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## MARITIME NAVIGATION OF TODAY AND TOMORROW

**Summary.** In this paper, there has been presented the today – development's state of maritime navigation, main factors characterizing this stage of development and factors generating the current changes in all aspects of maritime navigation. There has been also made an attempt to show the most probable changes in maritime navigation that might be expected in the nearest future.

## NAWIGACJA MORSKA DZIŚ I JUTRO

**Streszczenie.** W artykule podjęto próbę przedstawienia najbardziej charakterystycznych właściwości współczesnej nawigacji morskiej, a także najbardziej istotnych, zdaniem autorów, czynników, które będą generować zmiany w nawigacji morskiej. Przedstawiono również kierunki tych zmian. Jednym z podstawowych czynników zmian nawigacji morskiej w najbliższej przyszłości jest proklamowana obecnie „nowa strategia nawigacyjna”, zwana „strategią *e-navigation*”.

### 1. MARITIME NAVIGATION OF TODAY

Below, there are presented and shortly discussed the following issues:

- main forms of maritime navigation existence,
- factors influencing the development of maritime navigation,
- factors characterizing the today's maritime navigation,
- subject of today's maritime navigation.

#### 1.1. Main forms of maritime navigation existence

Maritime navigation, just as the other kinds of human activities, exists in the three main forms; there are:

- profession, i.e. the proper set of knowledge, proficiencies and competences of seafarers,
- activity, i.e. the kind of human activity performed on sea; the main and the most important human activity on sea constitutes today the shipping industry, that comprises:
  - o transportation of goods and people on sea,
  - o sea tourism and
  - o servicing by ports the ships' traffic and transported goods and people.
- applied science, i.e. the set of realized research and development projects regarding the maritime navigation and main aspects of safety of life and property at sea, safety of marine environment from pollution by ships, and antiterrorist security of ships and port facilities.

## 1.2. Factors influencing the development of maritime navigation

Main factors influencing the development of maritime navigation are similar to the factors influencing the development of each other kind of human activity. Only the contents of these factors must be adequate to the subject of the development.

Factors influencing the development of maritime navigation are the following:

- necessities,
- possibilities,
- constraining factors.

Kinds of necessities influencing the development of maritime navigation are the following:

- human,
- environmental,
- operational,
- economic,
- political, etc.

Possibilities that enable the development of maritime navigation constitutes mainly on the state of scientific and technological progress. It should be stated that today's level of science and technology development allows to implement into practice almost any new navigation's hard - and software.

Factors that constrain the development of maritime navigation are mainly the following:

- usefulness,
- worthwhileness,
- profitability,
- economic and operational efficiency, etc.

## 1.3. Factors characterizing today's maritime navigation

Factors that explicitly characterize the today's state of development of maritime navigation constitute of the following systems:

- Global Navigation Satellite System, i.e. SATNAV,
- Global Radiocommunication Satellite System, i.e. SATCOM,
- Maritime Geographical Information Systems (GIS).

The above systems completely changed nowadays the character of maritime navigation. In the not very distant past, i.e. 20-30 years ago, maritime navigation discerned itself from another kinds of navigation, e.g. air navigation, land navigation, etc., by the character and form realization of the two navigation processes, i.e. positioning process, and process of information providing and its usage. Now, these differences do not exist anymore.

## 1.4. Subject of today's maritime navigation

No longer then 10-20 years ago, the subject of maritime navigation was defined as follows:

- maritime navigation is the process of safe and efficient conduct ships at sea

Now, according to the International Maritime Organization (IMO) the subject of maritime navigation is defined as follows:

- maritime navigation is the process of planning, recording and controlling the movement of the craft from one place to another [1, 5].

The term "craft" used in the above definition means not only a vessel or other displacement sea vehicle but also the non-displacement craft such as the surface skimmers, air-cushion vehicles or other kinds of hovercraft, as well as ram wings, etc.

It should be also stressed that the above definition of the subject of maritime navigation is identical with the definition of other kinds of navigation, i.e. air navigation, land navigation, and even space navigation. It is enough to replace in the definition of maritime navigation the term "maritime navigation" with the term "air navigation" or "land navigation", or "space navigation".

## 2. PRESENT CHANGES IN MARITIME NAVIGATION

Maritime navigation, alike the other kinds of human activities, is the subject of permanent changes. The most important of them are the following:

- transformation of integrated ship's navigation system into the integrated ship's control system,
- permanent perfection of the Integrated Bridge System,
- fast growing role of the coastal navigation assistance systems in the realization of the ship's navigation process.

### 2.1. Transformation of the ship's navigation system into the ship's control system

In Figure 1, has been shown that Ship's Operation Process is composed of four component ship's processes; these are:

- ship's platform control process,
- ship's navigation process,
- ship's special task realization process,
- ship's command and control process.

