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## Management of the Development Programme of the Navy – a concept for the Polish Naval Forces

## Zarządzanie programem modernizacji marynarki wojennej – koncepcja dla Polskich Sił Morskich

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**Abstract.** The purpose of this article is to propose a model for planning the development of the naval forces in a medium-sized state through a process of their accurate and effective modernisation, on the example of Poland. Taking up such a subject arises from the delayed results of the current modernisation efforts. In order to achieve the aim mentioned above, it is recommended to solve the research problem by defining a suitable methodology facilitating the planning of naval development. The working hypothesis states that the methodology for the planning development of the naval forces should define a scope of modernisation activities undertaken with the use of tools and methods typical of management and quality sciences. The Allies' guidelines on acquisition of defence resources stated in the NATO standardisation publications have been also taken under consideration in the research analysis. This *modus operandi* allows the Authors to fill a research gap in an interdisciplinary approach toward planning the process in question. The study is of conceptual nature. However, it enables the creation of well - aimed and justified programmes for the development of the Polish Naval Forces. The article displays a new perspective in the research analysis, which was formerly conducted by Authors in the years 2020 and 2021, before the Russian invasion of Ukraine.

**Keywords:** naval forces, modernisation programme, planning, management and quality, reference model

**Abstrakt.** Opracowanie ma na celu przedstawienie modelu planowania rozwoju sił morskich w państwie średniej wielkości na przykładzie Polski, za pomocą trafnej i skutecznej modernizacji, w dynamicznie zmieniającej się politycznej i militarnej sytuacji na wschodniej flance NATO oraz w basenie Morza Bałtyckiego.

Tematyka ta, jak wskazuje dotychczasowa praktyka, jest skomplikowana i złożona, a osiągnięte do tej pory wyniki prac modernizacyjnych są dalekie od satysfakcjonujących. Osiągnięcie sformułowanego powyżej celu wymaga rozwiązania problemu badawczego, poprzez zdefiniowanie właściwej metodologii ułatwiającej planowanie rozwoju sił morskich, uwzględniając wymagania sojusznicze i narodowe. Hipoteza badawcza, którą należy zweryfikować w celu rozwiązania problemu badawczego stanowi, że przedmiotowa metodologia powinna jasno określać zakres działań modernizacyjnych, wykorzystując metody i narzędzia stosowane w naukach o zarządzaniu i jakości, uwzględniając jednocześnie wymagania w zakresie pozyskiwania zasobów obronnych zawarte w dokumentach standaryzacyjnych NATO. Takie podejście umożliwi autorom wypełnienie pewnej niszy badawczej w zakresie interdyscyplinarnego podejścia do przedmiotowego zagadnienia, uwzględniając zarówno kwestie typowe dla obszaru nauk o zarządzaniu i jakości, jak też problemy charakterystyczne dla nauk o bezpieczeństwie, głównie w zakresie obronności. Opracowanie prezentuje pewną koncepcję działania, wskazując w jaki sposób stworzyć trafny i uzasadniony program rozwoju sił morskich. Prezentuje ono również aktualizację wyników badań, prowadzonych w tym temacie w latach 2020 – 2021, przed atakiem Federacji Rosyjskiej na Ukrainę.

**Słowa kluczowe:** siły morskie, program modernizacji, planowanie, zarządzanie i jakość, model referencyjny

## Introduction

The NATO Naval Forces are of strategic significance as they secure global interests of the Alliance and its member countries. They come as the important elements of the security system and international policy pursued by Allies in the NATO area of interest (C.f.: [Björnehed, 2022](#), pp. 1-15). As a member of the NATO, Poland may pursue its interests on the seas of the world only when its naval forces reach the level that provides them with freedom of movement as well as force projection capability, both in the Alliance responsibility area and beyond (C.f.: [Makowski, 2023](#), pp. 1-22).

The aim of this paper is to present a concept of planning development of naval forces in a medium-sized country, on the example of Poland, in a dynamically changing political and military situation in Europe and in the area of the Baltic Sea, with the use of well-thought, efficient and well-grounded technical modernisation.

In order to achieve the above-mentioned aim, it is necessary to solve a research problem and to answer the following question: *How should methodology for planning development of naval forces look like in a medium-sized country, such as Poland, considering the national and the Allies' requirements?*

The solution to the problem requires verification of the following working hypothesis: *The methodology for planning development of naval forces should define a scope of modernisation activities undertaken with the use of tools and methods typical of management and quality sciences. It should also consider the Allies' guidelines on acquisition of defence resources that are contained in NATO standardisation publications.*

The paper is of interdisciplinary nature because the hypothesis refers to management and quality sciences and also to security sciences. The study comes as a concept. Hence, a significant limitation has been assumed in the field of describing methods and tools applied in the research. Considering the complexity of the problems

discussed in the paper, their detailed descriptions are not provided, however, the publications where such descriptions can be found are duly listed. It should be also mentioned that the paper comes as a new perspective of the research performed in the discussed area during the years 2020-2021 (see: Pac, 2021), in a very different military and political situation in the region.

### **Literature review**

The field related to the planning of development of naval forces is included in the Allied standardisation publications on the process of acquiring defence resources (i.e. NATO, 2022; NATO, 2015; NATO, 2011; NATO, 2009; NATO, 2004). The problems in question are also discussed in some US publications (e.g.: O'Rourke, 2014; Vance, Hinkle, 2011; Tilman et al., 2010).

Another area related to the problems discussed in the paper refers to the methods and tools applied in management and quality sciences that can be also used during the process of planning development of naval forces. They can be found in foreign and domestic literature (e.g.: Zanoni, 2021; Kulakowski et al., 2020; Barletta, 2019; Van der Last et al., 2002, Porter, 1998, Kolman, 2013; Stabryła, 2000). The analysis of specialist literature comes as a basis for creating a model of developing naval forces, as it integrates two scientific discipline fields, namely: management and quality sciences and security science.

### **A reference model of the development of the Navy**

Planning development of the naval forces through their modernisation should be based on a model solution that defines the sequence of activities undertaken to achieve the assumed result. A proper solution is a reference model (C.f.: Thunberg, Persson, 2014) (see: Fig. 1).

The model facilitates the understanding of significant relations among activities implemented in the particular areas and also the developing of norms and methods supporting their implementation (Poluha, 2007; Kasprzak, 2005, p. 69). It consists of four subsequent stages, namely: strategic analysis, development of the programme, analysis of the market of contractors / suppliers, acquisition and maintenance of military resources and assets. The first free stages are divided into phases (Table 1).

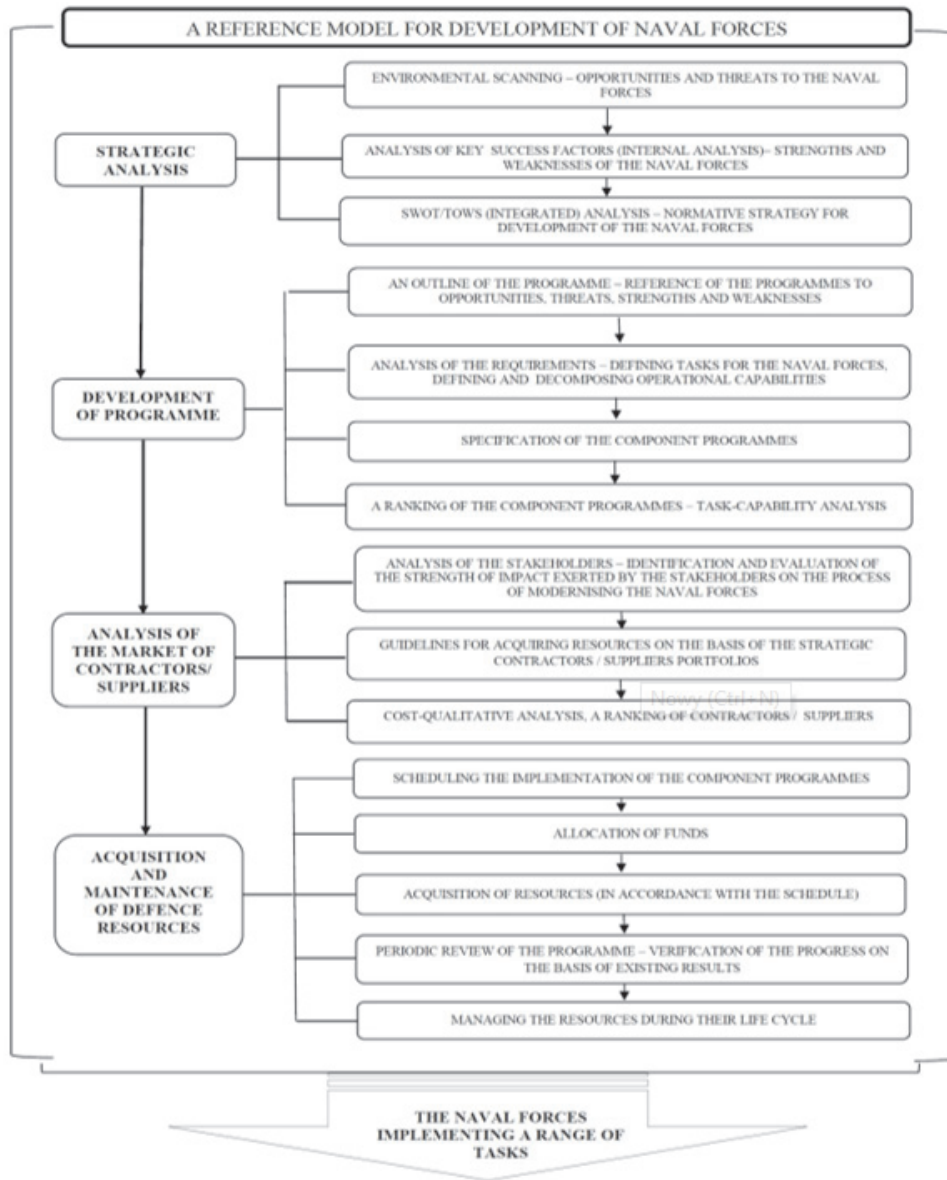


Fig. 1. A reference model of the programme of technical modernisation of the naval forces.

