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The maritime navigation an operational process, a field of study and applied science

In the paper, there is discussed and presented maritime navigation as an operational process, as a field of study and as a branch of applied science. There is shown the content of these forms, parts of navigation as well as relations among them.

INTRODUCTION

Almost each kind of applied science exists simultaneously in three following forms, i.e., as:
- operational or technological process or other kind of human activity,
- field of study (field of higher education),
- field of science.

Therefore, all the three main forms of maritime navigation are discussed and presented below.

1. *Maritime navigation as the operational process*

Maritime navigation, considered as an operational process, means "the process of safe and efficient operation of ship at sea".

The term "ship" should be understood as a ship, vessel, craft, high-speed craft, submarine, undersea vessel as well as any other movable object capable of being controlled and operated in two or three dimensional navigational environment.

The navigational environment is an environment composed of the following three components:
- the marine geographical environment, including its navigational features and dangers,

- the surrounding ships' traffic,
- the Maritime Safety System, i.e. its components, elements and its operational procedures.

The term "Maritime Safety System" means: "the set of legal, technological, operational and human elements, properly coordinated and operated whose main objective is to create and maintain the operational conditions necessary for safe and efficient operation of ships at sea".

The main components of the Maritime Safety System are the following [4]:

- the international institutions such as IMO (International Maritime Organization) and cooperating institutions that are passing the legal, technological, operational and other standards (international conventions and other legal acts) for ensuring the safety and efficiency of ships operating at sea,
- national law-enforcement institutions enforcing the laws and regulations regarding the maritime safety on all users of sea,
- operational institutions of the Maritime Safety System that create and maintain the conditions necessary for safe and efficient operation of ships at sea.

It should be stressed that among the operational institutions of Maritime Safety System the Traffic Monitoring and Traffic Management Systems are becoming more and more important and more and more independent.

It should be also emphasized and remembered that besides maritime navigation, being realized in marine environment, there are also the other kinds of navigation operating in their proper navigational environment; these are:

- air navigation,
- land navigation,
- space navigation.

The very characteristic feature of today's development of navigation consists in the fact that more and more navigation-infrastructure elements, especially those that have the global coverage, are becoming the common navigation – infrastructure elements of all kinds of navigation. The most known of these elements are the global positioning systems, radiocommunication systems, information systems (Internet, etc.) and other information--technology systems.

Maritime navigation, as well as all other kinds of navigation, according to the specific ships or environment's navigational features – can be divided into particular kinds of navigation; these are:

- submarine navigation,
- high-speed craft navigation,
- undersea-craft navigation,
- navigation in restricted areas, in ice, etc.

Operation process of each ship is composed of four processes. Each of them realizes proper ship's function. There exists the following ship's functions [10]:

- ship's platform control function,
- ship's navigation function,
- ship's main task function,
- ship's command and control function.

The term "ship's main task" means the task for which the ship has been built, fitted and equipped, and crew trained.

The ship's tasks can belong to one of the following kinds of maritime activities:
- transporting activities,
- industrial activities,
- naval warfare activities,
- law-enforcement and maritime homeland security activities,
- special activities (hydrographic, Search and Rescue, etc.),
- peace-keeping and human-relief activities,
- recreational activities,
- sports activities and others.

The term "process of safe and efficient operation of ship at sea" means the process that realizes the following subprocesses:
- voyage planning (planning the realization of ship's main task),
- operating the ship's machines, gears and systems which ensure her maneuverability, track (course) stabilization and her internal safety,
- monitoring and controlling the ship's conduct, i.e.: monitoring ship's movement and surrounding environment, avoiding the surrounding dangers; positioning the ship and correcting her track and movement's elements,
- maintaining the ship's command, cooperation and safety radiocomunication; maintaining the readiness for proper actions and for performing emergency procedures; as well as preventing the environment's pollution,
- realization of ship's main tasks,
- in emergency situations, realizing the proper emergency procedures including damage control procedures, etc.

2. *Maritime navigation as the field of higher education*

The term "maritime navigation", considered as a profession and field of higher education, means: "the knowledge, understating proficiencies and competencies of safe and efficient operation of ship at sea".

