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OPTIMAL CRITERIA FOR THE GOVERNMENTAL MULTIFUNCTIONAL SPECIAL SHIP

Zvaigzne A.

ОПТИМАЛЬНІ КРИТЕРІЇ ДЕРЖАВНОГО БАГАТОФУНКЦІОНАЛЬНОГО СПЕЦІАЛЬНОГО КОРАБЛЯ

Звaігзне А.

The effectiveness assessment of multifunctional specialized ships was discussed. Three groups of criteria such as financially-economic, technical and operational were analysed. Used of common multifunctional platform for the state mission fulfilment was proposed. Selection of the SWATH platform for the possible ship constriction form was analyse. Number of different mission modules were offered to carry out for solving the optimization problem, improve effectiveness of the state system and redaction of the state flites live time expansions.

Keywords: *criteria, specialized ship, optimization, effectiveness.*

Introduction. Countries which have access to the sea have several privileges and rights, as well as responsibilities which are defined in international laws, treaties and conventions. These countries are obligated to guarantee safe sailing, search and rescue in case of an emergency, the carrying out of laws enforcement in their exclusive economic zone and territorial waters, their protection and defence, to provide hydrographic information as well as many other tasks.

International requirements do not differentiate between big and small countries; these requirements are to be fulfilled regardless of the size of the coast, population or government budget. This is a great challenge for minor countries, as they are forced to fulfil these requirements with limited economic, pecuniary and human capital.

In order to fulfil these requirements in Latvia, there exist several organizations which supervise the carrying out of legislation in the sea- the Coastguard of the Latvian Navy, the Latvian Border Guard, the Fishing Inspection, and the Hydrographic Service of the Maritime Administration as well as others. Using System of the system approach, we can build table of some form of hierarchy in state maritime domain.

