Development of Scientific and Educational System: European Vector – 2024

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CHAPTER 1. MODERN BASICS OF ECONOMICS, MANAGEMENT AND TOURISM

1.1. Private-Public Partnership as a Modern Approach to the Preservation of Cultural Heritage

Ukrainian legislation stipulates that "cultural heritage is protected by law. The state ensures the preservation of historical monuments and other objects of cultural value" (Article 54 of the Constitution of Ukraine). Instead, non-governmental organizations or individuals "assist the bodies of cultural heritage protection in their work on the protection of cultural heritage" (Law of Ukraine "On Protection of Cultural Heritage", 2000). This "top down" approach does not meet the principles of public-private partnership. A viable mechanism for cooperation between the public and private sectors has not been developed either at the level of legislation or in everyday practice. Given the diversity of Ukrainian culture, strategic engagement of local community initiatives is needed, especially in those communities where they have traditionally been ignored. The development of an effective bottom-up approach based on public-private partnerships would better facilitate the integration of local, regional, ethnic and religious diversity into cultural heritage preservation policies. Recognizing and paying attention to the different categories of value of historical and architectural monuments, revealed through the involvement of a wide range of stakeholders, will emphasize the specialness of the place of interest.

Between February 24, 2022, and December 25, 2023, 872 cultural heritage sites in Ukraine were destroyed or damaged. Of these, 120 were monuments of national importance, 682 of local importance, and 70 were newly discovered [7].

After Russia's invasion of Ukraine, UNESCO announced that it was working to mark the country's key historical monuments with the emblem of the 1954 Hague Convention, internationally recognized as protection during armed conflict [7].

An important problem in the field of cultural heritage preservation is the reconciliation of interests related to its protection and interests related to the development of settlements and economic activity, in particular, construction and land use. The legislation in the field of monument protection, in particular, the basic laws “On the Protection of Cultural Heritage” and “On the Protection of Archaeological Heritage,” the European Convention on the Protection of Archaeological Heritage ratified by Ukraine in 2003, and the Convention on the Protection of the Architectural Heritage of Europe ratified in 2006, is intended to create a balance between these interests.

However, in practice, the interests of preserving cultural heritage are often neglected in the interests of developers and other economic entities, and this happens not only by violating or manipulating current legislation, but also by amending it to create restrictions on monument protection and research activities [1].

In our opinion, the preservation of cultural heritage is an important area of the state's humanitarian policy. At the same time, it is the area of cultural activity where the state's involvement is the greatest and its responsibility the highest. Therefore, the

current distribution of cultural heritage protection functions between different executive authorities does not seem justified, since any effective activity requires a single decision-making center, coordination of efforts and control over the consequences of their implementation, as well as a full-fledged management vertical.

It is necessary to create a unified system of cultural heritage protection, namely, to identify a single body in the system of central executive authorities for the formation and implementation of state policy in the field of cultural heritage protection with an appropriate management vertical. The competence of this central executive body and its subordinate bodies of regional, district state administrations and executive bodies of city councils should include not only accounting, licensing and control and supervision functions, but also research, restoration, preservation and use of monuments.

It is necessary to overcome the negative consequences of legislative changes in the field of cultural and archaeological heritage protection, which have unjustifiably limited the powers of cultural heritage protection bodies and the research capabilities of scientists, and endangered heritage sites.

The system of registration of cultural heritage sites is imperfect, as evidenced by the unacceptable slowness of the formation of the State Register of Immovable Monuments of Ukraine and the insufficiency of the information it contains. It is also obvious that without an effective, modern system of accounting for these monuments, there can be no question of effective preservation. The imperfection of the registration of cultural heritage sites hinders their presentation in international information databases and their popularization abroad, which would help to increase the tourism potential of Ukraine.

Thus, the main problem of reconciling the interests of preserving cultural heritage and the interests of economic entities, in particular, construction activities, is not so much the absence or imperfection of documentation that defines the restrictions on such activities in the historical areas of settlements, but the weakness of the current legislation in terms of determining sanctions for violation of the Law "On Protection of Cultural Heritage" and the neglect of the interests of preserving historical and cultural heritage by some representatives of state authorities and local self-government.

The issue of public-private partnership has recently received much attention from such scholars as Antonenko V.S., Antonishyn A.P., Zaburanna L.V., Lyubitseva O.O., Popovych S.I., Tkachenko T.I., O.O. Beidyk, L.D. Bozhko, V.G. Gerasymenko, V.F. Semenov and others. The problem is relevant and needs to be addressed in the context of internal and external challenges.

In the context of the inevitable transfer of monument preservation functions to the local level, with all the aggravating circumstances of the inadequate technical condition of the vast majority of historic buildings, lack of/insufficient funding, lack of administrative units and professional staff, the search for new opportunities and resources for local departments of culture is extremely important. It is non-governmental organizations, the initiation of public-private partnerships, diversification of funding sources, as well as coordination and moderation of processes

to encourage, involve, develop and implement joint actions aimed at preserving cultural heritage that can help solve the problem of "inconvenient" monuments'

In particular, the history of private initiative in preserving the national heritage of the United States is older than the National Park Service (National Park Service is an agency of the U.S. Department of the Interior, an analog of the central executive body that implements state policy in the field of cultural heritage in Ukraine, hereinafter - NPS). Currently, there are more than 160 partner organizations that assist the NPS in preserving national parks. A significant number of national parks operate exclusively through public-private partnerships.

Research and analysis of the United States' experience in sustainable cultural heritage preservation, modified to reflect the Ukrainian context, can serve as a model for an effective program to initiate and support private sector involvement in the preservation of Ukraine's cultural heritage.

Public-private partnerships are a method that has gained popularity over the past few decades and is mainly applied to large infrastructure projects. By definition, it is a contractual agreement between a public authority (at any level) and a private organization through which the skills (technical skills, knowledge) and property (property values) of each participant are shared to provide a service or deliver a facility for the benefit of the community. In addition to allocating resources, each participant shares the risks, rewards, and opportunities in the delivery of the service or project. The widespread use of public-private partnerships requires demonstrating tangible cost-saving and efficiency benefits to government officials and taxpayers (ultimately, all stakeholders).

When applied to the preservation of the cultural heritage of local communities and territories, public-private partnerships can be successful in some circumstances and a real disaster in others, depending on the context. Public-private partnerships can attract private sector funds, create profit opportunities for the private sector, and ease the burden on government agencies. Partnerships between the private and third sectors (community, non-governmental organizations, financially unmotivated groups of people, condominiums, activists, etc.) emerge as a mechanism to achieve the goal of preserving and restoring urban formations and less monumental historical sites.

According to Table 1, the advantages of public-private partnerships include the following aspects.

Table 1 - Advantages of public-private partnerships

Advantages of public-private partnerships:	
- optimal and multidimensional solution of large infrastructure projects;	- fast completion of projects and reduction of delays in deadlines;
- faster and higher return on investment compared to traditional methods through innovative developments and financing approaches;	- analysis of the expected cost of the project's "life" and programming of such project components as operational management and maintenance, their cost and expected cost reduction;

- balanced risks: from the initial stage to determining the feasibility of a particular project;	- Risks are shared between the public and private sectors, which ensures a win-win situation for all parties involved;
- freeing up additional budget funds to finance more important social and economic projects and reduce the budget deficit;	- Adopting and maintaining high quality standards throughout the project's life.

