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TRANSFORMATION OF SOFT AND HARD SKILLS OF SHIPPING SPECIALISTS AND IMPROVEMENT OF THE EDUCATIONAL PROCESS

Purpose. To establish the prerequisites and justify the directions of change in the soft and hard skills of human resources of the global maritime industry and to identify the current tasks of forming the skills of Ukrainian seafarers.

Methodology. The data analysis method indicated that Ukrainian seafarers form a significant share of the command staff of the merchant fleets of the EU. Logical analysis has shown that this not only demonstrates the success of Ukrainian maritime education, but is also a factor in the country's loss of human capital. The qualitative analysis method confirmed the break in the trend of diversification of work functions and competencies of seafarers (WFCS). The comparative analysis method allowed identifying the features of the formation of skills of Ukrainian seafarers

Findings. The need to take into account the rate of change in seafarers' skills and the need to coordinate it with the rate of change of other influencing factors is indicated. The factors that form the differences in the rate of change in the competencies of seafarers of the Ukrainian and world merchant fleets are indicated. The trend of diversification WFCS of seafarers is indicated. The high level of adaptability of personnel training in the Ukrainian system of higher maritime education and its impact on the provision of personnel for the Ukrainian and world merchant fleets is indicated.

Originality. The competence gap in the Ukrainian and global maritime industries and the trend of this gap widening have been identified. It has been proven that this creates a permanent loss of human capital by the country on a significant scale.

Practical value. The features of the formation of the skills of Ukrainian seafarers and the challenges they form for the country's fleet are indicated, which will allow the introduction of measures to neutralize negative impacts.

Keywords: *human resources, human capital, maritime industry, shipping, soft and hard skills*

Introduction. The global maritime industry is on the verge of implementing Industry 4.0 technologies. The pace of technology renewal on merchant ships is increasing year by year. This is influenced not only by the acceleration of scientific progress and, accordingly, the introduction of innovations, but also by economic, environmental and other factors. In particular, stricter environmental requirements and the increase in fuel costs accelerate the introduction of not only fundamentally new ship power plants, but also computerized systems for efficient fuel use, new principles for optimizing ship speed. Accordingly, this requires new crew competencies, which, in turn, requires us to take care of ensuring the transition to a new stage of shipping with human resources with the appropriate level of human capital quality today. Since the skills (soft & hard skills) of Industry 4.0 are significantly different from those in demand at this stage of development, this requires not only a review of the set of these skills and the identification of future demands of the seafarers' labor market, but also a radical change in training, including adaptation to the new requirements of the composition of teachers of maritime education institutions.

With the increase in the level of responsibility in ship maintenance, the requirements for seafarers to acquire non-specialized skills, such as teamwork, leadership qualities, the ability to analytically assess non-standard situations, stress resistance, cognitive interaction with modern technologies, etc., are increasing. This has even led to the emergence not only in scientific literature but also in the practice of crewing companies of the concept of "higher-order thinking skills".

Significant rates of technology renewal must be ensured by the corresponding rates of renewal of approaches in the training of personnel in the maritime industry. Since the process of renewal of the merchant fleet is uneven, the need for a hybrid approach to training seafarers is often indicated, which should combine traditional and new competencies. But this approach does not solve the problem, but creates a new one – in determining both the criterion of the balance of the specified competencies, and in determining the rate of change of this limit, since this limit is not fixed in time.

The shortage of qualified personnel in the global labor market in the maritime industry, primarily personnel with command licenses, creates new prospects for countries that supply seafarers. At the same time, merchant fleets of different countries have their own pace of implementing Industry 4.0 technologies. This will affect the acquisition of relevant skills by seafarers of national

fleets and needs to be taken into account when implementing the strategy for the formation of human capital of the maritime industry, in particular, in the direction of training and retraining of qualified personnel by national educational institutions.

Literature review. Scientists are closely studying the impact of technology on the human capital of the shipping industry. For example, in the article by Ichimura, et al. [1] it is indicated that the multifaceted impact of digital technologies is radically changing the structure of operations in the maritime industry. This not only changes the management of technological equipment, but also leads to changes in the challenges in shipping, which requires changes in human resource strategies both at the international and national levels, as well as at the level of shipping companies [1]. It is noted that these strategies will depend on how the process of digitalization of the maritime industry will proceed in the future: the widespread use of computerized systems ("smart ship"), or the management of a ship without a crew or with a minimal team on board ("autonomous ship"). This will require a corresponding change in personnel competencies.

At the same time, Pipchenko and Kovtunenko [2] indicate an increase in the level of unmet demand in the industry's labor market and, as a reason for this, note the rapid digitalization of the industry. This, in our opinion, creates a multiplier effect on the change in seafarers' competencies. Therefore, there are requirements for changing the minimum skills of seafarers under the STCW (Standards of Training, Certification and Watchkeeping) convention [3].

