Number Flow Past a Rotating Cylinder with and Without Thom Disc, M.S. Thesis, School of Mechanical, Aerospace and Civil Engineering Faculty of Engineering and Physical Sciences, University of Manchester, 2011.
[4] NUTTAL P., KAITU J, The Magnus Effect and the Flettner Rotor: Potential Application for Future Oceanic Shipping, The Journal of Pacific Studies, Volume 36 Issue 2, 2016
[5] PEATERSON G. – Spin Sail harness misterious Magnus Effect for ship propulsion, The What's New Magazine- Popular Science,1984
[6] PEARSON D. R., The Use of Flettner Rotors in Efficient Ship Design, The Royal Institution of Naval Architects, London, 2014.
[7] RAGHEB M.- Airborne wind turbine concepts, 2010.
[8] SILVANIUS M., Wind assisted propulsion for pure car and truck carriers, KTH Centre for Naval Architecture, 2009.
[9] THOM A., The Effect of Discs on the Air Forces on a Rotating Cylinder, Aeronautical Research Committee Reports and Memoranda No. 1623, His Majesty Stationery Office, London, 1935.
[10] TRAUT M., BOWS A., GILBERT S, MANDER P., STANSBY P., WALSH C., and WOOD R., Low C for the High Seas Flettner rotor power contribution on a route Brazil to UK, Second International Workshop on Successful Strategies in Supply Chain Management Template, 2012.
[11] WELLICOME J. F., Some Comments on the Relative Merits of Various Wind Propulsion Devices, Journal of Wind Engineering and Industrial Aerodynamics, vol. 20, pag. 111-142, 1985.
[12] Williams P., Lansdorp B., Ockels W., Optimal cross wind towing and power generation of tethered kites, AIAA Guidance, Navigation and Control Conference and Exhibit, Hilton Head, South Carolina, 2007.
[13] http://www.ames.ro, accesat 24 Ianuarie 2015.
[14] https://www.dantalmaciu.wordpress.com, accesat 24 Ianuarie 2015.
[15] http://www.greatlakes- seaway.com, accesat 15 Mai 2019.
[16] http://www.greenspotter.ro, accesat 24 Ianuarie 2015.
[17] https://www.greenstart.it, accesat 4 Iulie 2019.
[18] http://www.ecomarinepower.com, accessat 15 Mai 2019.
[19] http://www.inerjy.com/, accessat 19 Mai 2019.
[20] http://www.lshipdesign.blogspot.in, accesat 15 Mai 2019.
[21] https://www.norsepower.com, accesat 13 Mai 2019.
[22] https://www.rawlemon.com, accesat 6 Iunie 2019.
[23] http://www.renewablesinternational.net, accesat 20 Mai 2019.
[24] http://www.sdtb.de/Flettner-Rotor.1623.0.html, acceast la 20 Mai 2019.
[25] https://en.wikipedia.org/wiki/Rotor_ship, accesat la 6 Iunie 2019.

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FLETTNER ROTORS

Vasilescu Mihail – Vlad

Constanta Maritime University, Faculty of Naval Electro-Mechanics, 104 Mircea cel Batran Street, 900663, Constanţa, Romania, e-mail vladmihail_2005@yahoo.com

Abstract: The main focus of this article is the presentation of a new type of equipment for obtaining electrical energy, on ships, by using the wind energy, the Flettner Rotor. The main goal is the presentation of a type of wind turbine which can be used for the reduction of environmental pollution and of fossil fuels which are used for conventional propulsion systems on ships. I propose to show the principal components of the Flettner Rotor, his principal caracteristics, the power generated by the equipment at different ship and wind speeds. The main reason of this article is to try to show an equipment which can be used for reducing of ship pollution and the quantity of fuel used, increasing the energy efficiency, that means, to reduce the price of transportation and a method of saving money for the companies which own the ships.
As a result of my research I discovered that the Flattner Rotor, is an equipment which can successfully be used on ships, like an alternative source of energy, while passing the sea or oceans. In recent years, a lot of money had been invested in the development and research of security measures for eco- ships. In 2008 "Enercon" project had been launched and the first ship with Flettner Rotor had been built. This system saves about 30-40% of the fuel and the ship can touch a speed of 16 knots, of course in combination with the conventional propulsion engine. One of the advantages of this system is that the rotors can be used to maneuver the ship, even when the ship is stopped without using the main engine propulsion. Flettner Rotors can be the future of eco- propulsion on ships.