The following elements can form the basis of a successful private-public partnership between local authorities and the community, non-governmental organizations, condominiums, and activists (Table 2).

Table 2 - Success factors of public-private partnerships

№	Success factors
1	Effective methods of identifying the changing needs of each partner in cooperation between local authorities and civil society representatives.
2	A culture of trust and cooperation between community partners (progress moves at the speed of trust).
3	Transparency of the distribution of functions and roles of partners in the implementation of the project in the community.
4	Building sustainable partnerships and openness to communication.
5	The importance of leadership in the community and in project implementation.
6	The ability of each partner to fulfill its obligations.
7	Open access to important information for each partner.
8	Availability of financial and other resources.
9	Compatibility with relevant policy and regulatory requirements.
10	Possibility of wider application, development of skills, formation of a network of partners.

As a result, the following developments can be considered as criteria for a successful private-public partnership in the field of cultural heritage preservation (Table 3).

Table 3 - Criteria for the success of public-private partnerships

No. s/n	Criteria	Explanation
1	Recognition.	Recognizing a historic building as a community asset outside of its official property status.

2	Sustainability	The existence of a sustainable group that initiates the activity, usually from the government,the third sector or the community.
3	Transformation	The existence of a certain catalyst that moves the idea of transformation can come from the private, public, or third sectors.
4	Support from the authorities	Broad support of the project by the local community, which equates the public sector and various political interests.
5	Community support	Continuous support of the public sector that is not directly involved in the project.
6	Diversification of funding sources	Ranging from traditional, private sector, to non-traditional, including government institutions.
7	Flexibility	The commitment of all participants to be as flexible as possible in terms of possible use, funding, timing and interaction until a balanced and acceptable alternative scenario is developed. This requires diplomacy, compromise, and patience, as any project provokes a significant wave of resistance or distrust.

Thus, the application of the public-private partnership mechanism to the preservation of monuments and landmarks has its own specifics. In particular, it is necessary to recognize the full value of the monument and the need to apply the methodology of scientific restoration, to act in accordance with the requirements of monument protection legislation and restoration standards. In this case, the restoration of a single building can be seen as a catalyst for further socio-economic changes and rehabilitation of the historic district. At the same time, the community is a full partner in the relations and processes that determine the state and future fate of the historical heritage. Particular attention should be paid to recording the damage caused by the shelling of civilians and civilian objects in cities and villages, including cultural heritage sites, by Russian troops. To date, it is impossible to fully determine the damage caused, but recording and documenting these crimes will make it possible to assess the damage and seek fair judgments and compensation. Of course, it will be difficult to restore the full greatness of the cultural heritage, but we must do so for the sustainable recovery of Ukraine and for future generations. Public-private partnerships and the involvement of all stakeholders should also be an effective tool.

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1.2. Costs of the Enterprise: Classification, Types and Features of Analysis, Information Support and Impact on Activity

Objectives, main directions and information support of analysis

One of the fundamental objects of economic analysis at the entity level is cost of the enterprise (costs of enterprise activity).

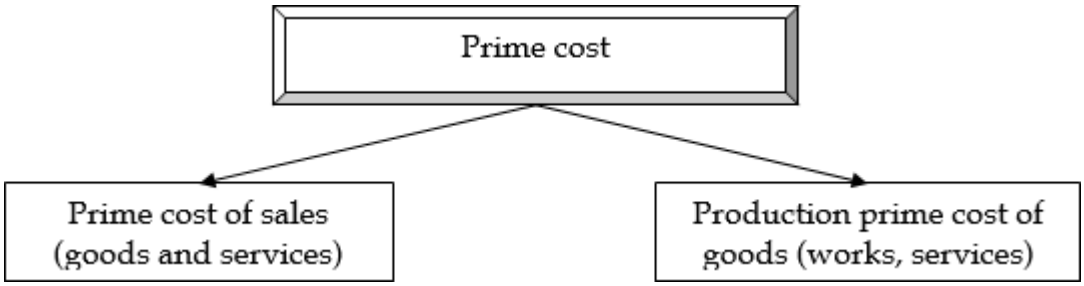
According to economic essence enterprise costs - a set of costs of living and materialized labor for ongoing economic activity of enterprise, and according to the natural-material composition - consumed part of material, labor and financial resources. According to P(S)BC 16, costs of the company - a decrease in assets or increase in liabilities, which reduces the equity capital of the enterprise (excluding capital reduction due to its removal or distribution by owners), if these costs can be measured reliably.

The concept of costs, which according to the terminology of P(S)BC has replaced the concept of "prime cost" is broader. In accounting at the accounts of Class 9 "costs of activity" are accumulated all costs: such as those previously attributed to accounts of prime cost, as well as those which were financed by the profit (maintenance of socio-

cultural establishments and of community purpose ones, development of new techniques and technologies, staff bonuses, etc.).

Prime cost is an assessment of production based on the cost of raw materials, fuel, energy, labor and other resources consumed during its production. Distinguish prime cost of sales (goods and services) and production prime cost of goods (works, services) (Ex.1).

Prime cost of sales of products (goods and services) - is expressed in cash operating costs of enterprise directly related to production and sale of goods, works and services. In the Income Statement in the article "Prime cost of sales of production (goods, works and services)" show the prime cost of sales of production (works, services) or prime cost of goods sold.



Ex.1. The types of prime cost

Prime cost of sales of production (works, services) consists of the production prime cost of products goods (works, services), which was sold during the reporting period, retained permanent general production costs and excessive production costs.

The production prime cost of products (works, services) includes:

- direct material costs;
- direct labor costs;
- other direct costs;
- variable general production and constant distributed general production costs.