Zayed, et al. note that working conditions in a new technological environment require not only changes in highly specialized skills of seafarers [3] but also changes in the profile of their competencies [4]. Only some competencies will be relevant in the future, and the need for other components of their traditional set will be leveled due to automation and computerization of vessels.

At the same time, even introducing a "conceptual model of competencies" of automated vessels [5], scientists bypass not only the need for skills in using integrated shore support systems and on-board operation of vessels, but also the need for remote validation of malfunctions on modern vessels. The specified competencies, in turn, determine the need for practical skills to eliminate them on board the vessel directly during the voyage, which, under conditions of minimizing crews or their absence at all, is an extremely difficult task and, accordingly, requires an appropriate skill profile.

A significant part of scientists see the main problem of the lack of human resources and the deterioration of the quality of human capital as the gap between the theoretical training of seafarers and the practice of the maritime industry [6]. At the same time, some scientists see the strategy of human resources management in the maritime industry as international management [7], which, in our opinion, is made impossible by the presence of corporate and national interests in the maritime industry.

In the conditions of technological renewal of shipping, a hybrid model of seafarers' competencies is proposed, which consists in forming a balance of traditional and new competencies [8]. But with the rapid renewal of shipping technologies, the problem lies in both the uncertainty of the boundary of this balance and the dynamic change of this boundary, which is often overlooked by scientists [8].

At the same time, the technology-oriented approach to acquiring competencies is not the only one. In particular, a career-oriented approach is proposed, which determines the acquisition of competencies by seafarers in view of the prospects for career growth [9]. The incentive to acquire a promising career is significant given the significant difference in the socio-economic development of the countries under whose flags the ships sail.

Also, scientific research offers different approaches to the stratification of competencies. Unfortunately, not all approaches can be agreed with. Thus, in the Karatuğ approach [10] there are individual skills that overlap with cognitive skills and, at the same time, an important group of operational competencies is not singled out.

Scientists note that the wrong choice by educational institutions of the set of promising competencies for seafarers can lead to a crisis in the industry. Thus, today more than 40 % of cadets indicate a lack of specialized knowledge regarding autonomous navigation [11].

At the same time, even studies of the interaction of the crew and technical systems (the so-called "human-machine" approach) indicate the need for sailors to acquire not only highly specialized technical skills, but also soft skills, which requires improving the approaches of traditional Crew Resource Management (CRM) [12]. But this is still hindered by the existing trend of increasing mismatch between sailors' training and the needs of the labor market.

This trend is also exacerbated by the difference in approaches to professional and university education of naval personnel, since the former is primarily aimed at functional competencies, and the latter at social and meta-competences [13]. At the same time, the steady automation of routine crew functions increases the importance of cognitive skills of seafarers even in non-command positions, which is to some extent neglected by both professional and university education [13]. The need for cognitive skills to solve problems in non-standard situations will deepen due to the growth of environmental requirements and requirements for maritime safety of both crews and vessels, especially in conditions of increasing risks. This will also determine the importance of organizational culture skills [14].

Strengthening the requirements for professional competencies, increasing the level of responsibility of the command staff in conditions of a significant increase in the technological and technical complexity of ship systems forms new requirements for the psychological resilience of seafarers. This affects the level of motivation of seafarers and, accordingly, reduces the supply on the industry labor market. The importance of these competencies is becoming so significant that the scientific literature has begun to use the concept of "psychological capital" as a component of human capital in the maritime industry [15]. This, accordingly, requires a change in the set of soft skills of seafarers.

The problems indicated in the literature review are discussed in detail in the presented article. While scientists have carefully considered various aspects of the issues of the transition of the global maritime industry to

a new stage of shipping, insufficient attention has been paid to the formation of a gap between the traditional competencies of the industry, which remain in demand, and the latest skills and the pace of their renewal, which differ for the merchant fleets of different countries. Different rates of implementation of new technologies also determine different strategies for providing global and national labor markets with human resources. This, accordingly, requires additional research.

The purpose of the article is to establish the prerequisites and justify the directions of change in the soft and hard skills of human resources of the global maritime industry and to identify the current tasks of forming the skills of Ukrainian seafarers. The tasks are as follows: to establish the differences in the competencies of seafarers of the national merchant fleet and the merchant fleet of the European Union countries. To develop the reasons for these differences. To determine the priority competencies necessary for Ukrainian seafarers, which must be taken into account when designing the training process.

Methods. The study used general scientific and special methods of scientific knowledge. The application of the data analysis method indicated that Ukrainian sailors form a significant share of the command staff of merchant fleets under the flags of EU countries. The logical analysis method indicated that this not only indicates the success of Ukrainian maritime education, but is also a factor in the loss of human capital by the country. The qualitative analysis method confirmed the reversal of the trend of diversification of work functions and, accordingly, the competencies of sailors.