Key words: Wind Energy; Ship; Magnus Effect; Flettner Rotor; Wind; Power.

1. INTRODUCTION

Environmental concerns for reducing CO_2 emissions will force the shipping industry to reduce fossil fuel consumption by increasing efficiency in shipping and equipping ships with renewable energy sources.
Wind energy is a renewable energy source generated by wind power.

It is free, abundant and with great potential at sea. Wind power is the use of the air flow passing through the turbines to provide mechanical power to rotate some generators and create electric current.

Flettner rotor is one of the various equipment use to capture and capitalize wind power.

In this paper, a Flettner Rotor , without end plates, has a height of 12.5 m and a diameter of 2.1 m. It is used for theoretical analysis to estimate how much net power the Flettner Rotor can generate. He using the values of the lifting coefficient

C_L = 12,5 and the traction coefficient al C_D = 0,2.

The calculations were made for a ship speed of 15 knots or 20 knots and a real wind speed variation from 5 m/s to 20 m/s. The net power obtained is maximum at true wind angles of 100 degrees and 260 degrees respectively.

Table 1.1: The power generated by the Flettner Rotor at various wind speeds and a ship speed of 15 Nd

Ship speed 15 Nd	
Wind speed (m/s)	**Maximum Power (kW)**
5	42.2
10	124
15	239.9
20	386.7

Table 1.2: The power generated by the Flettner Rotor at various wind speeds and a ship speed of 20 Nd

Ship speed 20 Nd	
Wind speed (m/s)	**Maximum Power (kW)**

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5	68.2
10	189.5
15	358.8
20	575.2

2. FLETTNER ROTOR OPERATION PRINCIPLE

The wind hits the rotating cylinder, generating a rotational speed for the cylinder.
The air accelerates on one side and delays the opposite side. Two areas are formed by this phenomenon: a low pressure region and a high pressure region.

As a result of this pressure differential, a force called the lifting force is developed in a direction perpendicular to the flow of the wind flow and in the direction of rotation, as shown in the figure below. The underlying cause of acceleration and deceleration is that the fluid layer adjacent to a solid surface has its velocity.

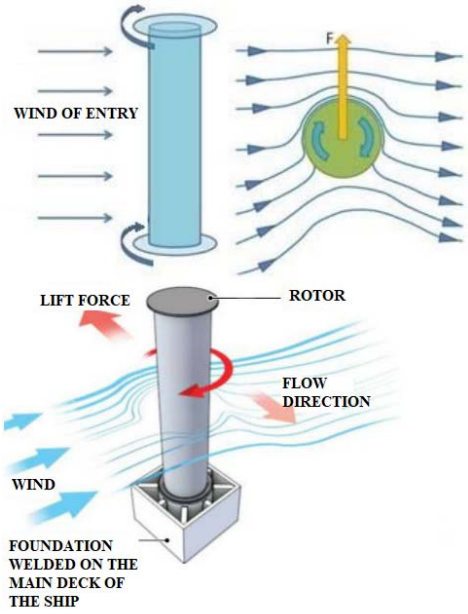

Figure 1 Flattner Rotor

The lifting force or traction force induced by the Magnus effect may be used as a propulsion system for ships if the system is properly mounted on the ship's deck. An electric motor is used to rotate the rotor. The number of rotors may vary depending on the ship's size and other characteristics.

In the following I will analyze Flettner Rotor performance in terms of power generation and the effects of various parameters including cinematic and dynamic ones.

3. SYSTEM SPECIFICATIONS

Appearance ratio
12.5 / 1.2 ≈ 6 (ratio of rotor height to its diameter).

Table 1.3: System specifications

Parameters	**Values**
Rotor highth	12,5 m
Rotor diamiter d	2,1 m
Aspect report	6
Lift coeficient C_L	12,5
Traction Coeficient C_D	0,2
Air density ρ_A	1,225 $\frac{kg}{m^3}$
Dinamic speed of air μ	1,789 x 10^{-5} $\frac{N-m}{s^2}$
Naval propulsion effeciency η_s	0,75
Angle of drift λ	Negligible value
Friction	Negligible value
Schlichting formula is used to calculate the friction coefficient (c_f).	