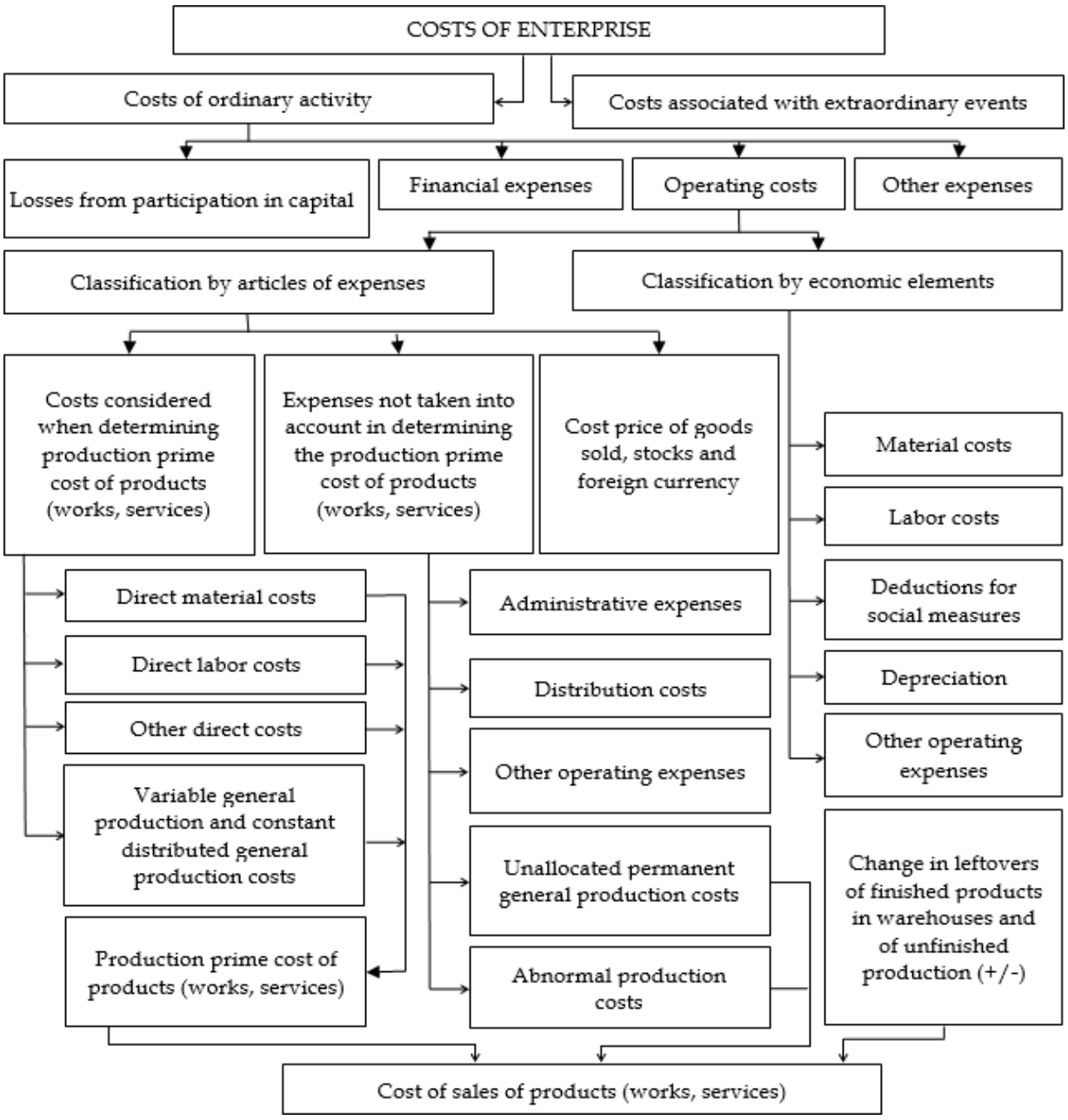
Enterprises engaged in trading activities, to prime cost of sold goods include: the cost of inventories sold, determined by calculation according to P(S)BC 9, "Stocks" and transport and procurement costs that are attributable to the sold goods.

It is necessary to distinguish the concept of "costs" and "costs of the company." The latter concept is wider and besides production costs (they in the terminology P (S) BC correspond to operating costs of enterprise activity) contains costs associated with extraordinary events, financial costs, losses from participation in capital (investment costs) and other costs. Summarized information about costs of the company is reflected in accounts of class 8 "Costs for elements" and Class 9 "Activities costs". Basic requirements for the recognition and assessment of these costs are contained in the P(S)16 "Expenses".

There are different approaches to the classification of costs of the company. The task of cost analysis of the company, which is mainly based on accounting data and statements best reflects the classification, shown in Ex. 2.

The cost of the enterprise is an important factor of price formation for products, the impact on level of effectiveness of production, the definition of the financial results of the company. Systematic cost reduction enables during stable market prices to increase profit per hryvnia of costs, increase competitiveness of production, strengthen the financial state of the company.

The economic analysis of costs of an enterprise is an important tool in their management. It allows to perform focused expenses formation by type, place of origin and carriers under conditions of continuous control over the level of costs and stimulate their decline.



Ex. 2. Classification of costs of the enterprise

The purpose of enterprise cost analysis is to evaluate the level of costs, identify opportunities for rational use of material, labor and financial resources, their effective management.

In an analysis of costs of the enterprise solve the following tasks:

- check the validity of adopted managerial decisions regarding costs of the enterprise;
- assess implementation of made decisions, during which reveal deviations of the actual costs from planned (normative);
- evaluation of tendencies of change of costs of the enterprise, allowing to intervene in the processes of enterprise activity and optimize them;
- research of the reasons of deviation of the actual costs from planned or expenses of prior periods (assessment of the impact of identified factors on revealed deviation);
- identification of reserves to reduce costs of the enterprise and develop measures for their mobilization.

Results of the analysis of costs are used by managers of the enterprise to search internal household reserves for their decrease, eliminate inefficient use of resources and unproductive costs, for assessing costs per unit of production, determining deviation of the actual costs from the normative (standard) with the identification of causes and perpetrators of such deviations and more.

For the analysis involve the following sources of information:

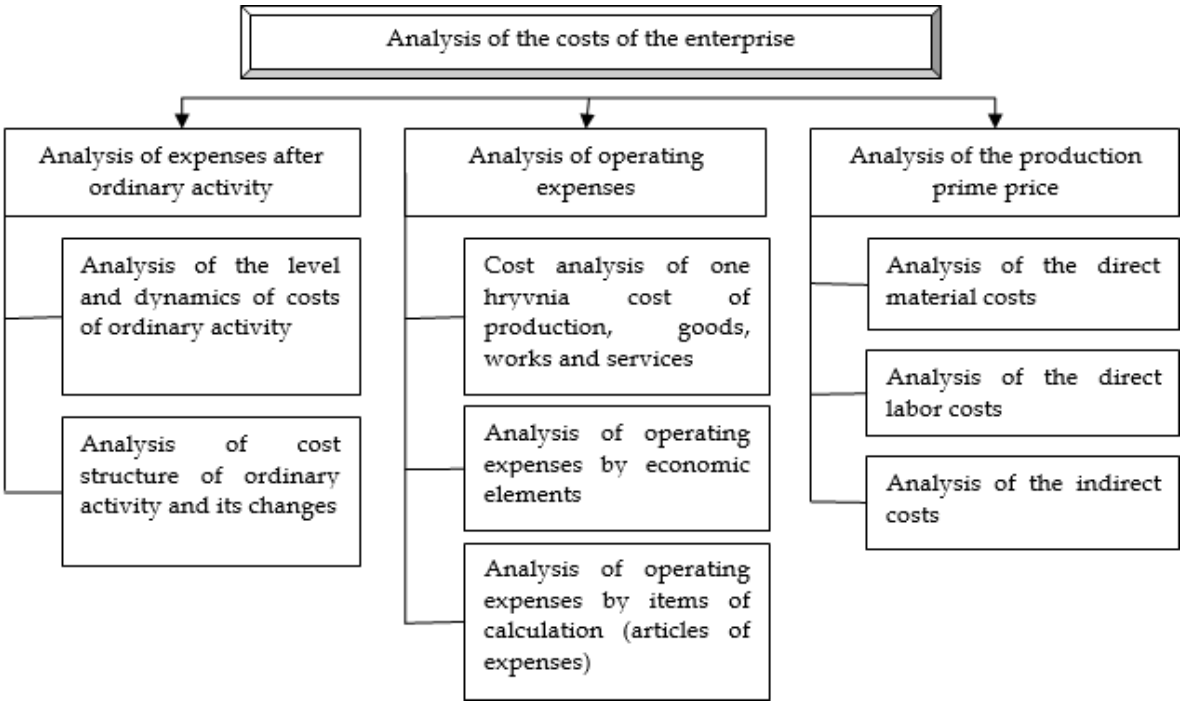
- plan and reporting calculations;
- norms and standards of resources consumption, data on deviations from norms;
- accounts of accounting (23 "Production", 80 "Material costs", 81 "Labor costs", 82 "Deductions for social measures," 83 "Depreciation", 84 "Other operating expenses", 90 "Cost of sales" 91 "General manufacturing expenses", 92 "Administrative costs", 93 "Distribution costs", 94 "Other operating expenses" and others);
- accounting registers (credentials and journals) - Journal 5 or 5A, sheet 5.1 on movement records of inventory;
- financial statements (form № 1 "Balance", form № 2 "Report on financial results" form № 5 "Notes to the Annual Financial Statements");
- statistical reports (Form № 1-enterprise (annual) "Report on the key indicators of enterprise activity," form № 1 - PV "Report on labor");
- primary documents;
- other sources.