The comparative analysis method allowed us to identify the features of the formation of skills of Ukrainian sailors and to establish differences in the competencies of sailors of the national merchant fleet and the merchant fleet of the European Union countries. The analytical method indicated a trend of increasing the average service life of Ukrainian vessels and allowed us to establish that the rate of its change is significantly higher than the corresponding indicator for the world fleet. Over time, this will lead to an increase in the gap in the sets of competencies for the Ukrainian and world merchant fleets. The system analysis method indicated that this would pose a threat not only to the manpower supply of national fleets of countries with weak economies, but also to the manpower supply of the global maritime industry, as it reduces the level of versatility of seafarers' skills.

Results. The introduction of new technologies in the maritime industry is a prerequisite for changing not only the production functions of crew members, but also a radical change in the ways in which they perform their operational tasks. Thus, with the latest trends in ship automation, this will lead to the need to revise, even in regulatory terms, the concept of "ship crew". This requires changing the skills and competencies of personnel.

In this study, the definition of "skills" is used to formalize specific professional abilities that are acquired in the training process and are used to perform production tasks. The definition of "competence" is aimed at formalizing attributes that integrate groups of skills and the acquisition of which is based not only on knowledge, but also on the personal qualities of the seafarer and his behavioral characteristics. Competencies are mainly aimed at fulfilling a significant role or solving a non-standard problem.

The established set of competencies and skills in maritime affairs is specified not only in the abovementioned STCW convention, which requires changes in connection with the change in technologies in shipping. Competencies and skills defined in international documents (conventions) will remain relevant for the management of modern vessels, primarily in the rules for preventing collisions between vessels at sea (COLREG), the features of the functioning of radar stations and computerized chart display information (ECDIS). The fundamental skills specified in these conventions are mandatory even in high-tech shipping, as they form the prerequisites for safety at sea and the efficiency of vessel management. At the same time, the needs for updating seafarers' competencies are changing at a much faster pace than changes are being made to the specified international documents. For example, Article 3 of the STCW Convention states that the requirements of the specified document apply exclusively to vessels with crews on board. That is, for land operators of highly automated vessels, a set of competencies under the STCW Convention is not established. At the same time, the concept of "seafarer" begins to be identified with the concept of "sea vessel operator", who must assess the situation on board, predict its consequences and promptly make decisions in permanent cognitive interaction with modern equipment and integrated ship systems, artificial intelligence, electronic information resources and crews (operators) of other vessels [16].

Also, international documents still do not use an assessment of the rate of change in seafarers' skills, which, accordingly, should affect changes in the educational process of future personnel in the maritime industry. And this is important in conditions when the training time becomes longer than the period of dynamic changes in competencies.

It is also important not only to take into account the rate of change in seafarers' skills, but also to coordinate it with the rate of change in other influencing factors.

It is often stated in scientific literature that only the technical skills required by a seafarer are determined by the level of technology. At the same time, non-technical, "soft" skills are also changing with the introduction of innovative solutions of Industry 4.0 in shipping. Technologies determine new requirements for the social and personal skills of seafarers.

It is proposed to stratify the latest competencies into the following categories:

1. Technical and technological.
2. Aimed at performing functional operations.
3. Cognitive competence.
4. Competencies in interpersonal communication.

The indicated competencies require appropriate skills of the command staff of ship crews. According to the first category: in cybersecurity, analytics of large data sets, cloud technologies, architecture of automated ship systems, features of their programming and operation; professional engineering skills in the latest technology, primarily in electronic and computer engineering, the use of integrated shore support systems and onboard operation of vessels, the use of digital twins to optimize operations and vessel routes under the influence of a significant number of factors.

According to the second category: skills in maintenance procedures for the latest vessel systems and their validation, skills in analytical assessment of production operations, permanent control of technological systems and prompt response to their unusual operating modes, the ability to relevantly assess the risks of operations even in unusual conditions of production activities; remote operation of automated vessels, primarily remote maneuvering skills, crisis management; safety management skills, implementation of safety protocols on the latest vessels; skills in conducting marine examinations for automated vessels, management of automated vessels in a dense flow of maritime transport.

According to the third category: stress resistance, cognitive interaction with modern technologies; the ability to learn continuously, critical thinking skills, sound and operational decision-making, relevant assessment of the levels of autonomy of different vessels and understanding the impact of this factor on the characteristics of decision-making.

According to the fourth category: communicative, adaptive skills, in particular, to the cultural differences of crew members [17] teamwork skills, leadership skills, etc.