4. SYSTEM CONFIGURATION

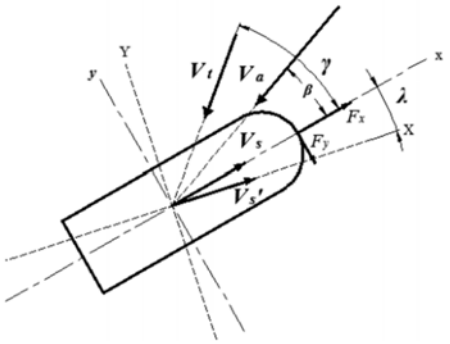

Figure 2 System variables and coordinates, considered strengths and angles

F_x and F_y is a system generated by air forces.

X and Y represent the global coordinates in which the ship moves.

- x and y represent the local coordinates
- λ is the angle of drift.
- γ is the true wind direction.
- β is the apparent wind direction.

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The apparent wind speed will depend on the actual wind speed

V_t and the speed of the ship

V_s which are known.

The calculations were made for a drift angle λ very small, so V_s `coincides with V_s.

Apparent wind speed V_a

is given by the ecuation:

$$V_a = \sqrt{V_t^2 + V_s^2 - 2V_t V_s \cos\gamma} \tag{1}$$

Direction of the apparent wind β can be calculated from the law of the cosine at the speed triangle:

$$\beta = \cos^{-1}\left(\frac{V_t^2 - V_a^2 - V_s^2}{-2V_a V_s}\right) \tag{2}$$

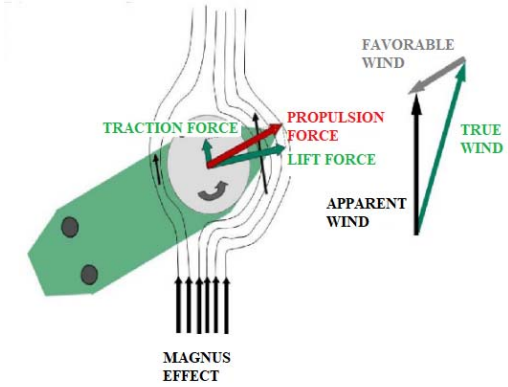

Figure 3 The Magnus Effect

The Effect of Magnus is when a rotating cylinder is hit by a free air flow with a lifting force and a pulling force. The forces are strictly dependent on the rotor size, angular velocity and free flow rate.

While the air mass in one part of the rotor is accelerating, the air mass on the other side is decelerated. According to the law conservation of energy, it puts a lower pressure on one side and a higher pressure on another part that creates the pushing force. This lifting force or pushing force per unit of length (L1 / l) in terms of movement Γ este dată de legea lui Kutta-Joukowski.

$$L_{l/l} = \rho_A V_A \Gamma . \tag{3}$$

Where:

$$\Gamma = \text{circulation};\ \Gamma = 2\pi\omega r^2 \tag{4}$$

ω = angular speed

r=the radius of the rotor

Coefficient C_{rot} is introduced by the relationship between rotor rotation speed U_{rot} and apparent wind speed V_a.

$$U_{rot} = C_{rot} V_a \tag{5}$$

Speed of rotor rotation U_{rot} varies depending on the apparent wind speed V_a.

4.1 Power consumed by the rotor

The resistive force and the energy of rotation (power) required to overcome this resistance created by metal rubbing is estimated by using the flat boundary theory. The Reynolds Re number, which is required for calculating the coefficient of friction C_f what can be expressed as:

$$R_e = \frac{\rho_A C_{rot} V_a L_{\text{Re}}}{\mu} \tag{6}$$

Where μ is the dynamic viscosity of the air and L_{Re} is the characteristic length, ie the circumference of the rotor (π,d). To find the metal friction coefficient C_f, using the Reynolds number, we will use the Schlichting formula that is valid for Re values around 5 x 10^5.

$$c_f = \frac{0.455}{(\log(R_e))^{2.58}} - \frac{1700}{R_e} . \tag{7}$$

To calculate the total power required to rotate the rotor, the required friction force F_f is given by the equation:

$$F_f = c_f \rho_A \frac{U_{rot}^{\ 2}}{2} A_r \tag{8}$$

Where:

A_r = is the rotor area

$$A_r = \pi d h . \tag{9}$$

The power required to rotate the rotor P_{con} is:

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$$P_{con} = F_f U_{rot}. \quad (10)$$

The rotor is able to create a large lift coefficient depending on its rotation speed. The disadvantage is that the higher the lifting coefficient, the ratio between lift and pull decreases and therefore pull increases.So we take it C_{rot}=5, C_L=12,5 and C_D=0,2.