Analysis of the costs of the enterprise, based on primary accounting data and financial statements is performed in the basic directions (Ex. 3).

Analysis of expenses after ordinary activity

Costs of ordinary activities - are costs of the enterprise associated with any of its main activity and operations that provide it or result from its implementation. This is one of the general indicators of intensification and consumption efficiency of resources by an enterprise.

Expenses of ordinary activities include: operating costs (operating expenses), financial costs, losses from participation in capital (investment costs) and other costs of ordinary activities.



Ex. 3. The directions of analysis of the costs of the enterprise

Operating expenses is the main type of company's expenses associated with the production and sale of products (goods and services), which include:

- prime cost of sales (goods, works and services);
- administrative expenses (general household costs, directed to servicing and enterprise management);
- distribution costs — associated with the sale of products (goods, works and services);
- other operating expenses (expenses for research and development, cost of sales of foreign currency, the cost of sold inventory, doubtful (hopeless) debts and losses from devaluation of inventories, recognized economic sanctions, other operating costs, except those belonging to cost of sales - goods, works and services).

Financial costs - interest the costs of (for using received loans, on issued bonds, of the finance lease, etc.) and other costs of the company related to the involvement of loan capital.

Losses from participation in capital (investment costs) are losses caused by investments in subsidiaries, associates or joint ventures accounting of which is carried out using the equity method.

Other costs of ordinary activities include costs arising during the ordinary activities (excluding financial costs), but not directly related to the operating activities of the enterprise - to the production and / or sale of products (goods, works and services). These costs include:

- prime cost of sold non-current assets (residual value and costs associated with the sale of non-current assets);
- prime cost of property complexes;

- non-operating losses from exchange rate differences;
- amounts of reduction of non-current assets and financial investments;
- costs of liquidation of non-current assets (disassembling, dismantling, etc.);
- residual value of liquidated (written off) non-current assets;
- other costs of ordinary activities.

Costs of ordinary activities analyze in two main directions (see. Ex. 3):

- *analysis of the level and dynamics of costs of ordinary activity*, that involves evaluating the overall level of costs and level of their components, to determine deviations from reporting indicators from indicators of previous periods or forecasted (planned) values, evaluate their dynamics, identify trends in changes in these costs;

- *analysis of cost structure of ordinary activity and its changes,* during which evaluate the structure of costs of ordinary activities, determine deviations of specific weights of components of these costs from similar data of previous years and plan, calculate the impact of such deviations on the change of the resulting indicator.

Analysis of operating expenses

Operating expenses (operating costs) is the main type of expenses of industrial enterprise directly related to the production of goods (works, services). In order to analyze operational costs usually classify them in two main directions which complement each other - by economic elements and by articles of expenses (articles of calculation) (see. Ex. 2).

The analysis of operating costs involves consistent analysis of:

- *cost analysis of one hryvnia cost of production, goods, works and services.*

The use of this indicator for the analysis of operating costs caused by, primarily, its universality: it can be determined to all industries and at all levels of management and be applied to products already produced (comparable), and for products which is only supposed to be produced (not comparable); it allows to keep the track of relative operating costs for several years. In addition, the indicator of costs for one hryvnia of production clearly reflects the relationship between costs and profit (the difference between the one and the value of this indicator is, in fact, the profitability of production).

The cost of one hryvnia output define as the ratio of planned or actual operating costs to amount of produced (sold) production (goods, works, services) in current prices.

This analysis carry out in two main directions:

- ✓ evaluation of dynamics. The dynamics of costs per one hryvnia cost of production determine in prices acting in the reporting year (current prices), and in average annual prices of the previous year;
- ✓ factor analysis. Main factors influencing changes in the level of costs per one hryvnia of cost of production are: changes in the structure and assortment of products; changes in the level of production costs (production prime cost) of certain products; change in wholesale prices for manufactured products (production). Their influence on the change costs per one hryvnia of production output determine by a method of chain substitutions.

- *analysis of operating expenses by economic elements*, which involves the study of their composition, structure and its changes during the reporting period or for several periods. Under the economic elements of cost understand the totality of similar by economic content types of production costs (works, services). Grouping of expenses by economic elements is performed in order to determine the total value of used material, labor and other production resources as well as organization of control after the level of these costs. Operating expenses of the enterprise are grouped in the following economic elements: material costs; labor costs; deductions on social measures; depreciation; other operating expenses.

This allows you to define the role of individual elements in the total expenses, estimate material capacity, labor capacity, energy capacity of production, identify trends of their changes and impact on the total change of operating costs, react promptly to deviations from forecasted (expected) indicators of operating costs, identify key directions of finding reserves of their decrease.

- *analysis of operating expenses by items of calculation (articles of expenses).*

Articles of expenses (items of calculation) - a certain type of expenses which form production prime cost of certain types of products and production in general. These can be a single element and complex articles of expenses, covering several economic cost elements. Thus one cost element may be present in several articles of calculation.

This analysis makes it possible to identify the purpose of costs and their relationship with a technological process, evaluate costs by types of output and the place of origin, to explore resizing of operating costs by types of products and place of origin, identify trends of these changes. As analysis of operating costs by economic elements, analysis of operating costs by articles of expenses involves determining absolute and relative deviation articles of the cost during the comparison of their reporting values from the data of prior periods, with corresponding planned values and calculating the share of every article of expenses in the total amount of operating costs of the enterprise , evaluation of structural changes that have occurred.

Expenses by articles are different from costs by elements because they reflect costs associated with the production and sale of commodity production for a certain period. Expenses by elements indicate all held by enterprise costs of resources for the reporting period, including costs of growth of unfinished production leftovers, costs attributed to deferred expenses and others.

Grouping of costs by articles enables to characterize the relationship of costs and results, their role in technological process, management and service, in inter business calculation, to define direct and indirect, variable and fixed costs and thus more fully disclose reserves of their economy.

The initial data for analysis of the structure of operating costs by articles of expenses are results of calculation of:

- production prime cost of products;
- distribution of indirect general production costs;
- estimate of administrative costs;
- cost estimate on production sales.

Analysis of the production prime price

Analysis of the production prime cost of products carry out in terms of:

- *direct material costs,* they include the cost of raw materials and main materials for manufactured products, semi finished purchased products and component parts, auxiliary and other materials that can be directly attributed to a particular cost object. Materials that are used not for production (maintenance of fixed assets, general workshop needs, etc.) are not a part of this article.