In the context of changing environmental standards and, accordingly, increasing the level of financial sanctions for their non-compliance, new operational restrictions on shipping appear, sophisticated hybrid and zero-emission equipment is installed on ships, new protocols are introduced to reduce environmental impact. This leads to the emergence of a new subcategory of transversal competencies, which should cover all the above categories. For example, limiting sulfur emissions requires optimizing fuel consumption, in particular limiting the speed of the ship, which in turn requires skills in optimizing the operation of gas scrubbers from the power plant under their dynamic load, competencies in coordinating logistics chains and, accordingly, skills in coordinating all subsequent elements of the supply chain in which maritime cargo transportation is only one of the components. Ukraine in the current conditions cannot exclude the need to provide personnel for both merchant fleets that use cutting-edge technologies and the national fleet. This determines the specific skills of Ukrainian seafarers and requires coordination and balancing of higher education and teaching in this area of activity. This should be accompanied by an adaptive institutional strategy to support the integration of sustainable development at the international level and to promote the improvement of the personnel composition of the national merchant fleet.

The complexity of performing production functions in the context of a radical technological renewal of the fleet, in the context of increasing automation of vessels and even a tendency towards their autonomy increases the level of responsibility and requirements for human resources, expanding responsibility for the safety of the vessel and the crew. Automation creates the prerequisites for changing the soft and hard skills of human resources of the global maritime industry, causes a decrease in the involvement of low-skilled personnel and, accordingly, an increase in the need for personnel capable of performing production functions with a high level of complexity. Crew members must be prepared to perform more strategic, coordination and creative functions. In general, this also leads to increased demands on stress resistance of both ship crews and port infrastructure workers. This requires a permanent reassessment of human capital both for the development of its potential and for receiving adequate payment for risky and responsible work [18].

Since the differentiation of competencies often occurs not even within the national affiliation of ships, but within individual companies, this requires the definition of corporate human resources management strategies. These strategies are no longer limited to the traditional areas of ensuring the hiring of qualified labor, selection, and crew recruitment. Today, there is a need for strategic formation of human capital of maritime transport companies, which should be aimed at increasing both individual personnel efficiency and the productivity of ship support teams (on board and in land infrastructure), stimulating the acquisition of knowledge, skills, and competencies for the formation of career growth prospects. At the same time, narrowing the acquisition of competencies only to the corporate level may lead to a decrease in the efficiency of providing the global maritime industry with human capital, the consequences of which are already felt today in the shortage of qualified personnel in the maritime industry.

In general, the following main areas of human capital development can be distinguished: personal improvement of seafarers and their acquisition of the appropriate set of competencies; development of ship crews while forming the appropriate level of cooperation; organizational support by improving production processes.

In previous periods of time, there was a tendency to increase the number of crew members of merchant fleet vessels due to the expansion of technological equipment. This, accordingly, led to the diversification of their work functions, which also required a significant diversification of their competencies. Given the above-mentioned prospect of the spread of remotely controlled, highly autonomous vessels, a tendency is determined to reduce the number of sailors on board to a minimum or even the absence of a crew. This leads, on the one hand, to the need for crew members to acquire not only new technical and technological, but also new 'soft" skills. On the other hand, minimizing the crew requires its members to have universal knowledge, which is due to the requirement to combine professions, since this increases the survivability of vessels. Lloyd's Register has stated that technological modernization creates an "irony of automation" in which the widespread introduction of technologies increases the need for highly skilled personnel to use them [1].

From a broader perspective, the transition to the next generation of ships should be expected to create a significant professional gap in the competencies of crews servicing ships with a significant service life and the newest ships. The problem is exacerbated by the fact that for some countries the pace of fleet renewal does not match the pace of technology renewal in the global maritime industry.

The gap in seafarers' competencies will deepen over time as the pace of technological progress will accelerate the process of "moral obsolescence" of ships and, accordingly, provoke an increase in the share of obsolete

ships in the merchant fleets of countries with weak economies.

Given the service life of ships by national fleets - twenty years or more, during this period crews suitable for work on such ships will be in demand. Since it is difficult to imagine specialists who are able to work with such technologically different vessels, this will obviously lead to the formation of radically different requirements for seafarers' competencies. This also determines the current trend of changing the personnel strategy of shipping companies in developed countries – moving away from the crewing practice of hiring seafarers for one or two voyages and ensuring the sustainable involvement of highly qualified specialists.

The difference in the requirements for competencies and the conditions for their dynamic change will require retraining of human resources on a significant scale, which will require the expansion of basic educational institutions and changes in the competencies of teachers. This accordingly increases the responsibility of maritime education and training institutions (Maritime Education and Training Institutes, abbreviated as METs) not only in acquiring the appropriate level of quality for human resources, but also for the future of the industry. This is due to the fact that METs approaches shape the pace of technological development of the maritime industry, its compliance with the requirements of Industry 4.0.