4.2 Power from the system

Knowing wind speed and wind direction we can calculate power in the system. We do this using the lifting force L and the traction force D of the system according to:

$$L = \rho_0 A C_l \quad (11)$$

$$D = \rho_0 A C_D \quad (12)$$

Where:

C_L =three-dimensional lift coefficient;

C_D =three-dimensional traction coefficient;

A = the maximum design area of the system;

ρ_o = stagnation pressure;

ρ_A =air density;

$$\rho_0 = \frac{\rho_A V_a^2}{2}. \quad (13)$$

To determine the effective force in the direction of the ship's motion (x-x), and in the perpendicular direction (y-y), the lifting and firing forces will be solved in the direction of the ship's displacement and perpendicular to it. Representing the shape of the matrix F_x and F_y.

$$\begin{bmatrix} F_x \\ F_y \end{bmatrix} = \begin{bmatrix} \cos\beta & \sin\beta \\ -\sin\beta & \cos\beta \end{bmatrix} \begin{bmatrix} -D \\ L \end{bmatrix} \quad (14)$$

$$F_x = L\sin\beta - D\cos\beta \quad (15)$$

$$F_y = L\cos\beta + D\sin\beta \quad (16)$$

F_x is calculated according to the above relationship, with L and D calculated previously.

System power P_s in the march direction of the ship is calculated by multiplying F_x with the speed of the ship V_s

$$P_s = F_x V_s \quad (17)$$

Net power of the system P_{net}

$$P_{net} = (P_s - P_{con})\eta_s \quad (18)$$

Where:

η_s = propulsion efficiency of ship = 0.75

5. THE ENERGY BALANCE OF THE SYSTEM, FOLLOWING THE APPLICATION OF VARIOUS CONDITIONS

Initial calculations are made by taking the above constants and from the equations mentioned above at a true wind speed of 5 m / s and a ship speed of 15 knots (or 7.71 m/s) at all true winds with angular values between 0° and 360°. Flettner Rotor performance depends on vessel speed, wind speed, real wind angle, and other aerodynamic parameters such as lift coefficient, pull coefficient and rotation coefficient.

The figures were represented using a polar graph for all true winds that knock from angles between 0° and 360 °.

5.1 Effect of the wind velocity variation on the output power when the vessel has 15 nd speed and the other parameters are kept constant

As the actual wind speed increases by 5 m / s, 10 m / s, 15 m / s, 20 m / s the output power generated by the Flettner rotor increases.

Where:

C_{rot} =5, C_L = 12,5 and C_D = 0,2 remain constant . However, the energy consumption through the rotor also increases, but the effect is net positive because the force generated exceeds the resistive power.

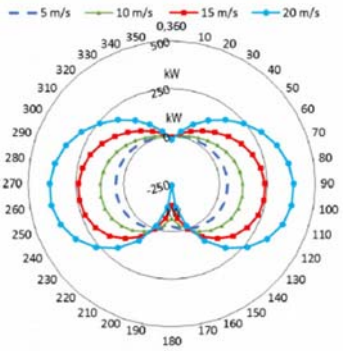

Figure 4 Net output power (kW) generated by the Flettner Rotor at various wind speeds, the ship's speed remaining constant at 15 Nd

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5.2 The effect of the wind velocity variation on the output power at a ship speed of 20 nd and the other parameters are maintained constant

Parameters C_{rot} =5, C_L = 12,5 and C_D = 0,2 remain constant. It can be seen here that the variance model is the same as in the previous case, but the magnitude of the net power is higher when the ship speed increases from 15 knots to 20 knots.

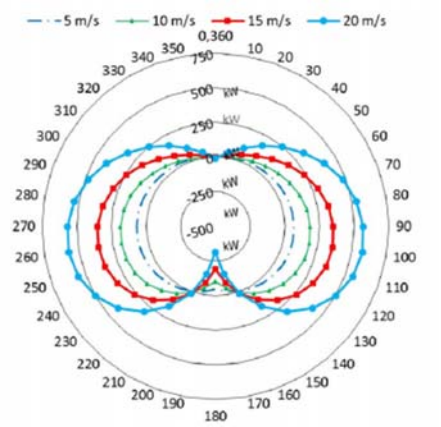

Figure 5 Net output power (kW) generated by the Flettner Rotor at various wind speeds, the ship's speed remaining constant at 20 Nd