In the majority of industrial enterprises, especially in finishing branches of industry, the level of direct material costs is the main factor in determining the level of prime cost of sales and gross profit value. Therefore, the study of these expenses should be given a special attention.

Analysis start from the overall assessment of their dynamics and the share in the production cost price of the entire commodity production. Material costs for all single-element articles of calculation estimate by comparing actual costs of the reporting period with planned or with data of the previous period (base), calculate the impact of individual factors on discovered deviations.

Factors of the first level which influence the change in amount of material costs are:

- change in volume of production output;
- change in the structure of output;
- changes in the level of material costs in prime cost of unit of production.

Factors of the change in volume of production output and production structure are elements which are not subject working out in detail. Change of the level of material costs in the prime cost of the unit of production is a complex factor which can be decomposed into factors of second and third levels.

In the first stage of analysis determine changes, that have occurred in the sum of direct material costs and their share in the total amount of operating costs.

In the process of further analysis investigate the influence of factors of the second level into changes in the level of material costs in prime cost of unit of production, which, as noted above, is a complex factor and is formed under the influence of such factors of the second level: norms of expenses of material values, energy and fuel per unit of production; the average value (price) of consumed material values and electricity tariffs. If necessary, the analysis can be improved by examining the influence of factors of the third level into factors of the second one.

Analysis of direct material costs usually ends with calculation of reserves of their reduction and developing adequate measures for their use;

- *direct labor costs*. For enterprises of the majority of industries labor costs is the second largest component of expenses in the structure of production prime cost of products (works, services). Therefore, the efficient use of human resources and caused by it growth in labor productivity, decrease cost of its payment and related allocations for social measures is an important source of prime cost reduction of products (works, services).

The composition of direct labor costs include basic, additional wages and other payments to workers (excluding not staff members), engaged in the production of goods, works or services that can be directly attributed to a particular cost object.

The analysis and assessment of direct labor costs involves determining of the dynamics of the sum of direct labor costs, their composition and structure and calculation of the influence of individual factors on their change.

Finishing the analysis of direct labor costs, calculate reserves to reduce production prime cost of goods (works, services) due to reduced unproductive payments of main and additional salary, bonuces and payments to tariff rates and salaries and other payments. Keep in mind that a decrease in unproductive labor costs does not contradict the increase of basic and additional wages, especially if there is a corresponding increase in labor productivity. Therefore, during the analysis it is important to assess the the ratio of growth rate of average wages and labor productivity growth rate. Expanded reproduction of enterprises suggests that labor productivity growth rate outstrip growth rate of labor costs.

- *indirect costs*, by which understand variable general manufacturing expenses and constant distributed general manufacturing expenses.

Analyzing indirect costs must take into account the complex nature of the formation of these costs - joining in their composition different expenses depending on the volume of production. General manufacturing expenses based on which formed indirect costs consist of separate elements: the cost of production management; depreciation of noncurrent assets of general manufacturing purposes (shop, district, linear); costs of maintenance, operation and repair, insurance, operating lease of non current assets of general manufacturing purpose; costs of improving technology and organization of production; the cost of heating, lighting, water supply, drainage, etc .; maintenance of production facilities; service costs of the production process; the cost of labor protection, safety and environmental protection; other expenses.

In the first stage of analysis of indirect costs study the dynamics of the total amount of indirect costs, their composition and structure, determine deviations of values of these indicators in the reporting period compared to the previous (baseline) period or estimate.

The next stage of indirect costs analysis involves the research of reasons for absolute and relative deviation of indirect costs in the enterprise as a whole and for each item of expenses. Considering the large number of cost items (types of indirect costs), most of which are complex, there are many reasons of their change (deviation). Obviously, the study of factors' influence on the change of sum of indirect costs should be focused on major articlets of expenses the share of which in the total amount of expenses is the highest.

The final stage of analysis - calculation of reserves of possible reduction of indirect costs and the development of measures on the use of these reserves as a prerequisite for reducing production prime cost of goods (works, services), the total cost of production.

Cost analysis is essential for a company's operations, as it allows for better understanding, control and optimization of financial resources. The main aspects of the need for cost analysis:

1. Optimization of resources. Cost analysis helps a company to determine which aspects of its operations spend more money than necessary. This allows you to make decisions to reduce costs or use resources more efficiently.

2. Planning and budgeting. Based on the cost analysis, you can more accurately predict future financial needs, create budgets and determine where you can save money or where you should invest.

3. Assessment of profitability. Cost analysis allows you to assess how profitable the company's activities are compared to the costs. This helps to determine whether it is worth continuing a particular activity, product or service or whether strategies need to be revised.

4. Management decision-making. Based on the cost analysis, management can make decisions on optimizing production, reducing costs, introducing new technologies or methods of work.

5. Control and monitoring. Continuous cost analysis allows you to control financial flows and respond in a timely manner to possible problems, such as rising production costs or budget overruns.

6. Assessment of competitiveness. Cost analysis helps a company compare its costs with those of its competitors, which can influence pricing strategies or improve the efficiency of operations.

7. Improving efficiency. Identification of unprofitable areas and optimization of processes based on cost analysis contribute to the overall efficiency of the enterprise.

Thus, cost analysis is an important tool for making informed management decisions, improving the financial stability of the company and its competitiveness in the market.

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1.3. Investment Attractiveness and Prospects for Further Development of the Hotel Business in Ukraine

Even in the pre-war period in Ukraine, most of the issues of managing the investment activities of the service sector were not resolved, and a certain part of the implemented solutions require adjustment taking into account the setting of the tasks of the country's exit from the economic crisis, including through the activation and efficiency of the hotel sector of the economy. The study of the theory and practice of the formation and development of the investment system, organization and management of its activities showed that the mechanisms of interaction of the system of hotel business investors with state management bodies have not been developed. The issue of creating conditions that stimulate participation in investment projects in the service sector and their legal protection remains unresolved. The formation of a high-quality and affordable offer on the hotel business market directly depends on the volume of investments involved in the industry. Based on this, understanding the interests and strategies of foreign investors financing the Ukrainian hotel real estate market, as well as other factors that have a direct impact on the flow of investments in domestic hotel real estate, is essential for developing an adequate toolkit for regulating their activities and using it in the interests of national economy.

The hotel business is one of the most profitable vectors of economic development in every country. This topic is very relevant and promising for Ukraine both during the full-scale invasion and in the post-war period. Currently, this sector of the economy plays a significant role even during the times of martial law in our country - hotel business establishments are used for the location of internally displaced persons. The state of the hotel and restaurant business affects the development of the tourism industry in general, the creation of tourist services, other key segments of the economy - transport, construction, communications, trade, etc. At the moment, it is already known

that a certain part of the hotel business establishments as a result of hostilities and actions of the occupiers was completely destroyed, and a large part was damaged. To a greater extent, this concerns the hotel sector of the occupied territories of Ukraine - Donetsk, Luhansk, Zaporizhzhia, Kherson, Mykolaiv, Odesa regions and the Republic of Crimea.

The above-mentioned problems definitely require systematic studies of directions and trends of hotel business development on the basis of scientific management, development of strategies and development plans at the level of managers and specialists of hotel and restaurant enterprises, as well as the involvement in practice of methodical approaches based on the assessment of the effectiveness of management decisions.