Source: Own elaboration based on: Zanoni, 2021; Kulakowski et al., 2020; Barletta, 2019; Cordell, Thomson, 2019; Kolman, 2013; Stabryła, 2000; NATO, 2022; NATO, 2015; Tilman et al., 2010

Table 1. Methods and tools applied in the process of naval forces development

Stages of the process	Phases	Methods and tools	Results
Strategic analysis	Environmental scanning.	GMPET analysis, Scenario Building, Cross Impact Matrix, ETOP analysis	Determining opportunities and threats to the naval forces
	Analysis of the Key Success Factors – Internal Analysis	Tree Diagram and an expert evaluation of the factors based on a preference scale with the analysis of the cohesion of the experts' opinions, with the use of a comprehensive coefficient of variation	Determining strengths and weaknesses of the naval forces, based on the accepted preference scale.
	SWOT/TOWS analysis - integrated analysis	SWOT/TOWS analysis with the use of the AHP (Analytic Hierarchy Process) or the Prioritisation Matrix	Determining a normative strategy for development of the naval forces.
Development of the programme	An outline of the modernisation programme	Matrix Diagram in the following relations: the programme – threats; the programme – opportunities; the programme – strengths; the programme - weaknesses	An outline of the programme and a preliminary ranking of all the component programmes.
	Analysis of the requirements	Decision Tree	Decomposing capabilities into sub-capabilities and operational features.
	Specification of component programmes	Decision Tree	Technical and tactical data and equipment of vessels
	Priority of the component programmes	Task-capability analysis with the use of the Analytic Hierarchy Process (AHP) or the Prioritisation Matrix and an expert evaluation with the analysis of the cohesion of the experts' opinions.	A ranking of the vessel programmes in their quality (operational capabilities) and functional (implementation of tasks) aspects.
Analysis of the market of contractors / suppliers	A stakeholder analysis	A stakeholder matrix	Determining stakeholders and their impact on the process of modernising the naval forces.
	Guidelines for acquiring resources	Configuring strategic contractor / suppliers portfolios	Determining strengths of the contractors /suppliers and buyers, internal and external risks for resources acquisition. Consequently, the guidelines for acquiring resources are defined.
	Ranking of the contractors / suppliers	Cost-qualitative analysis with the use of the AHP or the Prioritisation Matrix and the expert evaluation with the analysis of the cohesion of the experts' opinions.	A ranking of the contractors /suppliers for the particular vessel programmes, in accordance with the quality and economic criteria.

Source: Own elaboration based on: Zanoni, 2021; Kulakowski et al., 2020; Barletta, 2019; Cordell, Thomson, 2019; Kolman, 2013; Stabryła, 2000

Each phase contains relevant analysis and activities based on methods and tools applied in management and quality sciences adapted to the requirements of the security and defence areas.

## Strategic analysis

The first stage of the reference model, strategic analysis (Zanoni, 2021; Puyt et al., 2020; Stabryła, 2000), is oriented toward determining a normative strategy for development of the naval forces. For the purpose of the study, the strategic analysis used for business organizations has been adapted to the requirements of the naval forces. Therefore, it is necessary to perform a number of activities, in the following sequence:

- (1) The environmental scanning (Du Toit, 2016, pp.16-24; Stabryła, 2000, p. 146) that includes:
  - *GMPET analysis* that allows the external environment to be structured through the definition of its areas or zones. The structuring comes as a type of PEST analysis (political, economic, social and technological zones) (Aguilar, 1967; Correia, Wilson, 1997, p. 21; Porter, 1991, pp. 95-117; Cordel, Thomson, 2019, pp. 57-60) that is applied in strategic management. Considering the analysed organization, namely the naval forces, the political, economic, technological, military and geographical areas can be identified during the GMPET analysis. The next step in the GMPET analysis refers to the identification of factors (Fig. 2) that characterise the particular areas, where there are no trends determined at this stage.

The result of the analysis is an estimation of the factors identified by trend, according to the criterion of the impact strength and the probability of the occurrence of that impact that is expressed in three dimensions:

- growth that indicates a significant increase in opportunities or an increase in threats to the analysed organisation;
  - stabilisation that means maintaining the current status, which can indicate positive or negative influence in the field of the current stagnation;
  - a decrease that indicates a reduction of threats or a reduction of opportunities for the organisation, depending on the nature of the particular factor (Berliński, Penc – Pietrzak, 2004, pp. 175-179).
- *Scenario building process*. Under the scenario building process, an aggregation of the particular areas is provided, in accordance with the criteria of the impact strength and the probability of a trend occurring in the analysed factors. As a result of the aggregation, an evaluation of the environment is provided in terms of its turbulence and complexity. The turbulence of the environment determines the level of dependence indicated by an organisation on external conditions. The extent of the span between an optimistic scenario (best – case scenario) and a pessimistic one (worst – case scenario) in the particular areas determines the level of dependence indicated by an

organisation on its environment. A turbulent environment requires a considerable amount of attention in formulating a strategy for development. Considering naval forces, it requires accurate determination of component programmes that constitute the entire modernisation programme and detailed determination of priorities in their implementation. The complexity of the environment determines the level of the heterogeneity and structuring of the environment (C.f.: Daniluk, 2015, pp. 114-120). The next step of the analysis is identification and ranking of factors that constitute the leading trends (the most probable ones) or surprise trends (the least probable ones) (Berliński, Penc – Pietrzak, 2004, p. 200). The last element of the scenario analysis is a *Cross Impact Matrix* that involves determining trends that affect other factors in the strongest way and trends that are affected by other factors in the strongest way.

- *ETOP (Environment Threats Opportunities Profile) analysis* (Fig. 3) (Akamavi et al., 2004, pp. 455-471; Daniluk, 2015, p. 165) that makes it possible to define opportunities and threats for the analysed organisation, based on the previous analysis.

During the environmental scanning, it is possible to consider elements of far and near environment. The aim of such analysis is to identify current opportunities that can be taken by an organisation and to indicate threats that should be avoided or neutralised. Figure 3 presents a graphic interpretation of the results obtained at the end of this stage, namely: determining the balance of opportunities and threats to the Polish Naval Forces in a form of a profile chart (Cf.: Stabryła, 2000, pp. 165-164). As indicated in the research, when compared to the previous studies from the years 2020-2021, the relations between opportunities and threats have changed significantly. The previous research studies indicated that the threats dominated over the opportunities in terms of their quantity and significance (see: Pac, 2021 pp. 81-82). At present, the opportunities have become more equal to the threats in these respects. The basic reason for that fact refers to the consequences of the invasion of the Russian Federation against Ukraine. As a result, the consolidation of the NATO countries has been observed in the field of counteracting the Russian Federation and in the field of operations oriented toward the enlargement of the NATO by Finland and Sweden which will radically change the geo-strategic situation in the Baltic Sea region. It should be however remembered that such a situation may not be of a permanent character. Therefore, the oncoming opportunities should be used in the most efficient way.