This also increases the responsibility of the bodies issuing Certificates of Competence or Certificates of Conformity (SoS), as they must require and monitor their replacement. At the same time, the state of the economies of some countries, the level of implementation of new technologies on the vessels of their merchant fleets form certain national characteristics.

Thus, in Ukraine, according to ChartingTheGlobe [19], there is a tendency to increase the average service life of vessels (Table). The acquisition of new vessels by the Ukrainian merchant fleet has decreased.

A comparison of the average service life of Ukrainian vessels and the service life of vessels in the world fleet according to UNCTAD's "Review of Maritime Transport" [20] indicates significant differences in both the value of this indicator and the rate of its change (Table).

Table

Comparison of the average service life of Ukrainian merchant ships and ships of the world merchant fleet

Years	World Merchant Fleet, years	Merchant fleet of Ukraine, years
2015	19.4	32.1
2016	20.1	33.2
2017	20.2	34.1
2018	20.3	35.3
2019	20.5	36.2
2020	21.0	37.3
2021	21.5	38.4
2022	21.9	39.2
2023	22.1	40.3
2024	22.3	41.4

This largely determines the peculiarities of the staffing strategy of Ukrainian shipping companies and the requirements for seafarers to acquire the necessary competencies, since an increase in the average service life of vessels increases the risk of a ship's accident, which reduces the possibility of minimizing the crew. This factor, accordingly, forms another feature of the personnel composition of the Ukrainian merchant fleet – the lack of prerequisites for the integration of professional functions. This also leads to a decrease in motivation in acquiring new skills by seafarers of the Ukrainian fleet.

At the same time, according to the European Maritime Safety Agency for 2024 [21], there is a trend towards a significant level of use of highly qualified Ukrainian seafarers on ships under the flags of other countries, including on high-tech ships under the flags of the European Union countries.

As can be seen from Fig. 1, the number of command personnel with Ukrainian citizenship on EU ships is significantly higher than this indicator for citizens of the European Union countries. The significance of this fact is enhanced by the fact that shipowners of the EU countries control over 40 % of the tonnage of the world fleet [22], that is, they have a significant influence on the formation of trends in the change of competencies of the world merchant fleet. When analyzing and processing the data presented in Fig. 1, information from the European Maritime Safety Agency [23] was used.

This also indicates a high level of adaptability of personnel training in the Ukrainian system of higher maritime education and a high motivation of Ukrainian naval cadets to obtain a set of competencies necessary for work primarily on modern ships of the European Union countries. But, since seafarers study in different segments of maritime education institutions: vocational and technical institutions, technical colleges, universities, this contributes to an imbalance in the sets of competencies.

A restraining factor in changes in maritime education not only in Ukraine, but also in other countries is the conservative nature of the educational sector as a whole, which causes its slow response to changes.

This slowdown is based on the fact that traditional maritime education provided the appropriate level of training for seafarers in previous periods and therefore often does not feel the need for changes.

A tool for overcoming this trend is the activities of the International Association of Maritime Universities (IAMU), which unites 35 universities in different countries of the world, excluding the World Maritime University and the Nippon Foundation. IAMU initiatives are aimed at shaping a rapid change in the educational process. IAMU specialists analyze the knowledge and skills needed by seafarers in the following periods of time and, for their acquisition, develop training programs (General Mind-Up Programs, abbreviated GMP) [24]. But the problem is that IAMU recommendations are not mandatory for its members and, first of all, must be coordinated with national institutional structures. This causes significant differences in the sets of competencies provided in national universities.

The indicated differences in sets of competencies are also due to the fact that the pace of technological renewal of national fleets will depend on the economic