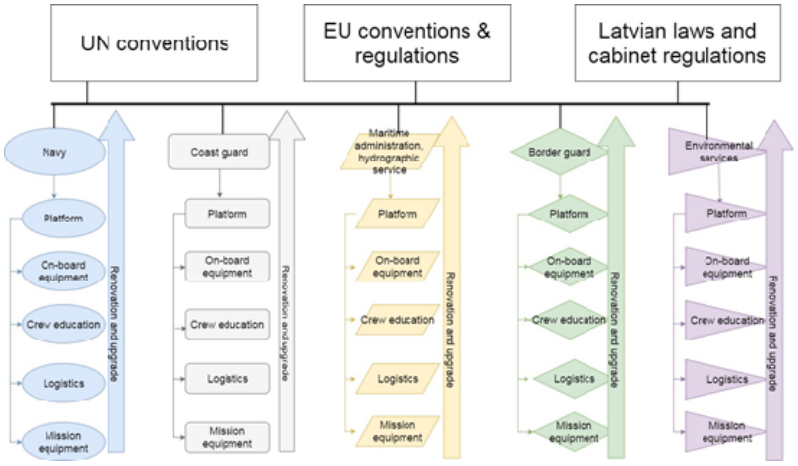

Fig. 1. Present situation

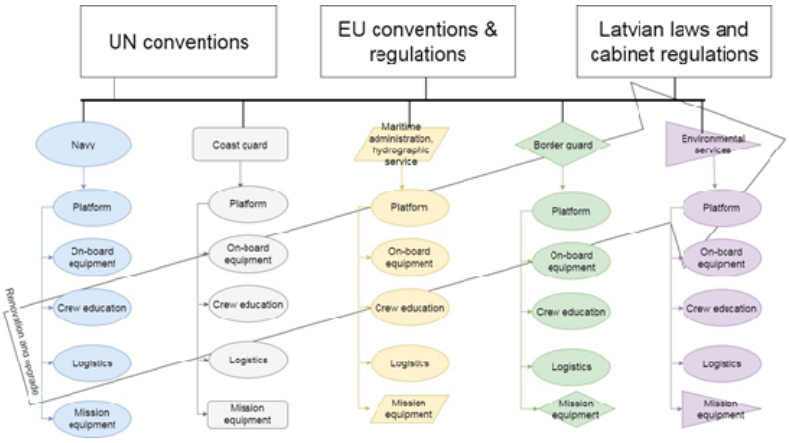

Fig. 2. Proposed situation

Each of these organizations fulfils their own specific function (even though they tend to overlap quite often) and each requires its own specific type of sea craft, with its own specific constructional and operational capabilities. Each of them develop specific live cycle upgrade and renovation plan for specific platform. For a country with severely limited resources, meeting these requirements is extremely challenging. Is it possible to optimise the requirements for such sea craft to reduce expenses? To answer this question, an analysis of the criteria by which these special sea crafts are chosen is needed. Author propose carefully analyse function and technical requirements for each organisation and found possibility to create common multifunctional platform for different missions. With creation of the new multifunctional platform, the new system of the system hierarchy for the maritime domain can be as on the table.

Author understand that such a multifunctional platform cannot be universal and other specific types of the vessels can be required. However, by understanding of laws requirements and organisational needs, technical and operational criteria, budget limitation, capability of multifunctional platforms such a platform can be selected and used for state obligation fulfilment. Selection of common multifunctional platform for the different state organization will allow us save on many expenses during vessels live cycle included renovation and upgrade. Only specific mission module will be different for each organization and will require individual approach. +

The Understanding of the Criteria.

The process of building new sea craft needs to be extremely researched and thought-out; all factors, criteria and risks connected with the project need to be analysed before designing the ship. As with each project, in the beginning the available knowledge is limited, but it is the time when the most important decisions are made. At the end of the project, the available knowledge is considerably higher, but not many major decisions are left to be made.

In this work, the following criteria will be examined:

Financially-Economic criteria; Technical criteria; Operational criteria. These factors, are, of course, interconnected, but in order to better understand them, they will be examined individually.

Financially-Economic criteria.

It is relatively easy to define Financially-Economic criteria (FEC) for commercial ships, where the main criterion is the profit relative to their expenses. Sadly, such a criterion is not possible for a Navy, Coastguard or Border Guard ship. Thus, a need for different criteria arises.

The most important FEC is political will- how much does the government desire to fulfil the international requirements and how many resources is it ready to invest?

Secondary -most important for the FEC is how rationally will these resources be spent? For this criterion an analysis of not only the construction expenses, but also operational expenses is needed.

FEC and their associated expenses can be divided into several categories:

1. Research and Development (R&D), 2. Purchasing/ Construction, 3. Operational expenses, 4. Utilization. The total costs of the ship can be calculated as the sum of all of the aforementioned categories:

$$\sum€=€1+€2+€3+€4 \quad (1)$$

By looking at each category individually, we will find that we are able to save money at almost all stages of life of the craft.

1. R&D is one of the most important phases and is also extremely risky with regard to completely new designs. In order to decrease the degree of risk and costs, it is possible to choose a pre-existing ship design. By choosing a pre-existing design, it is important to evaluate it based on its merits, its compliance with our requirements, as well as the costs of adjusting the ship for our requirements and the evaluation of whether our shipyards can build such a design.

2. Purchasing/Building. As we evaluate specialized ships for our requirements, it is extremely desirable from both a political and economic standpoint to build the ship in our own country's shipyards. From an operational viewpoint, building the ship in our own country's shipyards will allow for shorter repair times, as well as

guaranteeing their quality control and political independence from faring government. More importantly, it also allows for a cheaper and quicker modernization if the need arises.

3. Operational expenses. In general, operational expenses constitute 82% of the total costs of a ship. By taking into account the importance of this criterion, it is important to pay great attention to it during the design phase. The best time to reduce operational costs is during the R&D phase. Operational expenses can be divided into two broad categories: practical and administrative operational expenses.

Practical operational expenses are expenses which are formed by the ship's staying at sea, the doing of work, repair expenses, expenses on personnel and on modernization.

Administrative operational expenses are formed from ships administrative expenses, expenses from ensuring, environmental protection and others.