The study of the main provisions of the theory and practice of hotel business development has been given great attention by the following domestic scientists and specialists: Basyuk T. [1], Bordun O. [2], Hrynyova V., Golovko O., Karsekin V., Luchka O. [2] , Melnychenko O. [3], Monastyrskyi V. [2], Shvedun V. [3], Shevchuk V. [2] and others. Improving the investment attractiveness of the hotel business and, on this basis, increasing the amount of investment in the specified sector of the economy is the main problem, the solution of which depends on the further development of the industry. But as for the development of the hotel business in the post-war perspective for certain regions of Ukraine, this problem is insufficiently studied and requires additional research.

The purpose of the study is to consider the current main reasons for limiting investment inflows into the hotel business of Ukraine, to establish the shortcomings and negative consequences of this process, to assess the investment attractiveness of the hotel business in the process of financing its development, to determine ways to overcome negative consequences in this area and prospects for the formation of investment attractiveness.

The influx and inflow of foreign investments into the hotel real estate market is equally beneficial to both private business and the state. Together with financial infusions, foreign investments bring new technologies of hotel business organization, new quality standards, management methods, jobs, they bring with them new international clients and contribute to the establishment of international relations. In addition to high incomes, a developed hotel industry has a positive effect on the country's image in the world, the accompanying multiplier effect contributes to the development of infrastructure and the improvement of the quality of life of the country's population. The main problem is that, without a high-quality and affordable hotel offer, it is extremely difficult to create a high-quality tourist product that is competitive on the world market and, therefore, to ensure a stable and solvent tourist demand [1].

The hotel business is one of the promising directions of socio-economic development, which is a source of foreign currency income, conditions the development of other industries, contributes to the increase in the level of employment of the population, acts as a factor in the sustainable development of rural areas, creates

a positive image of certain regions and the country in general. Ukraine has all the conditions for the development of tourism: picturesque nature, landscape diversity, rich historical and cultural heritage, favorable recreational conditions and resources, but at the same time there is an inefficient use of the potential of the tourism sector, which can lead to the destruction of economic development. Our country is significantly different from the leading tourist countries of the world in terms of the quality and variety of tourist services, the level of development of tourist infrastructure [5].

Ukraine has significant tourism potential. In particular, it is one of the leading countries in Europe in terms of the number of historical and cultural heritage sites. Only 150,000 immovable monuments of history and culture are in state custody, including 57,206 monuments of archaeology, 51,364 monuments of history, 16,800 monuments of architecture and urban planning. However, during the years of independence, the country did not form a clear policy of informing the world community about achievements, historical heritage, culture and social reform. Therefore, tourists from other countries are not interested in visiting Ukraine for recreation, the attitude towards the country as a vacation destination is formed on the basis of the assessments of government officials and international organizations, and most of all thanks to publications in foreign mass media, which are mostly negative, as they are devoted to high-profile or scandalous events. and taking into account the realities of today - military actions.

Domestic tourism suffers due to excessive competition. It is exacerbated by the presence on the market of travel firms from other countries. Firms with foreign capital are supported by the governments of their countries, and some receive direct support from the budget. There is no such practice in Ukraine. The next problem is infrastructure. Almost no new hotels are being built in our country, the pace of their construction is rather insignificant due to the low investment attractiveness of many potential and actual tourist projects. At the same time, in foreign markets, investing in the tourism industry is profitable and has a long-term perspective. Ukraine has not made progress in solving another eternal problem - the lack of service. There are still few hotels with a sufficient number of "stars", and some regions do not have such facilities at all [3].

It is worth noting that the tourism sector was significantly affected by the quarantine restrictions. The year 2020 radically changed the current trends in the development of tourism and the approach of tourists to the choice of countries for recreation. Despite global trends, domestic tourism has become a springboard for the recovery of this sphere in 2020-2021. Despite closed borders and the absence of foreign tourists, domestic tourism in Ukraine increased in 2020. The tourist flow continued to grow due to the size of the tourist tax. In 2021, it increased by 24% compared to 2019. Russia's full-scale invasion of Ukraine on February 24, 2022 threatened not only tourism in Ukraine, but also the international travel sector, which has just begun to recover from the losses caused by the Covid-19 pandemic. The tourism sector, which began to confidently recover in January 2022, significantly narrowed the opportunities for full-scale growth as early as March 2022. Both inbound and outbound tourism in Ukraine

are under threat. So, the Russian-Ukrainian war caused a noticeable decrease in international tourist flows, which led to a number of factors related to the war, where the safety of tourists is the first place, which Ukraine cannot guarantee today [2].

In addition, instead of the development of domestic tourism, national tourism enterprises, multi-million migration of the population within the state was observed on the territory of Ukraine, and the mass departure of Ukrainian citizens abroad is not related to the tourist goal (7.7 million people became internal migrants) [3].

The main problems of hotel and restaurant industry enterprises that require additional attention from the management and top managers include the following: outdated specifics of management and methods of customer service; ineffective organizational structure; lack of competent advertising activity; inefficient income management; outdated fixed assets and the use of imperfect technologies; inefficient pricing policy; the low quality of the offered set of services, which is reflected in the unsatisfactory condition of hotel buildings, which require current or major repairs; the absence of a reserve of trained personnel, which allows to flexibly solve the problems of seasonal load fluctuations; ineffective organization of work in a number of hotels, which leads to an increase in labor costs in the process of hotel service; lack of a sufficient number of personnel on the market of hotel and restaurant services with the necessary qualifications for modern working conditions, etc.

Despite the negative trends associated with the development of the country's hotel industry, during the war in the western regions some positives were observed in the hotel sector. This is how hotels and hotel complexes were opened. However, if chain establishments appear in some places, new independent hotel establishments are practically not opened. The realities of the war prompted hoteliers to introduce new services and increase the social value of hotel enterprises. This is especially observed during the period of providing for the needs of internally displaced persons. Part of the hotels took over the costs of living in such categories and expanded their living quarters. And some considered the possibility of providing additional services for this category of consumers.

An important mechanism for stimulating the operation of hotels is the opportunity to apply for financing the reconstruction of destroyed premises from the "Fund for the Restoration of Destroyed Property and Infrastructure", created by the Cabinet of Ministers of Ukraine. Despite the military actions, the State Tourism Development Agency, together with the Association of Hotels and Resorts of Ukraine, is implementing a project to test the European hotel classification system "Hotels Stars Union". Such steps make it possible to bring the standardization of Ukrainian hotels closer to the peculiarities of standardization in the European Union, which is one of the directions of Ukraine's entry into the European Union.

However, in 2023, the tourism business paid 32% more taxes. In 2023, representatives of the tourism industry paid about UAH 2.05 billion in taxes to the budget. This amount is 32% more than in 2022, but 8% less than in 2021. For comparison: in 2022, the volume of tax revenues from tourism business amounted to more than 1.55 billion UAH, and in 2021 - more than 2.23 billion UAH.

In 2023, the largest volume of tax revenues from the tourism industry was provided by hotels - 64% or more than UAH 1.3 billion. This is almost 2 times more than in 2022 and almost the same as in 2021. For comparison: in 2022, hotels paid more than UAH 898.38 million in taxes, and in 2021 - about UAH 1.29 billion. Tax revenues from tourist operators in 2023 amounted to about UAH 205.83 million or 10.1% of the total tax revenues from the tourism industry. This is approximately 22.6% more than in 2022. For comparison: in 2022, tourist operators paid about UAH 167.86 million in taxes.