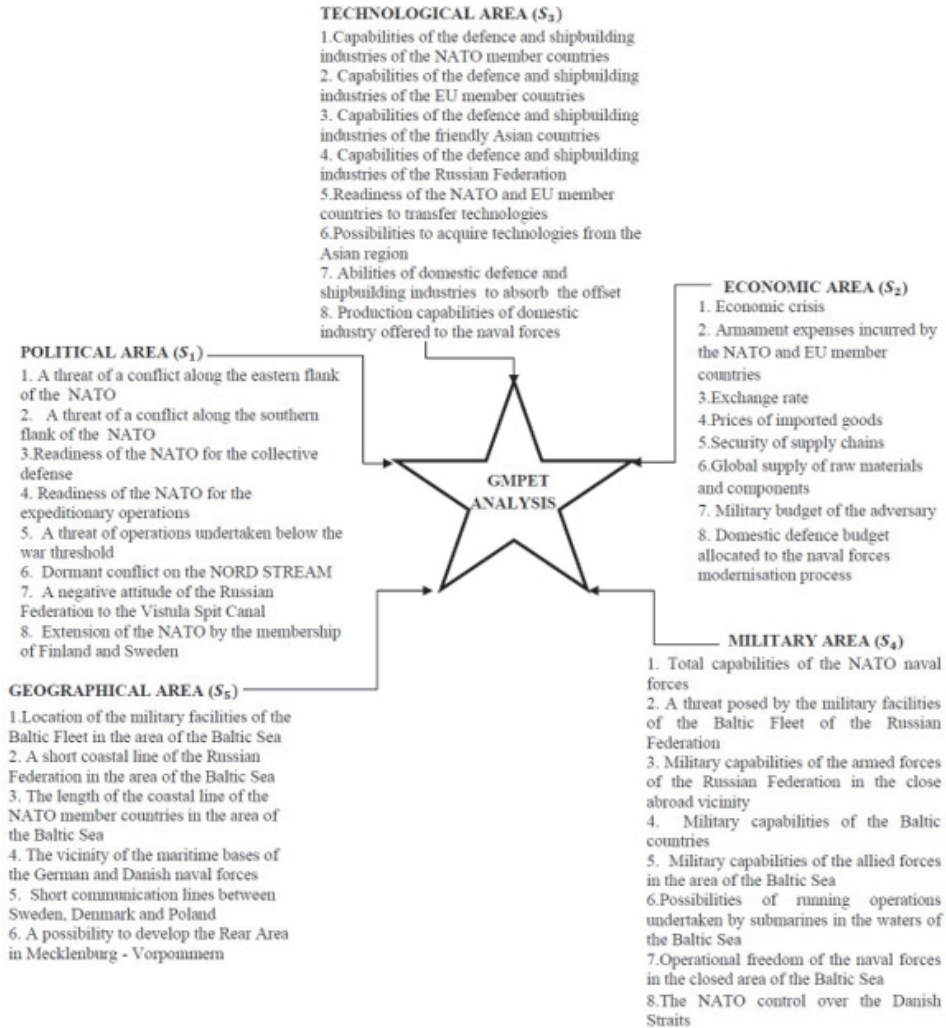


Fig. 2. Decomposing the areas into the factors during the GMPET analysis

Source: Own elaboration



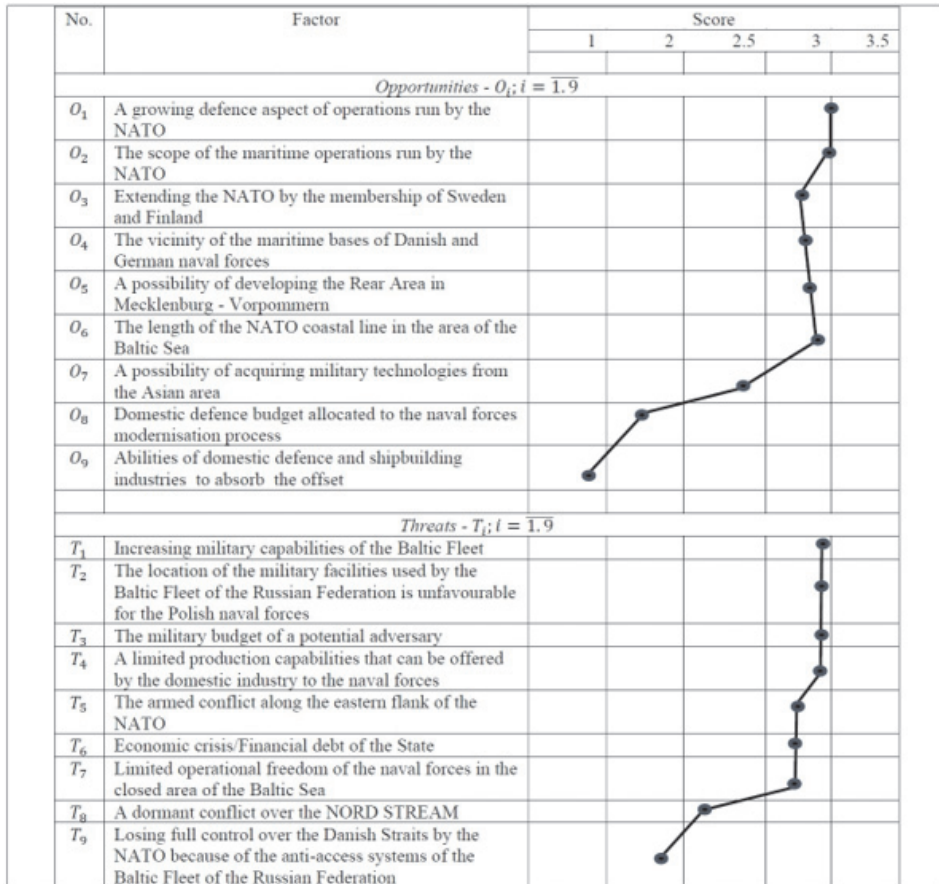


Fig. 3. The profile chart of the opportunities and threats (ETOP) for the Polish Naval Forces

Source: Own elaboration based on: Stabryła, 2000; Daniluk, 2015

(2) Analysis of Key Success Factors. In strategic management, the analysis of key success factors (see: Köseoglu et al., 2020; Janjić et al., 2019, pp. 98 - 106; Stabryła, 2000, pp. 163-165) comes as a useful tool for aggregating information necessary to perform SWOT/TOWS analysis in the fields of identification and evaluation of weaknesses and strengths of an organisation. Therefore, at first a set of key success factors has been defined. The key success factors have been identified, based on the normative documents of the Polish Navy (e.g.: MON, 2010). On this basis and with the use of a Tree Diagram (Fig. 4) (see: Tague, 2005), three areas of interest have been indicated, where the above-mentioned factors can be referred to:

- capabilities in the field of key combat operations run by the naval forces;

- providing a combat support for maritime units, groups and forces which take part in the operation;
- logistics resources required to support the above-mentioned combat operations run by the naval forces.

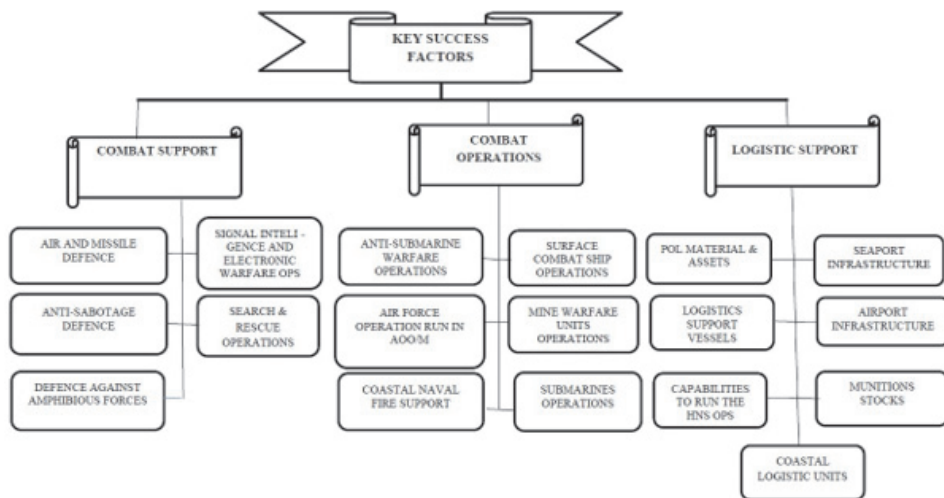


Fig. 4. A tree diagram of the key success factors in operations run by the naval forces.

Source: Own elaboration based on MON, 2010

Defined in such a way, the set of the factors has been evaluated by experts. The experts have been recruited from the retired Polish Navy officers and selected attendees of postgraduate studies run by the Polish Naval Academy. The expert evaluation has allowed the Authors to determine the weaknesses and strengths of the Polish Naval Forces (see: Fig. 5).

The expert evaluation includes an estimation of the particular factors in the specific areas provided by a panel of experts, in accordance with a preference scale (scoring) that has been assumed. It also includes analysis of the cohesion of the experts' opinions, which has been provided with the use of a comprehensive coefficient of variation (see: Everit, Brian, 1998, p.89). The factors are allocated to the strengths and weaknesses, based on the average expert evaluation that has been verified with the use of a comprehensive coefficient of variation, in accordance with the accepted scale.

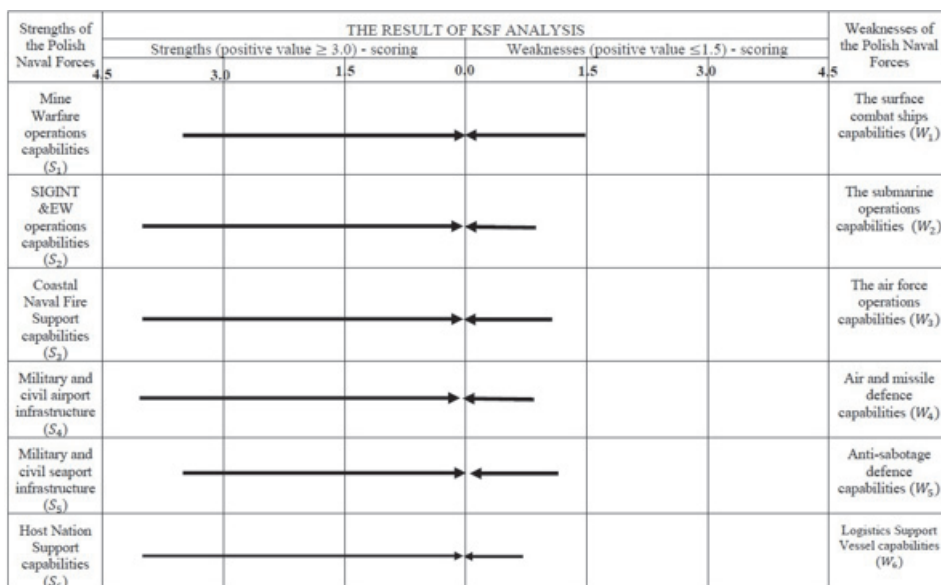


Figure 5. The strengths and weaknesses of the Polish Naval Forces  
 Source: Own elaboration

(3) *SWOT/TOWS analysis*. The analysis (Figure 6) allows interested parties to compare basic opportunities and threats coming from the external environment and also the strengths and weaknesses of the Polish Naval Forces. The sequence of steps undertaken during the SWOT (*Strengths, Weakness, Opportunities, Threats*) analysis starts with the strengths and weaknesses of the analysed organisation which are compared in pairs to the opportunities and threats. The sequence is reverse during the TOWS (*Threats, Opportunities, Weakness, Strengths*) analysis.

Generally, in the field of defence issues, the discussed analysis allows interested parties to:

- determine the significance of the analysed entity (the naval forces) and its operation in emergency situations and armed conflicts;
- determine the strengths and weaknesses of the analysed entity in terms of using its operational capabilities to perform planned actions and providing some specific operational capabilities, such as force protection and security, as well as logistic support and sustainment to the allied forces;
- define threats and opportunities in the above-mentioned areas duly in advance, in order to undertake adequate technological, organisational, personal and other actions required to carry out the intended operations.