An extremely important factor in reducing operational expenses is ensuring greater interdepartmental coordination. By correctly deciding on the technical specifications of newly built ships, as well as operational possibilities, use of modular equipment on the ship, how much the ship will be used and ensuring a strict interdepartmental contract, it is possible to greatly reduce future operational expenses. In Latvia, this point requires special attention.

4. Utilization. Ship utilization need to be included in to the common live cycle cost, this can be significant part of expenses, especially in case when hard utilized materials were used in ships construction.

Technical criteria.

Technical criteria consists of sailing capabilities, possibilities of placing various equipment, ship behaviour on waves, living conditions of the crew, manoeuvrability, ship speed. Use of taxonomy scheme and author experience by given 100- for the most important, 70- important, 50- less important, 30- need to have for the applicable requirements, we can found area of the optimal "most important" technical criteria (blue) for the special multifunctional ship. Area of "important" (violet) requirements also need to be carefully consider.

Operational criteria.

Let us list the possible missions specialized ships will have to do. Each mission consists of several elements (mission element):

Exclusive Economic zone (EEZ) control;

- Searching Suspected Illegal Activity Ship – (SIAV);
- Pursuit;
- Inspection, Boarding;
- Seize;
- Escorting;
- Etc. ;

Search and Rescue (SAR) operations;

- SAR;
- Fire-fighting;
- Towing of a damage ship;
- Divers support.

Marine environmental protection (MEP);

- Localization of oil spill areas and liquidation of pollution;
- Fishing control;
- Inspection, Boarding;
- Environmental pollution control;
- Hydrographical surveillance and support

Military readiness (MR);

- Interdiction
- Delivery of an inspection group to the ship
- Fulfilment of the ISPS code and its control
- Gathering of oil or other hazardous materials
- Towing of a damage ship
- Divers support
- Fire fighting
- Ensuring of safe sailing (military functions)
- Anti-mine warfare
- Anti-ship warfare
- Anti-air warfare
- Anti-submarine warfare
- ABC defence
- Mine deployment
- Anti-saboteur warfare
- Specialized transportation
- Anti-blockade warfare
- Etc.

Organization / Technical criteria	Coastguard	Navy	Hydrographic Service	Border Guard	Fishing Inspection
Sailing capabilities	100	100	30	70	70
Possibilities of placing various equipment	70	100	100	30	30
Ship behaviour on waves	100	100	30	70	50
Manoeuvrability	100	100	100	100	100
Ship speed	100	100	30	100	50
Living conditions of the crew	70	100	50	50	50

Fig. 3. Ship's technical criteria for organizations

Organization / Operational criteria	Coastguard	Navy,	Border Guard,	Fishing Inspection,	Hydrographic Service
SIAV	100	100	100	70	0
Pursuit	100	100	100	100	0
Inspection, Boarding	100	100	100	100	0
Seize	50	100	50	30	0
Escorting	70	100	50	30	0
SAR	100	70	70	30	30
Fire-fighting	100	30	30	0	0
Towing of a damage ship	100	30	30	0	0
Divers support	70	100	30	0	50
Localization of oil spill areas and liquidation of pollution	100	0	0	0	0
Fishing control	30	0	0	100	0
Environmental pollution control	100	30	70	70	0
Hydrographical surveillance and support	30	30	0	0	100
Interdiction	70	100	50	0	0
Fulfilment of the ISPS code and its control	100	100	100	0	0
Ensuring of safe sailing	100	100	0	0	100
Anti-mine warfare	30	100	0	0	0
Anti-ship warfare	30	100	0	0	0
Anti-air warfare	0	100	0	0	0
Anti-submarine warfare	0	100	0	0	0
Anti-blockade warfare	30	100	30	0	0
Anti-saboteur warfare	70	100	70	0	0
Specialized transportation	70	100	50	0	0
ABC defence	0	100	0	0	0
Mine deployment	30	100	0	0	0

Fig. 4. Ship's operational criteria for organizations

We can do similar taxonomy scheme for the operational criteria, and define area of the most common required operational criteria for the new special multifunctional ship (Blue and rose zone).

The analysis of common and each operative criteria has to be made thoroughly, taking into account both the Technical criteria and financial Economic Criteria.