Subjects of tourist activity in the following regions paid the most taxes: the city of Kyiv - more than UAH 499.29 million; Lviv region - more than UAH 345.48 million; Kyiv region - about UAH 239.01 million; Ivano-Frankivsk region - over UAH 138.84 million; Odesa region - about UAH 98.85 million.

In 2023, there was an active growth of domestic tourism and active development of tourist locations in the central and western regions. In January-September 2023, tax revenues from the tourism industry increased compared to the same period in 2022 in Kyiv and in 17 regions of Ukraine [7].

Unfortunately, the south of Ukraine as a tourist destination is temporarily lost. And in the Carpathians, if it does not grow, it at least remains at the same level as last year. This year, tour operators plan to expand opportunities for Ukrainians to go on vacation, including in central Ukraine, "to recharge, to relax psychologically" [2].

The war practically stopped tourist flows to Ukraine; fear of staying in most regions of the country, a lot of destruction of tourist infrastructure, monuments, museums, etc.; prohibited flights in the air space, etc. Today, the field of tourism in Ukraine is limited, and when working, tourist companies take into account routes that must include a map of bomb shelters or other protective structures. Also take into account the routes so that there are no important state and military facilities nearby.

Despite the difficult post-war situation with tourism, it should be an important part of the economic recovery strategy in Ukraine. And it is necessary not to wait for the end of the war, but to work on it today. To start including the development of tourism in the post-war reconstruction programs; apply international investments; prepare large-scale marketing campaigns; develop tourist programs; popularize non-standard forms of tourism; conduct business in less affected regions; reorient and use green, domestic tourism; conduct trainings on tourism business for schoolchildren and students of higher education; participate in the restoration of architectural heritage and museums; conclude agreements with educational institutions regarding the exchange of practical experience; creation of funds for the recovery of Ukraine and specific programs and strategies for recovery; to guide tourists who like extreme and historical events - military tourism. There are many cities and villages on the territory of Ukraine that are unique heroes of glory and resistance to Russian aggression. Since many tourists are interested in those places that have become symbolic and leave behind a memory, they will be willing to visit Ukraine [5].

Considering the military situation in our country, its tragic consequences, the hotel industry acquires a special value. Recently, the understanding of the category of "hospitality" as one of the important and fundamental dimensions of human civilization

has spread in the works of foreign and domestic researchers. The task of creating a positive image in the field of hospitality should be solved with the help of the comprehensive use of hospitality resources, which can be considered as a complex service that has certain consumer properties and requires the creation of a positive image of the enterprise. A hospitality business must, first of all, ensure an acceptable level of risk of the natural and urban environment for the consumer's life and health.

The current military and political situation in Ukraine allows us to identify promising directions for the development of the hotel industry: reorientation of the hotel business to the safer territories of Western Ukraine; reorientation of hotel services to rehabilitation, which has a greater demand; increasing the number of hotels that are more suitable for families and comfortable long-term stays; the delayed demand for tourism and the popularization of Ukraine at the international level will activate tourist activity after the end of the war, which will also affect the hotel industry; adaptation of hotel enterprises to the realities of wartime and the search for new forms of service; the formation of a "deferred offer" in the hotel industry market, which activates competition and the improvement of services in the country's hotel enterprises; conversion of hotels taking into account safety and autonomous operation requirements (availability of bomb shelters, autonomous power sources); development of eco-hotels focusing on alternative energy; strengthening control over the origin of investments invested in the hotel industry; approximating the standards of the hotel industry to the standards of the European Union; development of new enterprises and re-equipment of existing ones thanks to the attraction of funds from various post-war reconstruction funds.

State regulation of investment activity provides and stimulates certain conditions for subjects of investment activity, creates socio-economic, organizational and legislative and regulatory conditions for stimulating investment in various areas of the economy with the help of depreciation, tax and credit policy of the state, which should contribute to the activation of investment activity as in Ukraine and in its regions. In addition, the state influences the intensification of investment activity by developing the appropriate institutional base, without which the functioning of the investment sphere is impossible, namely, the organization of investment-oriented funds, the creation of a network of consulting firms, state scientific organizations, conducting scientific research, establishing the work of training centers for small and medium business. Investment policy, in turn, significantly affects the mechanism of formation and implementation of innovation policy, the result of which is the introduction of resource-saving, low- and zero-waste technologies in the country's economy [6].

Another source of financing is obtaining loans from commercial banks. But for enterprises engaged in innovative activities, problems arise when receiving loans. Most commercial banks provide short- and medium-term lending due to the high risk of innovative activities, as well as the desire of banks to obtain quick profits. And innovative activity can provide profit only at the end of the project term. Therefore, one of the effective sources of financing innovative activities is the formation of joint ventures, including with foreign partners. The investment attraction process takes place in several stages [4].

In general, the analysis of statistical data indicates a steady trend of reduction of infrastructural tourism resources, and therefore, the volume of services of this sector of the economy. This general and regional trend gives reason to talk about the need to introduce organizational and economic measures to intensify activities. Among the main directions and measures of such work, the following can be distinguished: changing the direction of tourist flows, tourist preferences in certain regions of Ukraine (for example, Bukovel); formation of a base for choosing vacation spots by tourists using Internet resources; activation of the mass media in the direction of forming the taste of customers for the quality of hotel services; initiation of the development of boutique hotels and traditional hostels, which have mass distribution in international reservation systems; diversification of the hotel offer to increase the occupancy level of the already existing room stock and the search for new hotel and tourist services for the attractiveness of the Ukrainian market.

Summing up, the aggravation of the political and economic crisis, military actions in Ukraine led to a significant slowdown in the development of the hotel and restaurant business. On the other hand, the slowdown in the growth of the hotel and restaurant business is caused by the lack of sufficient innovative provision of the industry, miscalculations in its regulation by the relevant state structures, and the low purchasing power of the population of Ukraine, which is unable to use these services. Under such conditions, it is necessary to form and implement an investment policy for the development of the hotel and restaurant industry, which would include such important components as: mechanisms of state regulation of this industry; resource provision and preferential financing of development; organizational and functional support of management processes; informational and methodological support of the industry (this means systematic information, evaluation of introduced innovations, etc.).

In order to attract domestic (national) investments, the key requirement is to reduce taxation and guarantee the provision of property rights. It is advisable to consider the issue of reducing taxation in the aspect of reducing rates for three main types of tax: value added tax, income tax and payroll, since these types of tax payments have the largest specific weight in the structure of taxes and mandatory payments equated to them and actually determines the general level of taxation (the so-called "tax press"). The reduction of rates will ensure a reduction of part of the alienated income and will stimulate interest in the development of entrepreneurship in the hotel sector. It is necessary to ensure the unity of the norms of the tax regime and economic legislation for all subjects of hotel activity, regardless of the country of origin of the capital and forms of organization. Fulfillment of this requirement sets equal conditions for national and foreign investments.