These component ship's processes are realized by the proper ship's systems. However, the factors influencing the permanent development of maritime navigation, but especially fast progress of science and technologies, result in permanent integration of component ship's systems into one integrated ship's operation system, i.e. into the Integrated Ship's Control System, (ISCS).

### 2.2. Permanent perfection of the integrated bridge system

The Integrated Bridge System (IBS) constitutes now of the higher development's level of the Integrated Navigation System (INS) (cf. Figure 1).

The substance of the Integrated Navigation System (INS) is defined as follows [3, 6]:

- INS is a composite navigation system which performs different functions of two or more shipborne navigation systems or equipment and uses evaluated information.

The subject of the Integrated Bridge System (IBS) is defined by the IMO as follows [7]:

- IBS is a combination of systems that are interconnected in order to allow centralized access to sensor information and to steering and propulsion controls with the aim of increasing safe and efficient ship's management.

Perfection of the Integrated Bridge System (IBS), if do not take into consideration the realization of the "E-navigation strategy", comprises mainly on the following issues:

- improvement of the performance capabilities of all the shipborne navigation systems and equipment, but especially the performances of the Electronic Chart Display and Information System (ECDIS),
- improvement of the interoperability of all component systems and equipment constituting of the IBS, but especially ship's monitoring systems,
- enabling the familiarization training for IBS,
- improvement of the information exchange capabilities with coastal navigation-assistance systems,
- improvement of the reliability of the IBS, but especially its integrity, and others.

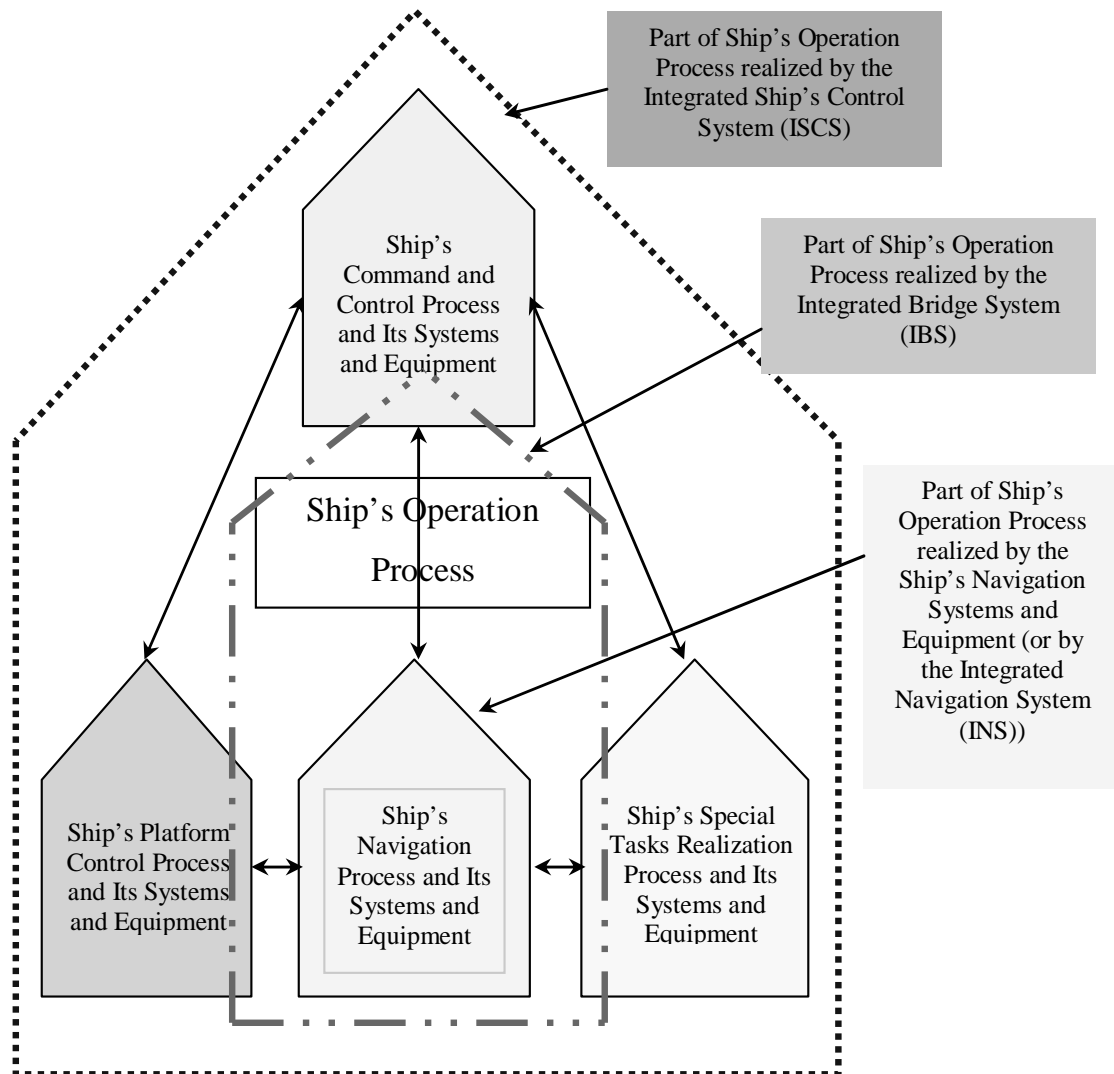


Fig. 1. Part's of Ship's Operation Process realized by the particular kinds of Ship's Systems