SWATH. Analysing financial, technical and operational requirements we can proposed possible solution for selection of common multifunctional platform. SWATH type of the vessels construction can be officiant to accommodate different mission module and stable enough for different missions, and as a multifunctional platform can be used in many organisations for the state obligation fulfilment. Acronym SWATH is staying for "small-waterplane-area twin-hull ship" a ship consisting of a component below the surface that has most of the buoyant volume, a component above the surface that contains most of the usable volume, and struts that connect these two volumes and pierce the surface." [11].

Advantages for the SWATH construction are:

-Possibility for a small craft to have a complete open-ocean capability that is not possible for a monohull vessel of a similar size.

- Provides a stable sensor platform that permits employment of different equipment and weapons system.

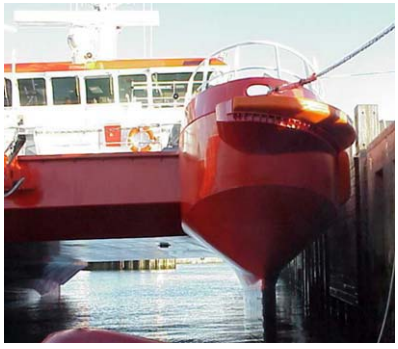

Fig. 5. SWATH

- Provide excellent manoeuvring ability.
- Reduced Water Resistance on high speed
- Large deck space allow functions as a larger vessel
- Minimal vessel motion enhances crew comfort, as result improve awareness and safety!
- Creates Benign Acoustic Environment. Because the propellers are set wide apart, there is not a great deal of turbulence produced directly astern.

SWATH big deck space provide opportunity for the vessel accommodate different kind of equipment, most easiest way to have standard place for the mission module adopted to the international standard. Such approach

will simplify module production, transportation and storage. Dependent on the mission, module can be changed in short time and will provide ship with new capabilities. Some of the mission modules examples we can found on SWATH project for the Latvian Navy. New build patrol vessel was designed to carry one mission module in front of the ship.

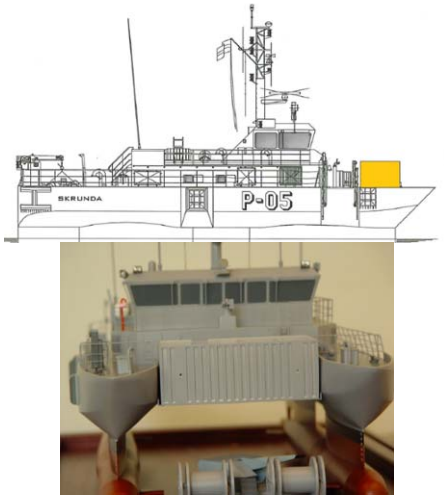

Fig. 6. Mission module

Ship have special place between the hulls for store one standard 20 fete container. There are four standard fasteners, two attached to the each of ship's bow.

Fig. 7. Mission module store position

There can be different containers with different size, depend on the mission equipment. Possible solution can see it tab1.

Possible mission modules are:

-Diver support units with diver presser chamber.

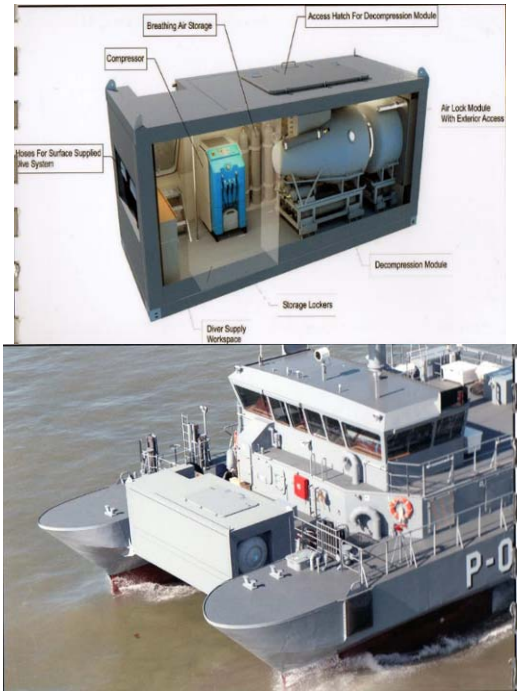

Fig. 8. Diver chamber mission modul [1]