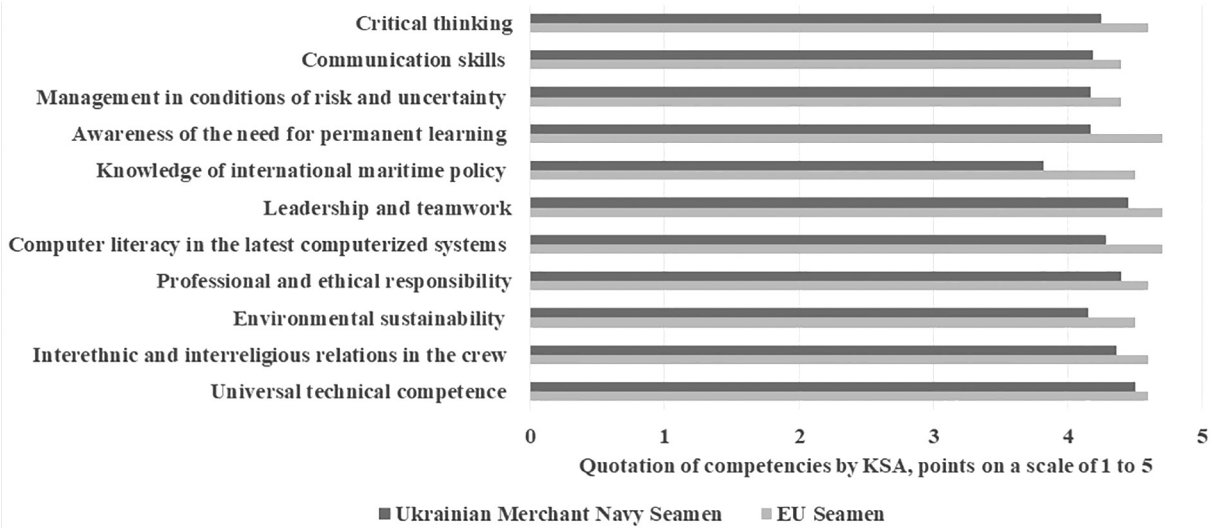

Fig. 1. Number of crew members by nationality on EU vessels, persons

and demographic state of the countries under whose flags merchant ships sail, other differences in the development of countries and, in particular, their social advantages (Fig. 1).

This will not only affect the formation of differences in the profiles of seafarers' competences and the levels of their qualifications required by different national fleets, but also cause a competence gap in the maritime communities of individual countries, since part of the industry's human resources will be directed to meeting the needs of national shipping, and the other part – to meeting the needs of the global maritime industry. This is typical even for the leading countries in the formation of command staff on ships of the EU countries – the Philippines and Ukraine (Fig. 1). But this process is not limited to these countries – this is how the industry's human resources of Vietnam, Nigeria and other developing countries are also advancing. The gap in competences, national features of the fleets' personnel should be reflected in the Body of Knowledge of Seafarers (BoK). This gap is also significant for seafarers' understanding of their own career growth, that is, it determines the choice of further personal and professional growth.

At the same time, the focus of higher maritime education in Ukraine on training qualified personnel to work on the latest vessels creates the prerequisites for the loss of human capital in this industry, and the most promising personnel aged 25–35 [21].

This is confirmed by the current trend of rapid growth from year to year in the number of command personnel from Ukraine (one and a half times from 2017 to 2024) on vessels under the flags of EU countries with confirmation of their qualification level by SoS certificates of conformity. As a result, the formation of a gap in competencies for the national fleet and shipping companies of developed countries reduces the importance of the contribution of higher maritime education institutions to providing personnel for the fleet under the flag of Ukraine. The tendency to increase this gap will increase the gap in personnel training. This leads not only to an increase in the level of uncertainty in the development of the national fleet, but is also a factor in its destabilization.

The use by individual shipowners of vessels with a significant service life and, accordingly, with a significant decrease in their residual value, creates negative prerequisites for strategies aimed at the abandonment of both vessels and their crews by the owners in unregulated situations. First of all, this is typical for vessels under "convenient flags", the share of which in the total volume of abandoned vessels is 90 %. There is a tendency to increase the number of abandoned seafarers – in 2024, compared to 2023, by 136 %. In foreign ports, seafarers with primarily a traditional set of competencies and a low qualification level remain without wages. This is a factor in the depreciation of human resources in the maritime industry with established functional skills, which accelerates the stratification of personnel by sets of competencies.

Trends in the renewal of the Ukrainian merchant fleet in the post-war period will be restrained due to the action of a group of factors. First of all, this process will be influenced by significant financial losses of Ukrainian shipping companies due to the blockade of Ukrainian ports, failure to resolve problematic issues of past periods. A significant factor restraining the renewal of the Ukrainian merchant fleet will be the lack of proper coastal infrastructure: providing vessels with environmentally friendly fuels, the inability of most Ukrainian ports to receive large deadweight vessels, the inability to ensure modern logistics processes and effective coordination of related modes of transport, etc. This will primarily lead to the use of outdated ships, with which Ukrainian shipping companies will replenish their fleet. Already today, there is a tendency for Ukrainian shipping companies to focus their activities on coastal voyages.

Therefore, based on the forecast according to the data on the change in the service life of Ukrainian merchant vessels [19] and vessels of the world fleet [20], in particular presented in Fig. 1 and using forecast data of the International Association of Maritime Universities [25] and assuming that today the competence of Ukrainian seafarers corresponds to the world level (Fig. 1), it is possible to form trend equations and perform their refining linearization.

Trend equation for the forecast of the average service life of Ukrainian vessels

$$y = 1.004x + 31.02.$$

The trend equation for forecasting the average operating life of the international merchant fleet is as follows

$$y = 0.3194x + 19.173.$$

As can be seen from the linearized trend equations, the growth rate of the average service life of Ukrainian vessels is significantly higher than the corresponding indicator for the global fleet, which indicates an increase in the gap in the sets of competencies for them over time.