Rys. 1. Udział okrętowych procesów operacyjnych realizowanych przez poszczególne rodzaje systemów okrętowych

### 2.3. Fast growing role of the coastal navigation assistance systems in the realization of ship's navigation process

The Coastal Navigation Assistance Systems, at the beginning as the Port Surveillance Radars, have begun to develop immediately after World War II (1946). It was a very essential event. It allowed to solve very important issues of maritime navigation. Ships' port traffic had become independent of foggy weather. But only in 1980s the Vessel Traffic Services (VTS) systems were fully implemented. However nowadays, the role of Coastal Navigation Assistance Systems has increased rapidly and immensely. There exist two reasons of this situation; these are:

- necessity to increase the safety of marine environment from pollution by ships, especially in areas sensitive to pollution,
- necessity to increase the antiterrorist security of shipping industry (ships and port facilities).

Therefore, such system as the Vessel Traffic Monitoring and Information System (VTMIS) of European Union are being now developed and perfected.

In tab. 1, there are given the component system of VTMIS System.

Tab. 1

**The Main Components of the VTMIS of European Union**

No	Names of VTMIS' Components	Note
1	Vessel Traffic Services (VTS) systems	
2	Automatic Information Systems (AISs)	
3	Ships Reporting Systems (SRSs)	
4	Maritime Assistance Services (MAS) systems, including: - Places of refuge - Emergency Towing Vessels (ETVs)	
5	Long Range Identification and Tracking (LRIT) system	
6	Computerized Data Exchanging Centres (SafeSeaNet Systems)	

In fig. 2 there is shown first three component system of VTMIS of European Union.