- Medical mission module for humanitarian operations

Fig. 9. Firefighting model [1]

Table

Mission module dimension

	empty weight	max. payload	Outer dimensions (l*b*h)
Enclosed container with thermal insulation	ca. 3.000 kg	3.000 kg	6,5m*2,5m*2,54m
Enclosed container without thermal insulation	ca. 2.750 kg	3.250 kg	6,5m*2,5m*2,54m
Flushdeck container	ca. 1.000 kg	3.000 kg	6,5m*2,5m*1,4m
Container flat	ca. 500 kg	3.500 kg	6,5m*2,5m*0,3m

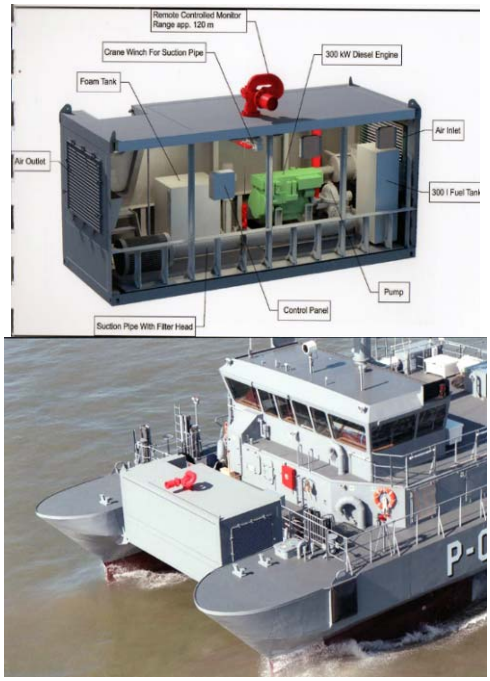

Fig. 10. Hydrographic module
(Estonian hydrographic vessel) [1]

Fig. 11. Hydrographic mission module [16]

Conclusion. Multifunctional special ship can be used for the different state organisations. Choosing criteria for a multifunctional specialized ship is a difficult process which requires deep knowledge in multiple disciplines. The working group for selecting a ship has to consist of experts of different fields, who can freely analyse and compare several possible solutions. Using the aforementioned criteria, it is possible to model different ship configurations, research how technical requirements collaborate with operational requirements and their effects on financially-economic indicators, as a result of which it becomes possible to choose the most adequate and effective project.

SWATH platform can be reliable type of vessel constriction to fulfil state obligation.

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Зваігзне А. Оптимальні критерії державного багатофункціонального спеціального корабля.

Розглянуто оцінка ефективності багатофункціональних спеціалізованих судів. Були проаналізовані три групи критеріїв, таких як фінансовоекономіческіе, технічні та оперативні. Запропоновано використовувати єдину багатофункціональну платформу для виконання завдань держави. Був проведений аналіз вибору платформи SWATH як можливої форми оцінки суден. Було запропоновано безліч різних модулів завдань для вирішення проблеми оптимізації, підвищення ефективності державної системи і зміни державного флоту в режимі реального часу.

Ключові слова: *критерії, спеціалізоване судно, оптимізація, ефективність.*

Зваигзне А. Оптимальные критерии государственного многофункционального специального судна.

Рассмотрена оценка эффективности многофункциональных специализированных судов. Были проанализированы три группы критериев, таких как финансово-экономические, технические и оперативные. Предложено использовать единую многофункциональную платформу для выполнения задач государства. Был проведен анализ выбора платформы SWATH как возможной формы оценки суден. Было предложено множество различных модулей задач для решения проблемы оптимизации, повышения эффективности государственной системы и изменения государственного флота в режиме реального времени.

Ключевые слова: *критерии, специализированное судно, оптимизация, эффективность.*

Зваігзне А. – в.о. ректора Латвійської морської Академії, Латвія.

Рецензент: д.т.н., проф. ***Горбунов М.І.***

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