By comparing the values of the tangents of the angles in the above equations to the time line, respectively, 1.004 and 0.3194, it is possible to introduce changes in the forecast of the competencies of Ukrainian seafarers that will be in demand in 15 years. The results, using the Global Maritime Professional [24] and the International Association of Maritime Universities [25] as reference data, are presented in Fig. 2.

The set of competencies for the Ukrainian merchant fleet during this period will require practically no changes, since no significant reduction in the average service life of merchant vessels is expected. At the same time, the set of competencies for international shipping will require improvement even in the range of skills that were in demand in 2019. This will be facilitated primarily by changes in environmental standards and the need to save fuel.

In this case, the regulatory pressure of international organizations regarding competency standards and even the pressure of competitors are weakened for the formation of the latest skills of Ukrainian seafarers. This will form a certain separation of the national maritime cluster from the global maritime industry.

Therefore, when designing the educational process, Ukrainian higher education institutions should introduce specialization for cadets to acquire skills in cutting-edge technologies.

At the same time, the trend towards crew optimization by shipping companies will require the expansion of meta-competences, i.e., not only the differentiation of Ukrainian seafarers' competencies, but also their integration at the individual level. First of all, this concerns functional skills. This will cause a lack of formal education and will create a need for permanent training of seafarers.

An important feature for Ukrainian seafarers in the tactics of their employment by crewing companies, aimed at a constant change of vessels, is the increase in the volume of transversal skills in the set of their competencies, which expands their demand.

This requires periodic shore-based retraining of seafarers. According to the requirements of the International Maritime Organization (IMO), a seafarer must undergo retraining in his country, since maritime educational institutions must be approved by the state where the certificate holder comes from. Shipowners are reluctant to make changes in the employment of seafarers and, even more so, to finance their retraining. Therefore, the costs of retraining are mainly a problem for the seafarers themselves. In conditions of economic hardship, such costs are not always affordable for the families of Ukrainian seafarers. This narrows the possibility of Ukrainian seafarers acquiring new competencies and increases the requirements for mobility in maritime education in Ukraine.

For the global development of the fleet, there is a need to coordinate the pace of acquiring competencies by seafarers and technological improvement of ships.

Although scientists point to the formation of a significant mismatch between the competencies required by the modern maritime industry and the existing skill profiles of seafarers [8], this dichotomy creates the prerequisites for the separation of national fleets from the global trend of development of the world merchant fleet. This is due to the fact that leveling the gap requires not only a change in the composition of the national fleet, improvement of coastal infrastructure, but also a rational restructuring of maritime education. This requires significant financial resources and the implementation of a national strategy aimed at shifting the balance of traditional and new competencies of seafarers in a rational and dynamic manner.

Conclusions. It is indicated that it is necessary to take into account the rate of change in soft and hard skills of seafarers, which, accordingly, affects changes in the educational process. And this is important in conditions when the training time becomes longer than the period of dynamic changes in competencies. It is indicated that the rate of change in soft and hard skills depends on the rate of fleet renewal. A tendency to accelerate the "mor-

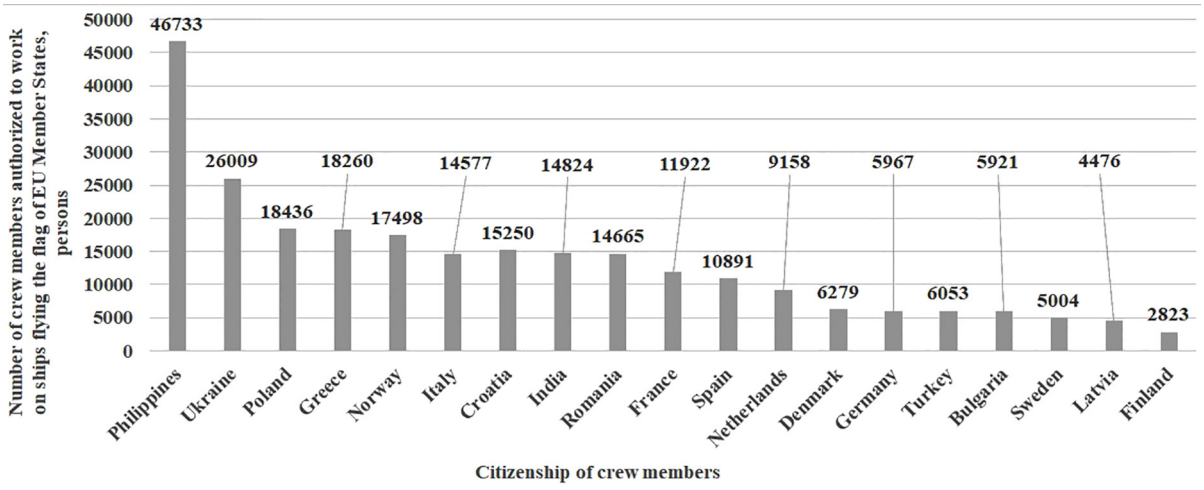

Fig. 2. Demanded competence of Ukrainian seafarers and seafarers of merchant fleets of EU countries over 15 years