The navigational knowledge, proficiencies and competencies regard to the following areas of marine sciences and maritime practice:
- ship, but especially the features and characteristics of her maneuverability, sea-going qualities and sea endurance, as well as her navigational equipment and systems,
- navigational environment and its influence upon the safety and efficiency of ship's operation at sea,
- subprocesses and procedures of the process of safe and efficient operation of ship at sea (cf. process's definition),
- technological and operational procedures of realization of ship's main tasks.

The scope and content of the navigational knowledge, understanding, proficiencies and competencies of ships' operators are defined in the International STCW* 78/95 Convention and are contained in STCW Code.

* STCW: Standars of Training, Certification and Watchkeeping for Seafarers

However, the scope and content of the navigational knowledge, understanding, proficiencies and competencies of operators of different kinds of ships can considerably differ from these contained in STCW Code, in the part regarding the realization of ship's main tasks, because in STCW Code these competencies regard mainly the transporting ships.

Taking into account the main four functions of each ship the basic subjects' curricula of maritime navigation's program can be expressed as shown in Table 1.

Table 1. The basic subjects curricula of the branch of study maritime navigation

No	Program's curricula – maritime navigation
1.	Core subjects' curriculum
2.	Nautical science curriculum
3.	Ship's platform control (marine engineering) curriculum
4.	Ship's command and control curriculum
5.	Ship's special tasks curriculum
6.	STCW – certification supplementary curriculum

The main branches of maritime navigation studies, i.e. the kinds of higher navigational education, are the following:

- education of ship's navigators/operators. The main objective of this kind of education are knowledge, understanding, proficiencies and competencies necessary for safe and efficient operating the ship at sea,
- education of the Maritime Safety System's operators. The main objective of this kind of education are knowledge, understanding, proficiencies and competencies necessary for ensuring the safety of ships and environment, especially in confined and restricted areas, by the means of monitoring, controlling and managing ships' traffic, as well as rendering the navigational assistance,
- education of specialists of gathering, processing and providing the users of sea with navigational information (marine hydrographers, navigation-information scientists and others); there are also educated the specialists of navigational designing of the different kinds of navigational-infrastructure elements.

It should be also emphasized that maritime navigation, as a minor, is being thought at the faculties of the universities and technical universities that deal with oceanography, oceanotechnics and other sciences dealing with marine environment and marine environment information.

3. *Marime navigation as the field of applied science*

Maritime navigation, considered as kind of applied science, can be interpreted as a specific kind of knowledge, understanding, proficiencies and competencies of safe and efficient operating ships at sea, together with proper research methods, which enable the improvement of that knowledge and perfection of the navigational proficiencies and competencies.

Taking into account the above the subject of maritime navigation above as the field of applied science can be defined as follows:
"It is the research process of studying the influence of being steadily changed conditions of navigational environment upon the safety and efficiency of ships operating at sea and perfecting the organizational, operational and technological methods and procedures of ships operating at sea, as well as improving the methods and procedures of navigational designing of the elements of Maritime Safety System, but especially the elements of navigational infrastructure".

Under the notion "steadily changed navigational conditions" it should be understood the steadily changing conditions of ensuring the safety and efficiency of ships operating at sea that result from:
- dynamic progress in science and technology,
- and connected with it an uninterrupted increase of ships' total number especially differentiated to their velocities and size,
- uncontrolled increase of marine – environment – pollution hazard,
- and others.

The navigational research activities must achieve two research objectives; these are:
- the scientific objective,
- the functional objective.

The scientific objective of navigational research activity is the steady increase and perfection of navigational knowledge (understanding, proficiencies and competencies), as well as preparation of the new research personnel.

The functional objective of navigational research activities is being achieved in the following way:
- studying and perfecting all components and elements of Maritime Safety System but especially all elements of navigational infrastructure, including the System's elements of monitoring, controlling and management of ships' traffic,
- studying the legal organizational, operational and technological issues and perfecting the operational and technological means, methods and procedures of the process of safe and efficient operating the ships at sea,
- studying and perfecting the means and measures of navigational (and hydrographic) support of ships' special tasks, industrial works and other human activities performed at sea whose need such support.