5.3 Effect of rotation coefficient C_{rot} on the net output power P_{net}

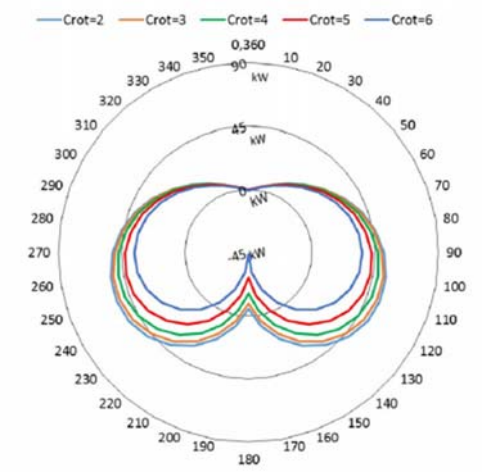

Figure 6 The effect of the rotation coefficient C_{rot} on the net output power P_{net} at a ship speed of 15 Nd

The rotation coefficient is the ratio of the rotational speed of the rotor to the apparent wind speed. In the figure above we can see how the net power output has changed due to the change in the value of the rotation coefficient C_{rot}.

The variation in the net output power is calculated for a rotation coefficient C_{rot} of 2, 3, 4, 5, 6. We can see that the higher the coefficient of rotation, the net output power decreases.

The calculations were made for C_L = 12,5, C_D = 0,2, V_t = 5 m/s and Vs = 15 Nd.

Table 1.4: Output power values for three suitable winds from different directions:

	Output net power (kW)				
Degrees (γ)	C_{rot} **=2**	C_{rot} **=3**	C_{rot} **=4**	C_{rot} **=5**	C_{rot} **=6**
70	40,36	39,48	37,82	35,18	31,34
180	-4,73	-8,58	-15,76	-27,22	-43,87
260	54,18	52,31	48,81	43,23	35,12

5.4 Effect of rotation coefficient C_{rot} on the power consumed P_{con}

The power consumed is calculated for values of the rotation coefficient C_{rot} of 2, 3, 4, 5, 6. Power consumption increases with the increase of the rotation coefficient C_{rot}.

The calculations were performed for constant values of C_L = 12,5, C_D = 0,2, V_t = 5 $\frac{m}{s}$ and V_s = 15 Nd.

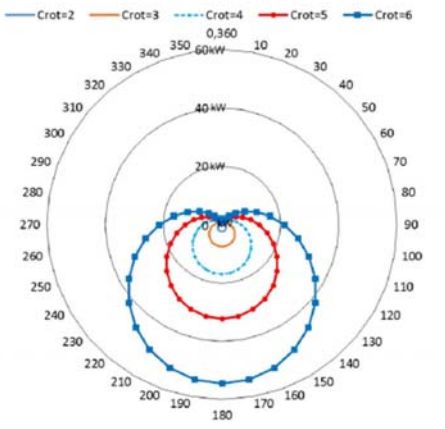

Figure 7 Effect of rotation coefficient on power consumption (kW) at a ship speed of 15 Nd

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Table 1.5: Power consumed by the rotor at different angles γ from which the true wind blows:

	Power consumed (kW)				
Degrees (γ)	C_{rot} **=2**	C_{rot} **=3**	C_{rot} **=4**	C_{rot} **=5**	C_{rot} **=6**
70	0,526	1,70	3,90	7,42	12,54
180	2,31	7,44	17,01	32,39	54,49
260	1,12	3,61	8,27	15,72	26,53

6. CONCLUSIONS

At a wind speed of 15 Nd, the net power output of the Flettner Rotor increases in proportion to the true wind power.

Table 1.6: Maximum output power given by the Flettner Rotor for a ship speed of 15 Nd:

True wind speed (m / s)	**Maximum output power (kW)**
5	42.2
10	124
15	239,9
20	386,7

Table 1.7: Maximum output power given by the Flettner Rotor for a ship speed of 20 Nd:

True wind speed (m / s)	**Maximum output power (kW)**
5	68,2
10	189,5
15	358,8
20	575,2

The net power output of the Flettner rotor decreases proportionally with increasing the rotation coefficient, since the power consumed by the rotor increases as the rotation coefficient increases.