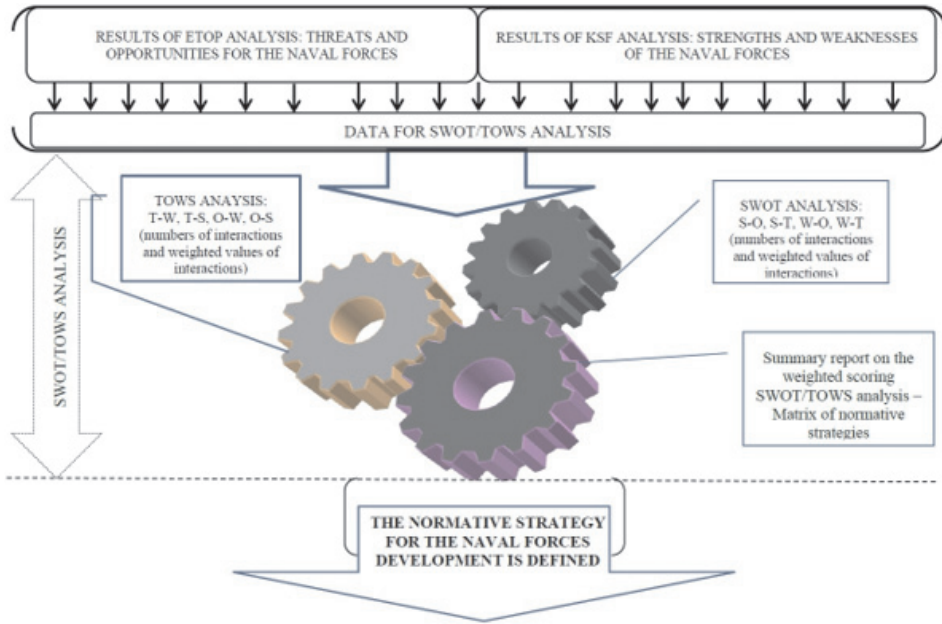


Fig. 6. The scheme of the SWOT/TOWS analysis  
Source: Own elaboration

As a result of the SWOT/TOWS analysis, a normative strategy has been defined for development of the naval forces (Fig. 7).

		FAR AND NEAR ENVIRONMENT	
		THREATS	OPPORTUNITIES
NAVAL FORCES	STRENGTHS	ACTIVE DEVELOPMENT	DYNAMIC DEVELOPMENT
	WEAKNESSES	SELECTIVE DEVELOPMENT	INTEGRATED DEVELOPMENT

Fig. 7. Matrix of normative strategies - the result of the SWOT/TOWS analysis of the Polish Naval Forces

Source: Own elaboration based on Daniluk, 2015.

As indicated by the SWOT/TOWS analysis, the Polish Naval Forces should pursue the strategy of integrated development (Cf.: MON, 2010-2011). Such a solution is applied whenever opportunities should be used for overcoming an entity's own weaknesses.

It is dedicated to entities that are not able to develop their own resources with the required capabilities in a short-time range, by changing the structure of their own strengths and weaknesses. In such a situation, apart from focusing on some selected, well-grounded programmes/projects (that are strictly adjusted to the particular tasks of the naval forces), it is necessary to take maximum advantage of the current opportunities in order to reduce one's own weaknesses in the face of the current threats. Using fewer assets of an entity in an efficient and effective way against the adversary is possible through cooperation in alliances.

Considering the Polish Navy, it is advisable to focus on actions that make it possible to:

- defend and protect the interests of the State at sea as well as participate in operations run under the NATO structures;
- develop multi-task capabilities of the naval forces, with particular consideration of air defence, capabilities to protect critical infrastructure and capabilities required to run pre-emptive operations (e.g.: reconnaissance and signal intelligence operations as well as mine warfare);
- provide efficient anti-sabotage defence to the own resources and installations under the armed conflict and hybrid operations through joining the programmes implemented by the NATO and the EU;
- increase the range of the available munitions through obtaining support from the Allied in the field of guidance and reconnaissance systems;
- extend the fleet basing system through incorporating the facilities located outside the close vicinity of the Kaliningrad Oblast, with the use of funds under the NSIP (the NATO Security Investment Programme) and the EU Cohesion Fund oriented to the maritime logistic infrastructure development;
- implement programmes with the support granted by the strategic partners who have experience and competences to construct particular classes of vessels;
- acquire resources required to achieve the economies of scale through simultaneous supplying other components under the programme of modernising the armed forces.

### **Development of the modernisation programme**

The first phase of the second stage is to determine the scope of the programme of modernising the naval forces, which follows the results of the strategic analysis. Considering the mission of the naval forces and the normative strategy for their development, it is possible to define the scope of such an endeavour. For the requirements of this study, the codenames of the programme components have been assigned as follows:

- the *Multi-Role Ship* (NATO, 2004, pp.58-60) programme – a multi-task vessel that allows the naval forces to participate in the integrated system of air defence of the State and to implement tasks of the Allied (e.g.: participation in the Standing NATO Maritime Group – SNMG);
- the *Naval Mine Warfare Unit* (NATO, 2004, pp. 70-73) programme – a mine warfare vessel – it allows the naval forces to run offensive and defensive operations in the field of mine warfare during the operations conducted in AOO/Maritime (operational area of the maritime component) and in JOA (Joint Operations Area) (NATO, 2021, p. 2-A-14 and p. 2-J-1) as well as to implement tasks of the Allied (e.g.: participation in the Standing NATO Mine Countermeasure Group - SNMCMG);
- the *SIGINT Vessel* programme – a vessel used for running signal intelligence operations undertaken by the maritime component in AOO/Maritime as well as in JOA;
- the *Horizon* programme – the development of the Polish Coastal Missile Regiment which is a component of the Polish Navy, through increasing the striking range by the acquisition of reconnaissance and guidance resources capable of striking within the radius of the nominal range and also the increase in the number of squadrons available;
- the *Dogfish* programme – unmanned floating vehicles used for running reconnaissance operations and surveillance of offshore wind farms that are planned to develop in the Słupsk Bank;
- the *Third Gate* programme – the extension of the fleet basing system, considering the close vicinity of the Tricity ports to the Kaliningrad Oblast;
- the *Krill* programme (Grzybowski, 2009, pp.158-179) – a system of anti-terrorist maritime protection;
- the *Oyster* programme – securing the critical maritime infrastructure – mainly sea ports;
- the *Dragonfly* programme – a helicopter for the naval aviation to perform operations in the following fields: mine warfare, SAR, anti-submarine warfare, early warning, anti-surface warfare, VERTREP (NATO, 2004, pp.74-77);
- the *Logistic Support Vessel* (NATO, 2004, pp.64-66) programme – a logistics support vessel that is also a base platform for unmanned floating vehicles developed under the *Dogfish* programme;
- the *Submarine* (NATO, 2004, pp.61-63) programme – a programme for acquiring a submarine that can be viewed as an additional endeavour.

Presented above, the selection of the component programmes is well-justified and it explains their relations to the opportunities and threats that have been defined during the strategic analysis for the naval forces and also their weaknesses and strengths, as indicated in a Matrix Diagram (Tague, 2005) (see: Figure 8). The

diagram is used for performing systematic analysis of interactions observed between two sets of the elements. For the requirements of the study, it has been assumed that the component programmes come as the constant elements in the development of the programme of modernising the naval forces. Other elements are constituted by the results of the SWOT/TOWS analysis that are subsequently compared to the first element, namely: opportunities and threats posed to the naval forces and their weaknesses and strengths. The assessment of the value of the component programmes is the result of the number of interactions observed between these programmes and the results of the SWOT/TOWS analysis, according to the following dependence: 1 – there is positive dependence; 0 – there is no dependence; 0.5 – there is half/partial positive dependence.

The last line of the diagram makes it possible to determine the significance of the programmes in terms of their relations to the external and internal factors that have been identified during the strategic analysis. It is also possible to assume that it is a preliminary ranking of all the component programmes that constitute the programme of modernising the naval forces.

The next phase of the discussed stage is defining the requirements necessary for military assets to be acquired. For the requirements of this study, the phase is limited to the vessel programmes that are the easiest ones to compare with each other in their functional and quality aspects. The functional aspect refers to the scope of tasks that are going to be performed with the use of the acquired assets. The quality aspect refers to operational capabilities of these assets. In other words, operational capabilities condition the implementation of tasks that are to be performed by the naval forces – that is namely: the functional aspect. Operational capabilities come as a set of capabilities in the field of running various types of operations at the operational and tactical levels, with the use of combat and logistics support. They are defined in the standardisation documents issued by the NATO (i.e.: NATO, 2010; NATO, 2011).

The functional criterion includes the scope of operations related to defence and protection of the interests of the State at sea, collective defence, crisis response operations run by allied and international organisations and other non-military operations. A comprehensive list of the criteria in both aspects is presented in Fig. 9.