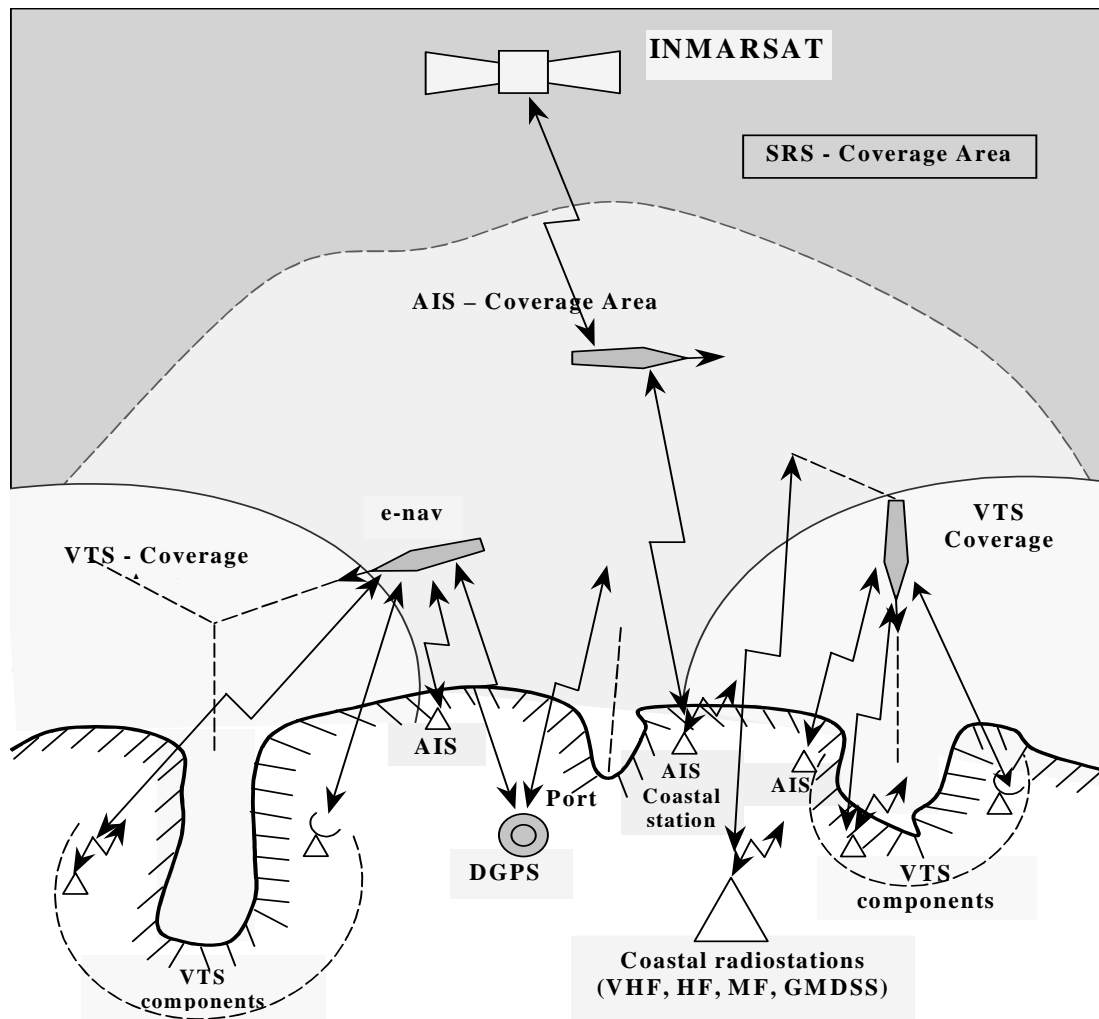


Fig. 2. VTMIS: its component systems (VTS, AIS, SRS) and its assistance systems (DGPS, INMARSAT and coastal radiostations: VHF, HF, MF)

Rys. 2. VTMIS: jego systemy składowe (VTS, AIS, SRS) oraz systemy wspomagające (DGPS, INMARSAT oraz radiostacje brzegowe: VHF, HF, MF)

### 3. MARITIME NAVIGATION OF THE NEAREST FUTURE

Below, there are discussed shortly two main issues of the tomorrow's maritime navigation; these are:

- expected results of influence of the "E-navigation strategy" on the maritime navigation,
- science of maritime navigation of tomorrow.

#### 3.1. Expected results of influence of "e-navigation strategy" on maritime navigation

The main objective of the E-navigation strategy is the substantial and permanent increasing of the maritime safety and security of the whole shipping industry as well as increasing its operational and economic efficiency. The subject of the E-navigation strategy is not precisely defined, and therefore it is considered as the "catchall" of all navigation's and its safety and security matters [4, 6].

E-navigation strategy provides for the following:

- the considerable improvement of performance characteristics of all the shipborne navigational systems and equipment,
- further fast increasing the integration of ship's navigation systems and equipment and permanent improvement of the Integrated Bridge System,
- profound standardization of all navigational procedures, but especially the procedures of operating and use of the main ship's navigation systems,
- considerable improvement of the cooperation of ships with the coastal monitoring information and navigation assistance systems but mainly improvement of the exchange of information.

As was already mentioned that today's level of science and technologies development does not constitute any obstacle to realizing the E-navigation strategy.

The limiting factors that might and will impede and slow down the process of realization of E-navigation strategy constitute the very numerous stakeholders of shipping industry whose interests are usually not only contradictory but also incompatible.

Taking the above into consideration, it seems justifiable to conclude that the E-navigation strategy will be permanently realized, however the process of changes in maritime navigation will be rather slow.

#### 3.2. Science of maritime navigation of tomorrow

The subject of maritime navigation, as it was defined in 1.4., is as the process of planning, recording and controlling the movement of the craft from one place to another. However, the process of conducting the ships at sea must be today, as it was in the past, not only safe but also efficient. Additionally now, this process must be also secure from terrorist threats. Therefore, the main objective of maritime navigation considered as the science will be also in the future the permanent contribution to the process of ensuring the acceptable level of maritime safety and security of shipping industry.

However, the danger of pollution of marine environment by the ships transporting more and more hazardous materials is permanently growing. Also the threat of terrorism for the shipping industry increases continuously. Therefore more and more maritime research and development institutions must and will participate in working out the reliable and effective measures necessary for maintaining the safety and security of shipping industry, at the acceptable level.

Maritime navigation deals almost with all aspects of maritime safety and security of shipping industry. Therefore, it becomes stepwise a kind of the maritime science that pulls over to itself and cooperates with all the other maritime sciences dealing with the maritime safety and security matters. This way, maritime navigation, considered as the applied science, permanently increases not only the scope of its interests, but also the degree of integration with the other maritime sciences dealing with the subject of maritime safety and security, but especially, safety and security of the shipping industry. The above means that there is being developed the new field of the integrated maritime science, i.e. the maritime safety and security science in which the role of maritime navigation is becoming more and more important.

#### 4. CONCLUSIONS

In this paper, there have been presented and shortly discussed the most important issues of today's and tomorrow's maritime navigation. Authors tried to work out the very short synthesis of nowadays issues of maritime navigation, and call attention of these readers that are interested in these maritime navigation's development aspects which are less commonly known.

Authors' belief is that their attempts might be of interest to the more than some readers of this Journal.

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