Table 1.8: Maximum power consumption calculated according to the rotation coefficient:

C_{rot}	2	3	4	5	6
P_{con} **(kW)**	2,3	7,44	17	32,29	54,49

Table 1.9: Maximum generated power calculated according to the rotation coefficient:

C_{rot}	2	3	4	5	6
P_{gen} **(kW)**	54,62	52,39	48,81	43,23	35,96

6.1 Norsepower rotor sail solution

Norsepower Rotor Sail Solution has upgraded the Flettner Rotor by using composite materials and advanced control systems

6.2 Components

The main components of the modern Flettner Rotor - "Rotor Sail Solution" are:

- Norsepower engines that offer the forward force.
- A control panel that gives the master full control over the operation and performance of the rotors.
- A fully automated control system that optimizes the feed force of the rotors.
- A low-voltage electrical source for each rotor.

6.3 Operating principle

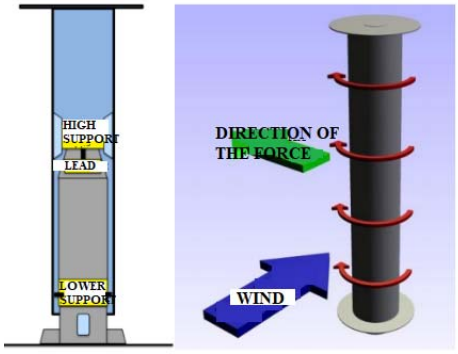

Figure 8 The rotor operating principle created by Norsepower

The rotor rolls are installed on the ship's main deck with a specific foundation.

The rotor control equipment will be installed on the main deck.

After the system is turned on, the equipment is fully automatic. Thanks to some sensors, he calculates the value of the wind force, to start the rotors and start saving fuel.

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Figure 9 Modern Flettner Rotor Controls

Table 1.10: Technical Characteristics of the Modern Flettner Rotor

Model	24 x 4
Rotor	
Height x diameter (m)	24 x 4
Material	Fiberglass reinforced plastic / carbon fiber reinforced polymer
Rotor speed (rpm)	0-225, variable
Structure	
Tower	Cylindrical - steel
Foundation height (m)	2,5
Weight (t)	34
Components	
Electrical motor	90kW, 50/60 Hz IE4,IP55
Ambient conditions	
Operating Temperature	+50- -30 C
Wind speed required for operation	0-25 m/s
Resistance to wind force	70 m/s
The pushing force	175 kN

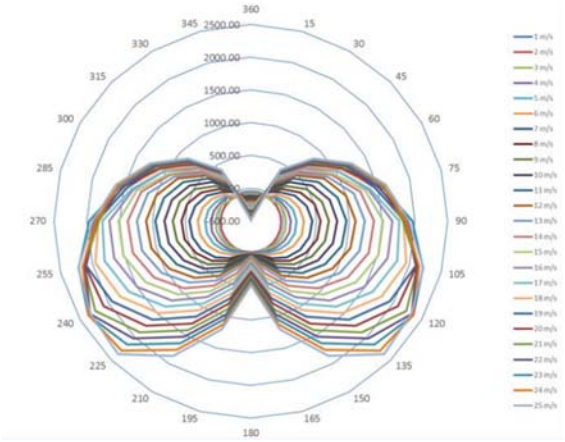

Figure 10 Polar chart with net power output (kW) generated by the Flettner Modern Rotor at various wind speeds, the ship's speed remaining constant at 19 Nd

Table 1.11: The traction power generated by the Flettner Modern Rotor

Ship speed : 19 Nd		
True wind power (m/s)	**True wind direction**	**Generated power (kW)**
10	60-130 and 230-300	500
22	105-135 and 225-255	2000

Given that:

- The prices of fuel fossils are increasing;
- It is attempted to reduce the greenhouse gas emissions due to fossil fueled ships,

we can use the Flettner Rotors, like an alternative source of energy on ships, which is an environment-friendly.

In experimental research carried out on different types of vessels it has been found that fuel consumption can be reduced by 40% -45% in the case of the mixed motor-rotor propulsion and by 100% if only the rotors are used.