Factors of SWOT/TOWS analysis	COMPONENT PROGRAMMES										
	Multi-Role Ship	Naval Mine Warfare Unit	SIGINT Vessel	Horizon	Third Gate	Krill	Oyster	Submarine	Logistic Support Vessel	Dogfish	Dragonfly
<b>WEAKNESSES</b>	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>	<b>VIII</b>	<b>IX</b>	<b>X</b>	<b>XI</b>
W1	1	1	1	1	1	0	0	0	0	0	0
W2	0	0	0	0	1	0	0	1	0	0	0
W3	0	0	0	0	0	0	0	0	0	0	1
W4	1	0	0	0	0	0	0	0	0	0	0
W5	0	1	0	0	0	1	1	0	0	1	0
W6	0	0	0	0	0	0	0	0	1	1	0
<b>Eliminating weaknesses</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>1</b>
<b>STRENGTHS</b>	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>	<b>VIII</b>	<b>IX</b>	<b>X</b>	<b>XI</b>
S1	0	1	0	0	0	0	0	0	0	0	1
S2	0	0	1	0	0	0	0	0	0	1	1
S3	1	0	1	1	0	0	0	0	0	0	0
S4	0	0	0	0	0	0	0	0	0	0	0
S5	0	0	0	0	1	1	1	0	0	0	0
S6	1	1	0	0	1	1	1	0	1	0	0
<b>Reinforcing strengths</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>2</b>
<b>THREATS</b>	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>	<b>VIII</b>	<b>IX</b>	<b>X</b>	<b>XI</b>
T1	1	1	0	1	1	0	0	1/2	0	1	1
T2	0	1	0	1	1	1	1	0	1	1	0
T3	0	0	0	0	0	0	0	0	0	0	0
T4	1	0	1	1	1	1	1	0	0	1/2	0
T5	1	1	1	1	1	1	1	1/2	1	1	1
T6	0	0	0	0	0	0	0	0	0	0	0
T7	1	1	1/2	1	1/2	1/2	1/2	1/2	0	1/2	1
T8	0	0	0	0	0	0	0	0	0	0	0
T9	1	1/2	1	0	0	0	1	0	0	0	0
<b>Neutralising threats</b>	<b>5</b>	<b>4.5</b>	<b>3.5</b>	<b>5</b>	<b>3.5</b>	<b>3.5</b>	<b>4.5</b>	<b>1.5</b>	<b>2</b>	<b>4.0</b>	<b>3.0</b>
<b>OPPORTUNITIES</b>	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>	<b>VIII</b>	<b>IX</b>	<b>X</b>	<b>XI</b>
O1	1	1	1	1	1	1	1	1	1	1	1
O2	1	1	1	1	1	1	1	1	1	1	1
O3	1	1	1	1/2	0	0	0	0	1/2	0	1
O4	1	1	1	1/2	0	0	0	1	1/2	0	1
O5	1	1	1	0	0	1	1	1	1	0	0
O6	1	1	1	1	1	1	1	1/2	1	1	1/2
O7	0	0	0	0	1	1	1	1	1/2	1	1/2
O8	1	1	0	0	1	1	1	0	1	1	1/2
O9	1	1	1	0	0	1	1	0	1	1	1
<b>Increasing opportunities</b>	<b>8</b>	<b>8</b>	<b>7</b>	<b>4</b>	<b>4</b>	<b>7</b>	<b>7</b>	<b>4.5</b>	<b>7</b>	<b>7</b>	<b>6.5</b>
<b>Total / Ranking of the programmes</b>	<b>17.0 I</b>	<b>16.5 II</b>	<b>13.5 V</b>	<b>11.5 VIII</b>	<b>11.5 VII</b>	<b>13.5 V</b>	<b>14.5 III</b>	<b>7 IX</b>	<b>11.5 III</b>	<b>14.0 IV</b>	<b>12.5 VI</b>

Fig. 8. The Matrix Diagram presenting the dependence of the component programmes on the external and internal factors of the SWOT/TOWS analysis

Source: Own elaboration



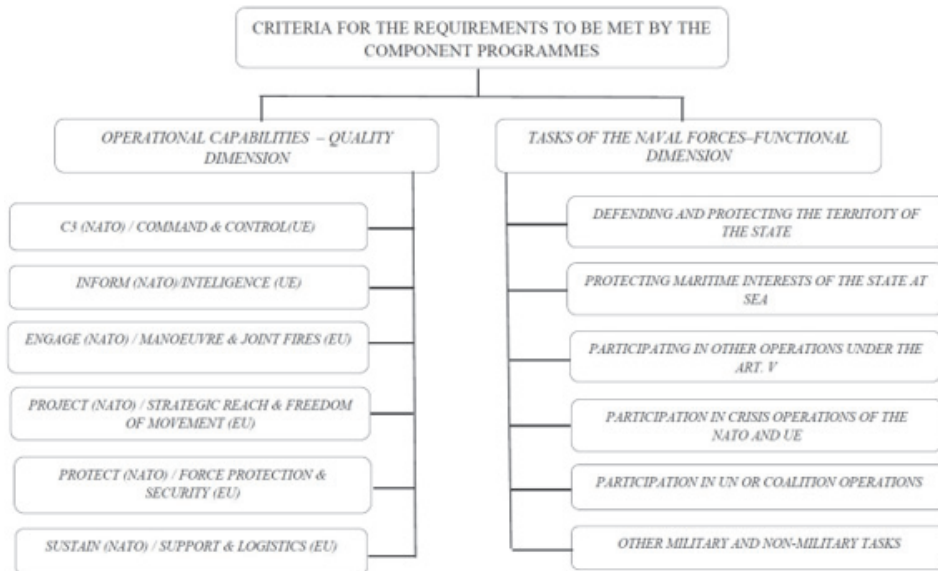


Fig. 9. The criteria of the requirements for the modernisation programmes

Source: Own elaboration based on: NATO, 2010; NATO, 2011

The process of developing the component programmes related to vessels involves a sequence of activities presented in a form of a Decision Tree (Fig. 10), including:

- decomposition of operational capabilities into sub-capabilities at the level of a vessel programme and decomposition of the sub-capabilities into operational features;
- allocation of weapon systems, vessel systems, material and technical resources as well as naval personnel to the particular operational features; identification of any possible limitations related to their use;
- identification of requirements related to the displacement (including the tonnage reserve for the future modernisation process), seaworthiness, autonomy and the maximum cruising range of a vessel.

Considering the above-mentioned undertakings, it would be advisable to refer to the requirements defined in the standardisation documents of the NATO (NATO 2004; NATO, 2016) and other specialist publications (e.g.: Janes, 2022). As a result, it is possible to provide identification of vessel classes and vessel types that should be acquired and their approximate tactical and technical data.

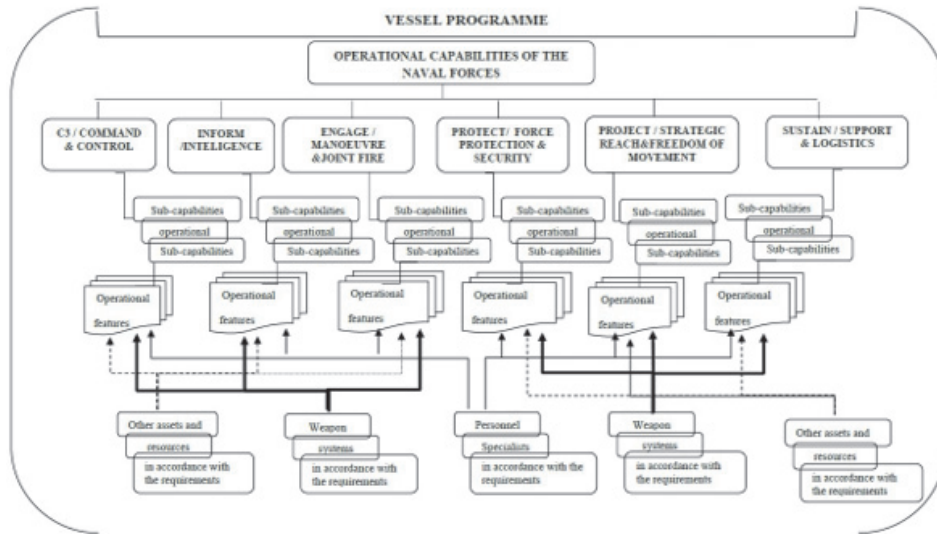


Fig. 10. The decision tree of capabilities and technology of developing vessel programmes  
Source: Own elaboration

The last element of this stage involves establishing priorities in the area of the indicated vessel programmes, with the use of the task-capability analysis (Fig. 11), where the zero-unitarisation method is applied (Cf.: Kukuła, 2000 pp. 152-162). The analysis makes it possible to establish a ranking of the discussed component (vessel) programmes (Table 2), according to the quality criterion (operational capabilities) and the functional criterion (tasks to be performed by the naval forces) and also the result that takes both criteria into consideration because the defence resources acquired for the naval forces should be characterised by the operational capabilities adjusted to the tasks assigned to the navy.

The position of a particular programme in the ranking is defined by the values achieved by the particular preference rates in terms of the actual operational capabilities and the tasks under implementation, as well as an average decision-making rate that takes both the above-mentioned criteria equally into account (Pac, 2021, pp. 127 – 143). A positive correlation between the quality and the functional aspects is observed. On such a basis, it is possible to develop a preliminary schedule for the implementation of the vessel programmes, to provide a preliminary allocation of funds and to indicate which programmes can be implemented within one planning perspective (e.g.: 15 years) and which programmes need more time or should be moved to the next period of modernisation work.