Maritime navigation very closely cooperates with the following fields of sciences and technologies:
- geodesy, cartography, geomatics,
- hydrography and maritime Geographic Information Systems,
- traffic engineering,
- marine environment protection,
- navigational designing of the navigation-infrastructure's elements,
- legal and economical issues of maritime navigation (different kinds of laws, transport technologies, logistics, insurance, management, etc.)

Maritime navigation applies the basic research methods adapting them to the research problems and issues of maritime navigation; these are:

- research methods of natural sciences (physics, chemistry, biology and related sciences). There are two kinds of these methods:
  1) observation, including data gathering and mathematical methods of its processing, interpretation and presentation, and
  2) experimentation, including different kinds of scientific testing,
- method of logical inference, but especially the method of logical analysis and creation of the logical structure of problem solution,
- methods of mathematical modeling and computer-aided-simulation. These methods become ones of the widely used research methods of maritime navigation,
- heuristic methods, among these the widest used are the experts' methods.

Navigation also uses readily the specific research methods (techniques) applied by the other sciences close related to maritime navigation.

Maritime navigation in Poland possesses the qualified research personnel, i.e. research community. It is represented by the Navigation Section of the Geodesy Committee of Polish Academy of Sciences.

The Navigation Section of Geodesy Committee constitutes the heart of Polish Navigation Forum that has existed for 5 years. This Forum consists mainly of the teachers and research workers of maritime and air navigation and of many geodesy teachers and scientists cooperating closely with the navigation's and hydrography's institutions, as well as with the maritime administration and maritime industries.

The Polish Navigation Forum is being considered and treated abroad as the Polish Institute of Navigation. This Forum (Institute) is also the member of the International Association of Navigational Institutes (IANI).

Maritime navigation possesses the internationally recognized research achievements. The Polish Navigation Forum, since 1999, has issued its scientific journal "Annual of Navigation" that is highly estimated in Poland and abroad.

The research reports and scientific papers of Polish Navigation Forum's members are widely published in many scientific and professional journals; these are:

- "Geodezja i Kartografia", organ of the Geodesy Committee of Polish Academy of Sciences,
- "Archives of Transport" organ of the Transport Committee of Polish Academy of Sciences,
- "The Journal of Navigation" organ the Royal Institute of Navigation,
- International Hydrographic Review, organ of the International Hydrographic Organization, as well as in many other professional journals and magazines.

The navigation research activities find out their expression in the scientific conferences and workshops. On an average every half a year, there is carried out a scientific conference or workshop session. They are organized, in succession, by the Navigation's Institutes of Polish Naval University and by two Marine Universities of Gdynia and Szczecin, together with the Navigation Section of the Geodesy Committee of Polish Academy of Sciences.

Many Polish navigation-teachers and researchers also participate actively in the international navigation conferences, including these organized by the International Association of Navigational Institutes.

CONCLUSIONS

Maritime navigation, similarly as the other applied sciences, can be and should be considered as the operational process, as the field of higher education and as the field of applied science. It means that maritime navigation exists in three basic forms.

In this paper, all the existence forms of maritime navigation have been discussed and presented. There are also shown the logical relations between all three forms of navigation.

The main authors' objective was to present the cohesive, comprehensive and logical image of the whole maritime navigation. The authors' belief is that this paper fulfils partially their intentions.

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Nawigacja morska jako proces działalności ludzkiej, rodzaj wykształcenia oraz dyscyplina naukowa

Streszczenie

W artykule podjęto próbę analizy nawigacji morskiej jako procesu operacyjnego, kierunku studiów oraz dyscypliny naukowej. Przedstawiono zakres części składowych nawigacji oraz zależności między nimi.

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Вацлав Моргась
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Морская навигация как процесс человеческой деятельности, вид учёбы и научная дисциплина

Резюме

В статье предпринята попытка анализа морской навигации как операционного процесса, направления учёбы и отрасли науки. Представлен объём составных частей навигации, а также зависимости между ними.