al" aging of ships is forming. It is indicated that countries with weak economies are not able to renew the fleet at the rate of developed countries. This not only causes a gap in the competencies of crews for ships under the flags of developed countries and countries with weak economies, but also forms a trend of increasing this gap over time. Differences in the rates of change in soft and hard skills of seafarers in developed and developing countries will lead to de-universalization of seafarers' employment, which will pose a threat to the personnel supply of the world merchant fleet. It is indicated that the trend of diversification of work functions and, accordingly, seafarers' competencies is breaking. Automation of vessels and, accordingly, minimization of their crews causes a reverse process of integration of competencies and causes a need for new skills. This will increase both the cognitive gap between sailors and the gap in technical competencies for servicing morally obsolete and modern vessels.

The specified gap in competencies in the personnel communities of individual countries will also lead to the stratification of human resources in their maritime industry, since one part of the human resource will be directed to meeting the needs of national shipping and the other part – to meeting the needs of shipping of developed countries, which will shape the trend of development of the global maritime industry. This will accelerate the outflow of capable young people from the national fleets of countries with weak economies.

The analysis of statistical data indicates a significant share of Ukrainian sailors in the command structure of merchant fleets under the flags of the European Union. The above indicates a high level of adaptability of personnel training in the Ukrainian system of higher maritime education and a high motivation of naval cadets to obtain a set of competencies necessary for work primarily on modern ships of the European Union countries. However, since sailors study in different segments of educational institutions of maritime education: vocational and technical institutions, technical colleges, universities, this contributes to an imbalance in the sets of competencies. It is noted that in the current conditions, Ukraine cannot exclude the need to provide personnel for both merchant fleets that use cutting-edge technologies and the national fleet. The analysis of the growth rate of the average service life of Ukrainian vessels indicated that it is significantly higher than the corresponding indicator for the world fleet. This will lead to an increase in the gap in the sets of soft and hard skills for the national and world fleets over time. This determines the specifics of the skills of Ukrainian sailors and requires coordination and balancing of higher education and teaching in this area of activity. Therefore, Ukrainian higher education institutions face an urgent task regarding the priority competencies required by Ukrainian seafarers, which must be taken into account when designing the educational process. In particular, hard skills regarding "technical competence related to the function on board the vessel" characteristic of the Ukrainian merchant fleet require modification to "universal technical competence". Soft skills regarding interethnic and interreligious relations, environmental sustainability, and critical thinking require significant strengthening for work in the crews of the modern fleet. The above should be accompanied by an adaptive institutional strategy to support the integration of sustainable development at the international level and promote the improvement of the national merchant fleet.

Further research is expected to assess the impact of uncertainty factors on the formation of the personnel strategy of the Ukrainian fleet.

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Трансформація м'яких і твердих навичок фахівців судноплавства й удосконалення освітнього процесу

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Мета. Встановити передумови й обґрунтувати напрями зміни м'яких і твердих навичок людських ресурсів глобальної морської індустрії та виявити актуальні завдання формування навичок українських моряків.

Методика. Метод аналізу даних указав, що українські моряки формують вагому частку командного складу торгових флотів країн ЄС. Метод логічного аналізу вказав, що це не лише свідчить про успіхи української морської освіти, але й є фактором втрати людського капіталу країною. Метод якісного аналізу підтвердив злам тенденції диверсифікації робочих функцій і, відповідно, компетентностей моряків. Метод порівняльного аналізу дозволив виявити особливості формування навичок українських моряків.

Результати. Вказано на необхідність урахування темпу змін навичок моряків і потребу його узгодження із темпами змін інших факторів впливу. Зазначені фактори, що формують розбіжності темпів зміни компетентностей моряків українського та світового торгового флоту. Указано на злам тенденції диверсифікації робочих функцій і навичок моряків. Зазначено високий рівень адаптивності підготовки кадрів в українській системі вищої морської освіти та його вплив на забезпечення кадрами українського й світового торгового флоту.

Наукова новизна. Визначено розрив компетентностей в українській і світовій морських галузях і тенденцію розширення цього розриву. Доведено, що це формує перманентну втрату людського капіталу країною у значних масштабах.

Практична значимість. Вказані особливості формування навичок українських моряків і виклики, які вони формують для флоту країни, що дозволить запровадити заходи нейтралізації негативних впливів.

Ключові слова: *людські ресурси, людський капітал, морська індустрія, судноплавство, м'які й тверді навички*

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