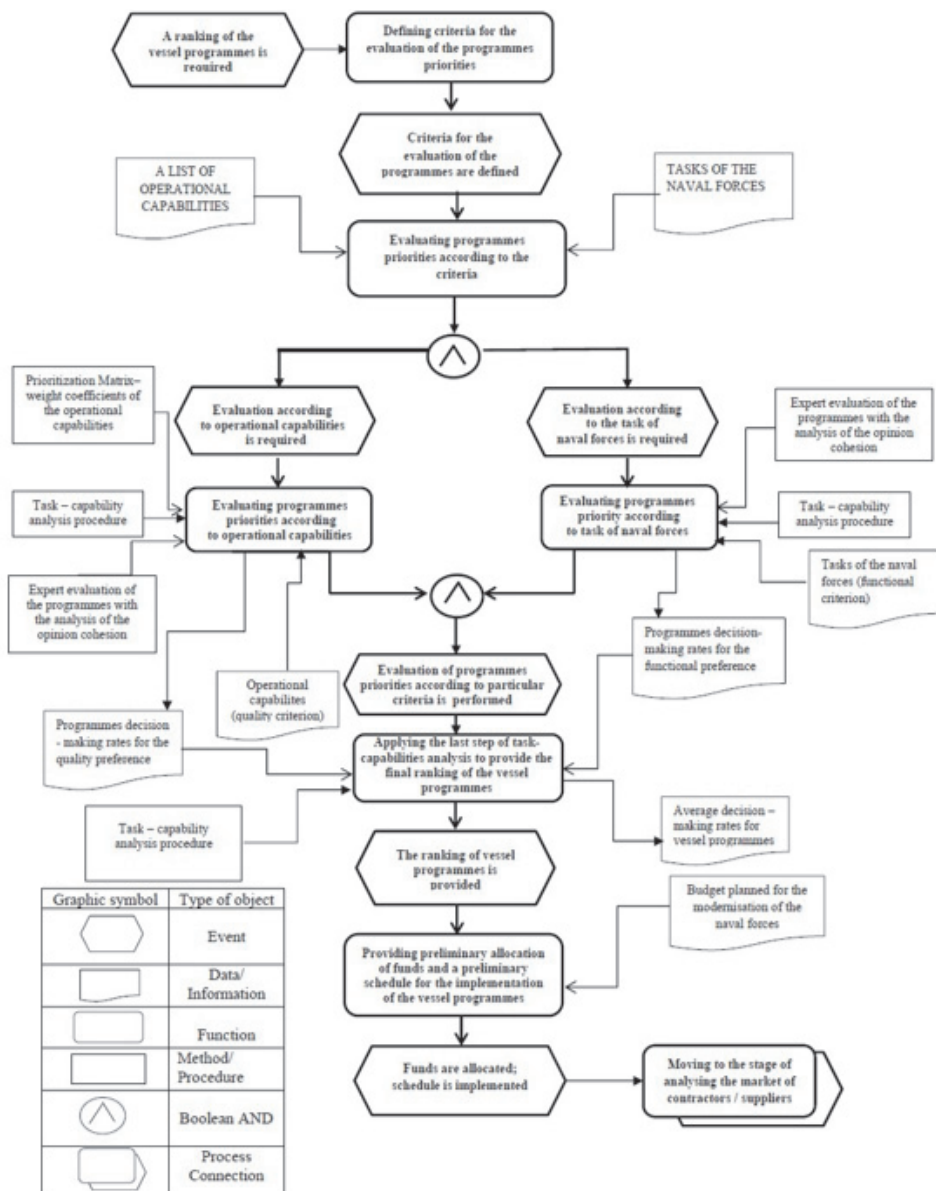


Fig. 11. The task-capability analysis  
Source: Own elaboration

Table 2. A ranking of the vessel programmes for the Polish Naval Forces, in accordance with the task-capability analysis

Programme	Multi-Role Ship	Naval Mine Warfare Unit	SIGINT Vessel	Submarine	Logistic Support Vessel
Position according to:					
Decision making rate for the quality preference (operational capabilities)	1	2	4	3	5
Decision making rate for the functional preference (tasks for the naval forces)	2	1	4	5	3
Average decision – making rate (considering both criteria)	1	2	3	5	4

Source: Own elaboration

## Evaluation of the market of contractors / suppliers

Considering some practical aspects, the next stage of the reference model is also limited to the vessel programmes. The evaluation of the market of contractors / suppliers is composed of three basic phases that should be implemented for each defence asset that is acquired under the programme of technical modernisation of the naval forces, namely:

- analysis of stakeholders (Kujala et al., 2022, pp. 1136-1196; Cordell, Thomson, 2019) that makes it possible to identify entities defining the environment of the implemented programme of modernising the naval forces. Stakeholders form a target environment as they have possibilities and need to affect the implementation of the programme of modernising the naval forces. Considering the Polish Naval Forces, the group of stakeholders includes those who generate the main influence in the target environment to a various extent, namely: the State administration, political parties, trade unions, self-government authorities, local communities, national ministry of defence and armed forces, international organisations (e.g.: NATO and EU) and authorities of other countries. Another group includes entities operating in the discussed sectors (domains): domestic (State and private) shipbuilding industry and defence industry, contracting parties/suppliers – foreign

entities, research and development centres, academic centres. The influence exerted by stakeholders on the modernisation process can be determined with the use of a stakeholder matrix. The stakeholder matrix makes it possible to provide two basic rankings referring to the stakeholders analysed in the environment. The first ranking defines the strength of the influence exerted by a particular player on the component program, whereas the second ranking presents the level of being interested in that programme (see: Imperial College London, 2017). The allocation of the entities in the matrix classifying the stakeholders, falls into four typical groups, based on the above rankings. (see: Fig. 12).

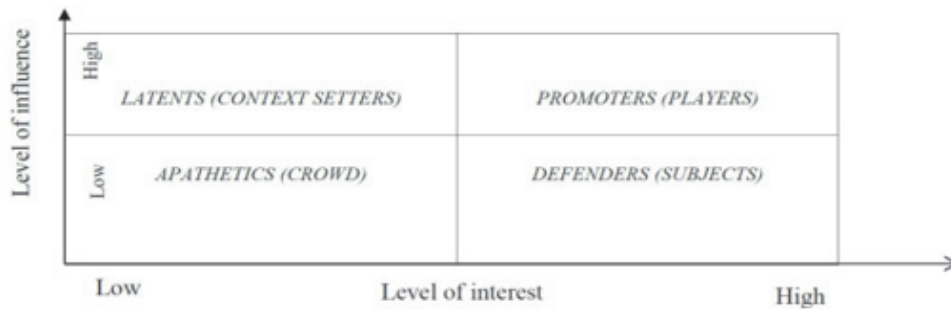


Fig. 12. The matrix of stakeholders (Influence - Interest Grid)

Source: Own elaboration based on Imperial College London, 2017

- guidelines for acquiring resources – executed with the use of configuring strategic contractors/supplier portfolios (see: Fig. 13) (Cf.: Neumler et al., 2016 pp. 194 - 221, Schuh et al., 2014). This is another type of analysis that is performed in accordance with the reference model. It is executed for each of the analysed component programme separately. The analysis consists of four strategic variables that are presented in two-dimensional tables. The tables are analysed in pairs under two component analyses. The first component analysis comprises the analysis of the portfolio of buyer-contractor/supplier relationship, where similarly to logistics, the power and interdependence of buyers and contractors/suppliers are analysed for the implementation of a particular programme. The second component analysis is focused on the risk management in the external and internal aspects of the implementation of a particular programme. In each component analysis, the strategic variables are defined by the particular factors.

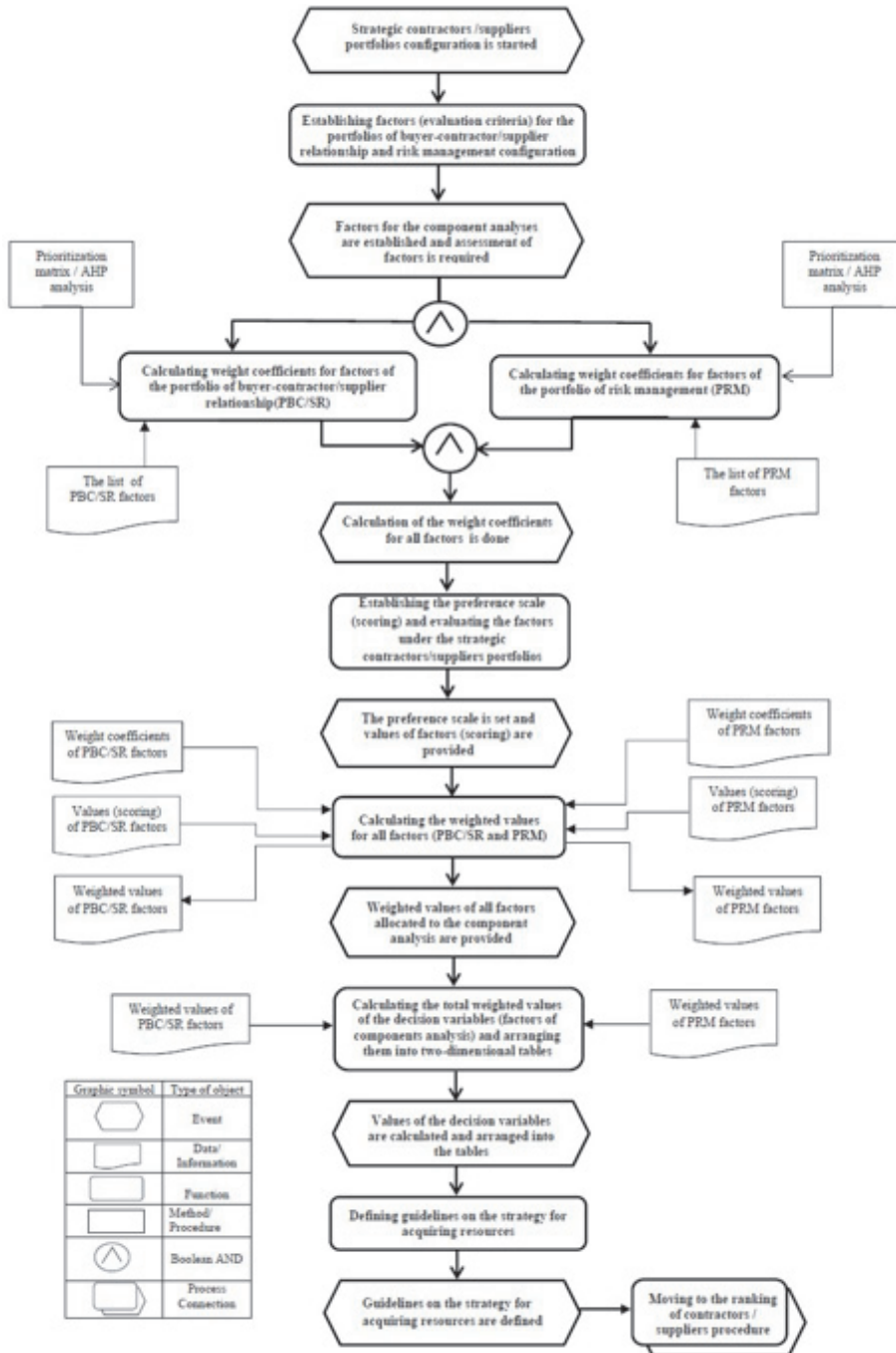


Fig. 13. The algorithm of strategic contractor/supplier portfolios configuration.