7. ACKNOWLEDGEMENTS

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8. REFERENCES

[1] CRAFT T. J.,IACOVIDES H., JOHNSON N., and LAUDER B. E., Back to the future: Flettner-Thom rotors for maritime propulsion, Editura Begell House, Londra, pag. 1–10 2012.
[2] FAGIANO L, MILANESE M., PIGA D.,High Altitude Wind Generation: renewable energy cheaper than oil, EU Conference "Sustainable development: a chalenge for European research". Brussels, Belgium, 2009.
[3] JOHNSON N. D., High-Reynolds Number Flow Past a Rotating Cylinder with and Without Thom Disc, M.S. Thesis, School of Mechanical, Aerospace and Civil Engineering Faculty of Engineering and Physical Sciences, University of Manchester, 2011.
[4] MOLLER H., Ten times better than a conventional cloth sails, University of Flensburg, 2006.
[5] Naaijen P., V. Koster - Performance of auxiliary wind propulsion for merchant ships using a kite , 2nd International Conference on Maritime Research and Transportation, ICMRT, Napoli, Italy, 2007
[6] NUTTAL P., KAITU J ., The Magnus Effect and the Flettner Rotor: Potential Application for Future Oceanic Shipping, The Journal of Pacific Studies, Volume 36 Issue 2, 2016
[7] PEATERSON G. – Spin Sail harness misterious Magnus Effect for ship propulsion, The What's New Magazine- Popular Science,1984
[8] PEARSON D. R., The Use of Flettner Rotors in Efficient Ship Design, The Royal Institution of Naval Architects, London, 2014.
[9] RAGHEB M.- Airborne wind turbine concepts, 2010.
[10] RUTKOWSKI G. , Study of Green Shipping Technologies - Harnessing Wind, Waves and Solar Power in New Generation Marine Propulsion Systems, Gdynia Maritime University,volumul 10,Numarul 4, Gdynia, Poland, 2016.
[11] SILVANIUS M., Wind assisted propulsion for pure car and truck carriers, KTH Centre for Naval Architecture, 2009.
[12] SHARMAL V., GIDWANIL L., A Comprehensive Review: Energy Storage System for Hybrid System Including Wind Energy Generation System and Solar Energy Generation System for Utility Grid,1Department of Electrical Engineering, Rajasthan Technical University, Kota, India, 2017.
[13] THOM A., The Effect of Discs on the Air Forces on a Rotating Cylinder, Aeronautical Research Committee Reports and Memoranda No. 1623, His Majesty Stationery Office, London, 1935.
[14] TRAUT M., BOWS A., GILBERT S, MANDER P., STANSBY P., WALSH C., and WOOD R., Low C for the High Seas Flettner rotor power contribution on a route Brazil to UK, Second International Workshop on Successful Strategies in Supply Chain Management Template, 2012.
[15] WELLICOME J. F., Some Comments on the Relative Merits of Various Wind Propulsion Devices, Journal of Wind Engineering and Industrial Aerodynamics, vol. 20, pag. 111-142, 1985.
[16] Williams P., Lansdorp B., Ockels W., Optimal cross wind towing and power generation of tethered kites, AIAA Guidance, Navigation and Control Conference and Exhibit, Hilton Head, South Carolina, 2007.
[17] http://www.ames.ro, accesat 24 Ianuarie 2015.
[18] https://www.dantalmaciu.wordpress.com, accesat 24 Ianuarie 2015.
[19] http://www.greatlakes- seaway.com, accesat 15 Mai 2019.
[20] http://www.greenspotter.ro, accesat 24 Ianuarie 2015.
[21] https://www.greenstart.it, accesat 4 Iulie 2019.
[22] http://www.ecomarinepower.com, accessat 15 Mai 2019.
[23] http://www.inerjy.com/, accessat 19 Mai 2019.
[24] http://www.lshipdesign.blogspot.in, accesat 15 Mai 2019.
[25] https://www.norsepower.com, accesat 13 Mai 2019.
[26] https://www.rawlemon.com, accesat 6 Iunie 2019.
[27] http://www.renewablesinternational.net, accesat 20 Mai 2019.
[28] http://www.sdtb.de/Flettner-Rotor.1623.0.html, acceast la 20 Mai 2019.
[29] http://segelenergie.de, accesat la 2 Iunie 2019.
[30] http://www.ship-efficiency.org, accesat la 1 Iunie 2019.
[31] http://www.thiiink.com/ advantages-rfr-technology, accesat la 2 Iunie 2019.
[32] http://www.walleniuslines.com/, accesat la 5 Iunie 2019.
[33] https://en.wikipedia.org/wiki/Rotor_ship, accesat la 6 Iunie 2019.

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