Source: Own elaboration

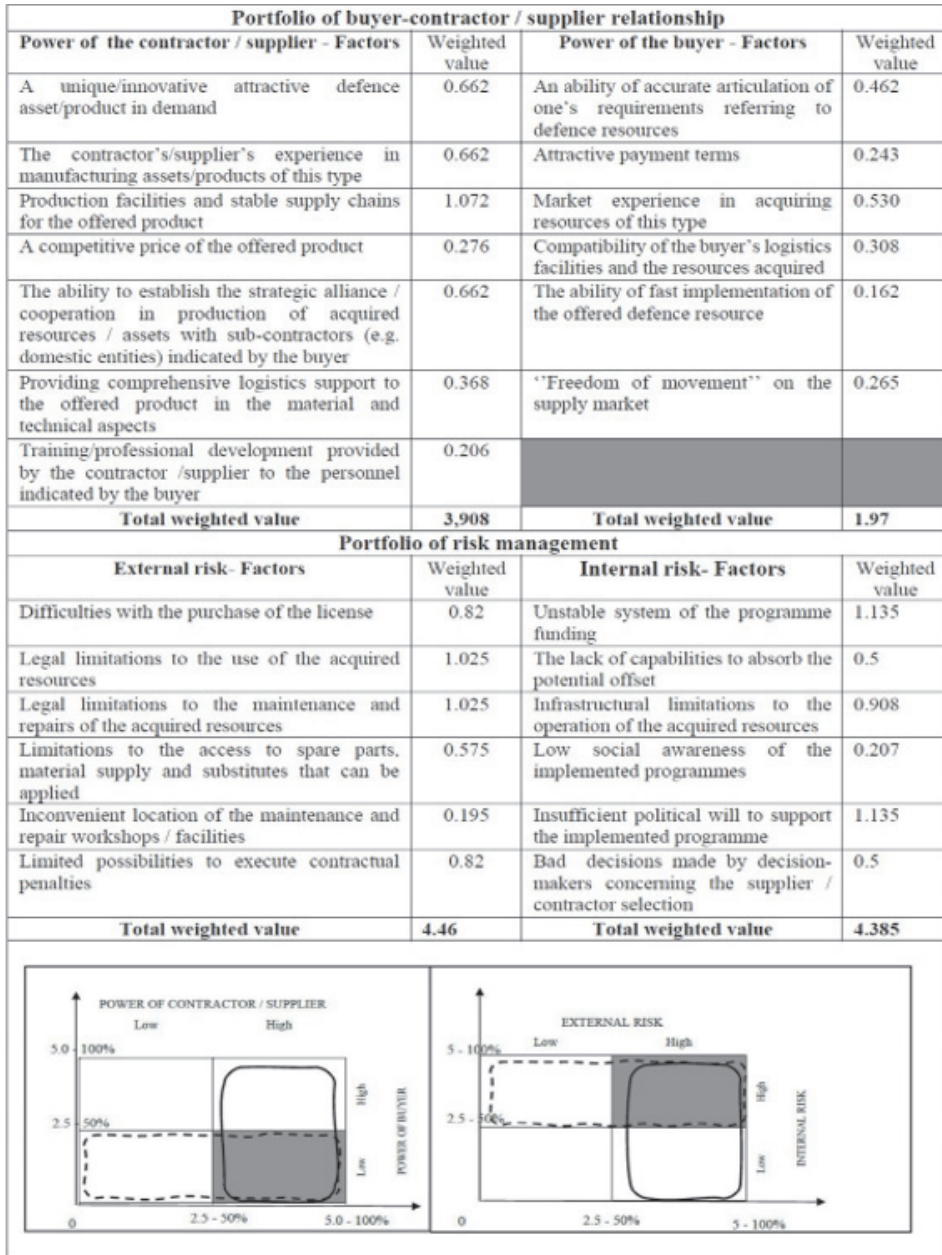


Fig. 14. An example of the result of the strategic contractors / suppliers portfolios configuration

Source: Own elaboration

For each factor, the weight coefficient is defined and then its weighted value is calculated with the use of the assumed preference scale (scoring). The sum of the weighted values calculated for component analyses (Fig. 14) makes it possible to indicate a leading directive on how to acquire particular defence resources, through proper relationship management with contractors/suppliers and risks neutralisation.

The result of the configuration of the strategic contractor/supplier portfolios allows us to define proper guidelines for acquiring particular defence resources (implementing the particular programmes). The interpretation of Figure 14 indicates that during the process of acquiring a particular defence resource, the contractor's /supplier's power is higher than the buyer's power, considering high external and internal supply risks. In such a case, it can refer to an oligopolistic market of contractors/suppliers, numerous legal and logistic restrictions on the use of acquired resources and one's own limited capabilities. Hence, it is possible to recommend a strategy involving acquisition of defence resources that includes the following solutions and alternatives:

- opportunities to participate in a programme implemented under the framework of an international organisation (the NATO or EU) by its several member countries;
- entering into bilateral cooperation with the countries that have been implementing a similar programme;
- looking for contractors/suppliers who come as an alternative to the entities that have been currently taken into consideration;
- purchasing a project from a contractor / supplier and implementing it with an external strategic partner, with the participation of domestic entities of the shipbuilding and defence industries;
- guaranteeing the continuity of supplies of material and munitions required during the exploitation period of the resource that has been acquired in the programme;
- providing training to the military and technical staff in order to prepare them for proper operation, repairs and technical maintenance of the resources to the largest extent possible;
- launching production of the optimal number of components included in a particular programme by one's own shipbuilding industry;
- acquiring products from the secondary market, negotiating proper training and logistics support and developing training and maintenance centres in the country;
- purchasing ready-made products, considering a possible risk related to the limited level of involving one's own production capacity and capabilities in the field of logistics support.



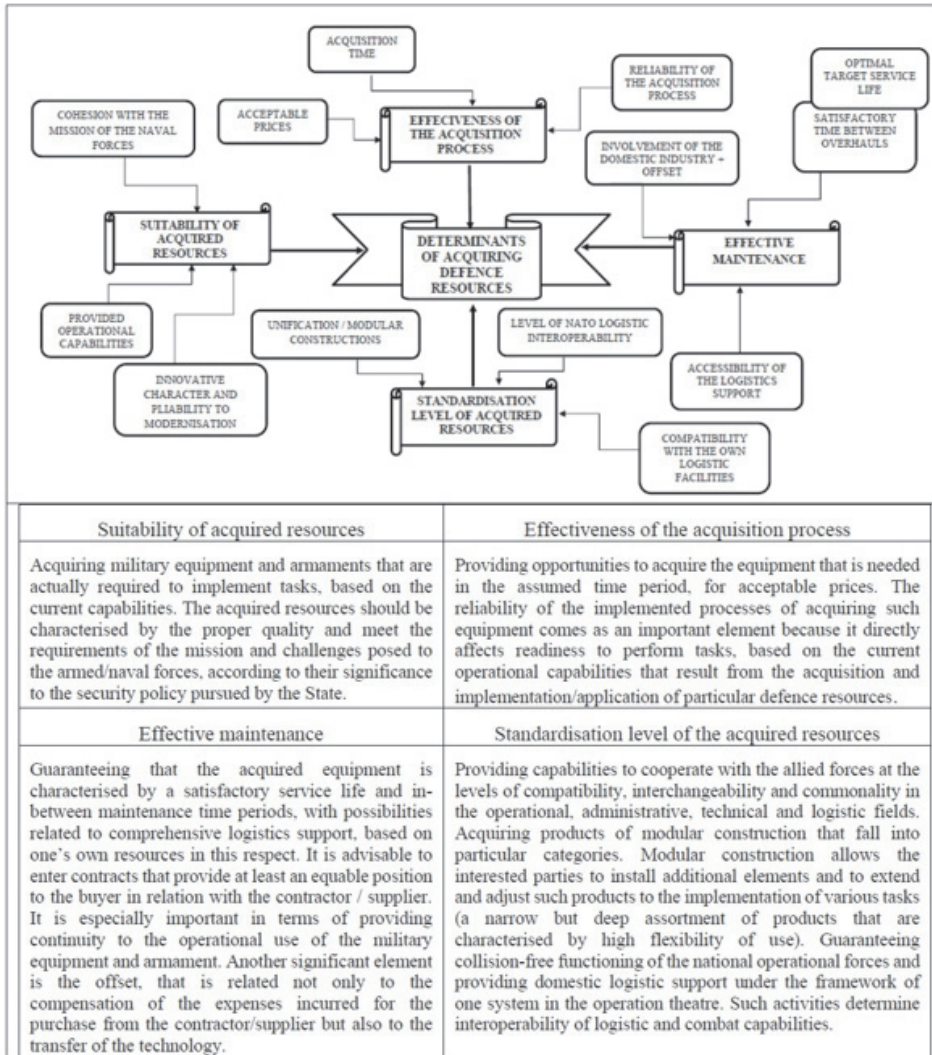


Fig. 15. A relationship diagram– determinants and diagnostic features that determine the quality of the defence resource

Source: Own elaboration

The next phase of this stage is the selection of a tool for a direct evaluation of contractors/suppliers offering defence resources, under the particular component programmes (Cf.: Porter, 1998, pp. 108-127). Among methods applied in the field of quality management, Romuald Kolman's cost-qualitative analysis (Kolman, 2013, pp. 402-407) can be taken into consideration for evaluating the contractors/suppliers. The resources that are offered by the contractors/suppliers are evaluated in

two aspects. The first one refers to quality. Its value results from four determinants defined for the process of acquiring defence resources. Each determinant includes three diagnostic features (Fig. 15). The above-mentioned determinants refer comprehensively to the question of the relevance of acquiring defence resources and providing the operational continuity of their use, with the consideration of the cost-effect relationship criterion.

Another aspect refers to the total costs of acquiring a resource under a component programme. This value refers not only to the price of purchasing defence resources but also to the capital expenditure related to their acquisition and implementation and also to the total costs related to the use of the resources that are estimated in a specified time period. (e.g.: 10-15 years). Fig. 16 presents a scheme of the analysis (Cf.: Van der Last et al., 2002).

The cost-qualitative analysis makes it possible to select a preferable contractor / supplier, with the consideration of quality and economic factors. In the analysis, a negative correlation between costs and the contractor's / supplier's position on the market is to be observed.

The evaluation of the contractors/suppliers is provided with the use of the following:

- a decision – making rate for the qualitative preference (determinants of acquiring a defence resource);
- a decision – making rate for the economic preference (total costs of acquiring a defence resource);
- an average decision-making rate that takes both the above-mentioned rates equally into consideration.

Depending on the preferences presented by the buyer of defence resources, the rate indicated by the buyer determines the decision about selecting the contractor / supplier. The value of the respective rate defines the position of the contractor / supplier in the ranking.

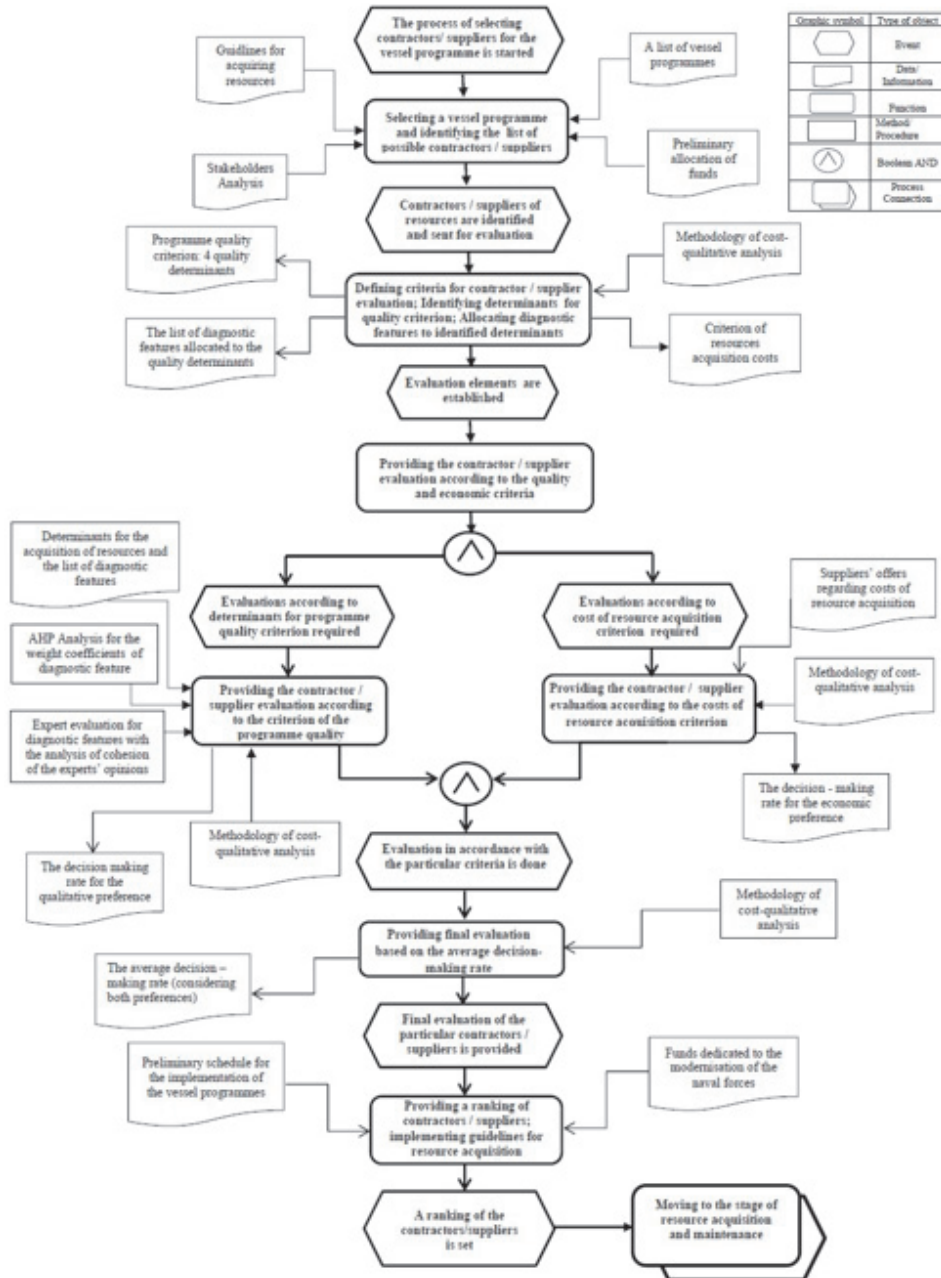


Fig. 16. The cost-qualitative analysis

Source: Own elaboration

## **Acquisition and maintenance of resources**

The last stage of managing the modernisation programme includes a number of tasks that determine the effectiveness and efficiency of actions directly related to the acquisition and use of defence resources. The schedule for the implementation of the component programmes and the allocation of funds to the respective programmes should be executed on the basis of the result of the component programme ranking process, the task – capability analysis and the cost – quantitative analysis performed for the vessel programmes. In order to meet the programme schedule, the budget requirements and the expectations of the national economy, at this stage it is necessary to pay attention to the following:

- proper functioning of units responsible for technical modernisation and management staff that implement the particular tasks under the programme;
- verification of the procedures through periodic measurement of effectiveness and efficiency of operations regarding the progress of the programme;
- periodic reviews of the programmes (changing priorities, schedules), evaluating the progress of the component programmes implementation, implementing changes that result from the budgeting process (maintaining the continuity of the programme) (see: Vance, Hinkle, 2011);
- managing the resources during the entire cycle of their service life (see: NATO, 2022), generational replacement of the systems, accurate identification of resources that should undergo modernisation and the scope of that modernisation (see: Fig. 17);
- maintaining the strategic national and international alliances in the public and private sectors of the shipbuilding and defence industries;
- funding R&D (Research and Development), including prototypes; integrating and coordinating activities undertaken in the field of R&D;
- providing efficient management to marketing and commercial activities undertaken in the field of purchase and distribution of defence assets;
- defining the division of competences and identifying the complementarity of production entities (public, commercial and foreign entities).

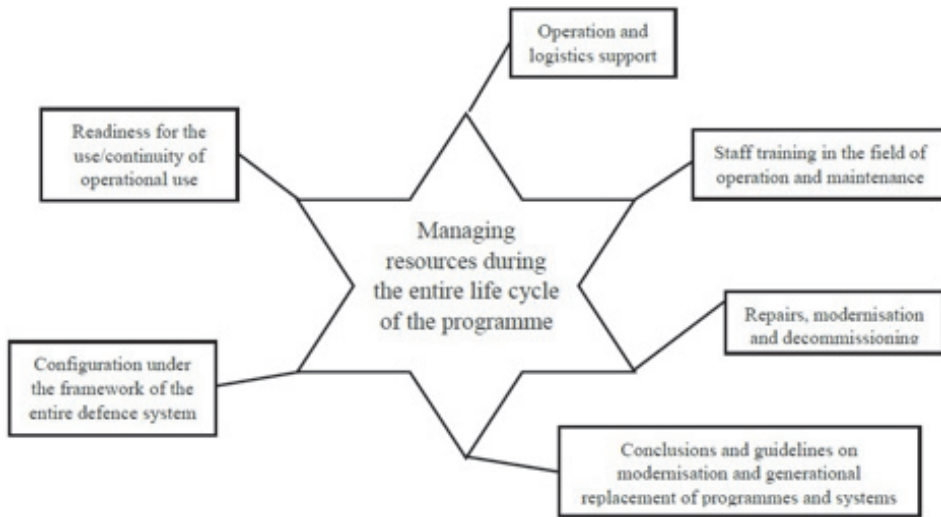


Fig. 17. Management of resources during their entire life cycle

Source: Own elaboration

## Conclusions

While comparing the solution discussed in this study to the current modernisation work under implementation, it is possible to define the following:

- leading positions in the programme of modernising the naval forces, in accordance with the Matrix Diagram and the task-capability analysis, namely: *Multi-Role Ship*, *Mine Warfare Naval Unit* and *SIGINT Vessel* correspond to the following component programmes that are currently being implemented in Poland, respectively: *Swordfish*, *Cormorant* and *Dolphin*;
- the latest information provided by the Polish MOD indicates an intention of continuing the programme dedicated to the development of the Polish Naval Missile Regiment which is analogous to the *Horizon* programme;
- purchasing the AW101 helicopters in their ASW/S&R versions partially corresponds to the *Dragonfly* programme;
- other component programmes are either unprocessed or postponed;
- the areas that require more involvement into the process of modernising the naval forces mainly include the extension of the fleet basing system (*Third Gate*), implementation of unmanned sea platforms in order to develop operational capabilities, such as *Inform / Intelligence* and *Protect / Force*

*Protection & Security (Dogfish)* and also protection of the critical maritime infrastructure and anti-terrorist protection (*Oyster and Krill*).

The considerations presented in the paper lead to the following conclusions:

- taking into account the limitation assumed in the Introduction, the sequence of actions suggested in the study indicates numerous opportunities to use tools and methods typical of management and quality sciences for a planning process in question;
- the research process indicates the functionality and the interdisciplinary character of these methods. Their application is of universal nature and it can streamline the processes of planning and managing problems in the field of the naval forces development;
- application of the solution discussed in the article is particularly relevant at the stage of establishing the outline of the programme (strategic analysis and matrix diagram) and building operational capabilities at the component programme level (task – capability analysis). It allows the naval forces, as a whole, to meet the NATO and national requirements in this respect;
- the suggested set of methods applied in the research process is, however, not free from some shortcomings. Therefore, it is important to find a proper and competent panel of experts to represent a spectrum of logistic and operational experience and knowledge at various levels of command;
- another key problem is an access to sensitive data. The application of the above-mentioned methods is based on some assumptions that have been accepted during the research, however, the access to the actual data, including sensitive ones, should allow the approved programmes to be fully justified in terms of their operational and economic aspects (supplier/contractor selection process), according to the cost-effect relationship (cost – qualitative analysis).

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