After the end of the full-scale war, the economy of the regions of Ukraine faces a rather difficult period of recovery and reconstruction, the same applies to the hotel business. A certain increase in tourist demand is expected, but at the same time, it is necessary to attract significant investments in the specified sector of the economy and state support for such business entities. We believe that adaptation to new conditions requires support and stimulation of the development of this industry at the macro level

- from the state and at the micro level - by tourism business enterprises. At the macro level, it is expedient to implement a number of strategically-oriented measures, which are defined in accordance with the National Economic Strategy for the period until 2030 in order to ensure the state economic policy and support the development of the creative hospitality industry and tourism potential of Ukraine.

As part of the reconstruction of tourism in Ukraine, it is worth relying on the experience of other countries that actually restored their tourism industry after crises, including war. In the post-war recovery of tourism in Ukraine, rely on the support of national and international organizations through the development and implementation of various programs and projects. It is necessary to develop and create recovery strategies in the affected regions at the expense of special economic zones and scientific and industrial parks. Many countries are ready to help with words and investments in the restoration, the opportunity to involve international experts in the modernization of the country will greatly help speed up success in this matter. Since the experience of many countries in which military operations took place will be able to advise how to increase the number of tourists in the post-war period.

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CHAPTER 2. INNOVATIVE AND MODERN FOUNDATIONS OF PEDAGOGY AND PSYCHOLOGY

2.1. Psychological Well-being of Mental Health Service Providers in Ukraine During the War

Considering the socio-political conditions and military operations, the need to develop a culture of seeking psychological help is very urgent and necessary for the Ukrainian state preservation. In modern Ukrainian society, the topic of mental health and seeking help in this area is stigmatized. Some studies suggest that public "mental health literacy," or awareness, significantly reduces the stigmatization of mental health and increases the likelihood of seeking help from professionals in the field. Mental health workers have emerged as critical support pillars, providing care to those traumatized by the war. However, these professionals face significant challenges that affect their own psychological well-being.

Mental health literacy is a medical literacy term. According to the observations of scientists, low functional literacy was associated with numerous adverse health consequences (Dewalt et all., 2004) "Mental health literacy" is defined as understanding how to achieve and maintain positive mental health; understanding of mental disorders and their treatment; reducing the stigma associated with mental disorders; and improving help-seeking effectiveness (knowing when and where to seek help and developing competencies aimed at improving mental health and self-management) (Kutcher et all., 2016).

Empirical research on mental health literacy among young people has shown that such awareness promotes early help-seeking. Studies of mental health literacy in Portugal showed that the level of such awareness increased with age, level of education and was higher among women and health professionals. Regarding the level of stigmatization, older people and men showed more stigmatizing attitudes and behaviors. In addition, results showed that stigma decreased with higher mental health literacy (Simões de Almeida et all., 2023).

C. Kelly and a team of researchers suggest four categories of mental health literacy interventions: community-wide campaigns; public campaigns aimed at a youth audience; school-based interventions that teach help-seeking skills, psychological health, or resilience; and programs that teach people how to cope in a mental health crisis (Kelly et all., 2007). Researchers suggest increasing mental health literacy through interventions in primary care settings or in mainstream or online media. Public education activities serve as key preventive measures and can potentially reduce stigma and promote early help-seeking (Tay et all., 2018). F. Sampaio, P. Gonçalves, C. Sequeira claim that, first of all, mental health literacy should be at a high level among nurses who accompany the patient and his relatives during treatment (Sampaio et all., 2022).

The importance of mental health literacy in promoting public health is recognized among academics. Relevant studies determine numerous directions for future scientific research. The obtained results can become the basis for the development of a program

of psychological support during the war based on the development of literacy in the field of mental health.

According to scientists research, the war in Ukraine has significant and long-lasting mental health consequences for Ukrainians (Elvevåg, DeLisi, 2022; Hyland et all., 2023). A significant burden in war conditions on the medical system (Segev et all., 2024; Foster et all., 2024), special attention is paid to forced migrants and children (Straiton et all., 2017).

Fleeing a country for safety is an extremely stressful event. Forced migrants feel desperate and hope to find safety and work. Conditions in their homeland make it unsafe or uninhabitable, and they move across borders in search of safety. They can arrive at the border without employment guarantees, without money for housing and without additional resources. Most of the forced migrants job offers are unskilled manual labor. All of them experienced loss: loss of family members, home and country. When forced migrants arrive at the border, they need psychological support in addition to financial needs (Hinton et al., 2005).

The impact of war, living in conflict zones, flight and forced migration can create or increase the risk of wide-ranging physical and mental health consequences, especially for children and their caregivers, depriving children of developmental opportunities and essential resources. The impact on children's health is the result of actual violence manifested by inadequate health care, malnutrition, infectious diseases, and the suffering inflicted on their families (Kadir et al., 2019).

Children who have experienced war and forced displacement show a wide range of possible responses to distress and stress, such as specific fears, dependent behavior, prolonged crying, lack of interest in their surroundings, psychosomatic symptoms, and aggressive behavior (Pfeiffer et al., 2019; Shaw, 2003). Children's games can also suffer, for example due to the emergence of morbid themes, restrictions on fantasy games and social isolation (Slone, Mann, 2016). It is important to understand that each case is individual and it is important how each child subjectively perceives, evaluates and interprets his war experience. Thus, there can be huge differences in children's stress reactions. Such differences must be considered in the context of the child's social-emotional and cognitive development (Joshi, O'Donnell, 2003).

Forced resettlement burdens the adolescents' psyche with additional stressors, including separation from loved ones, peers, socio-economic inconveniences, and then the difficulties of adaptation in a new place. Researchers of forced migrants pay attention to the violence propensity as a verified risk factor for mental health deterioration (Reed et all., 2012). Adolescents can be burdened by problems caused by changes in family dynamics, such as caring for younger siblings who are psychologically or physically affected, as well as property damage, poverty, school closures, which can have an additional effect and make them more prone to anxiety and depression (Silwal et all., 2022).

The American psychologist R. M. Lijtmaer studied the connection between trauma, mourning and nostalgia in forced migrants. The author explains the interrelationship of these phenomena through the term of mourning, which forced

migrants carry out adaptively or destructively. Although the prevailing trend in the literature is forced migration as a psychologically harmful process, a traumatic event. However, according to R. M. Lijtmaer, the experience of immigration and exile can also strengthen character and resilience: a person is forced to become more flexible and tolerant (Lijtmaer, 2022).

Undoubtedly, the population in war conditions should receive psychological support as part of the overall process of relief, rehabilitation and recovery. The experience of past world wars and local conflicts in the 20-21 centuries has shown that, in addition to the winners and those who lost in wars, there is at least one more category of people - people whose psyche is traumatized as a result of hostilities and needs treatment, long-term psychological help. Ignoring this problem can lead to an increase in the number of suicides, as well as the number of individuals prone to gambling, alcoholism, drug use and other types of deviant behavior among the military and civilian population. High-intensity stressful events during war with associated stressors lead to a sharp decrease in the level of vitality and mental health deterioration. This requires innovative approaches to providing professional assistance and support to people affected by war, using appropriate interventions, techniques and strategies.

Given the relevance, we decided to investigate whether the workload of mental health professionals has increased.

The research sample consisted of 289 people who provide mental health and psychosocial support services in various institutions (the field of medicine, social protection, etc.). The average age of the subjects was 42.7 years. Of them, 270 are female and 19 are male. Such homogeneity of the sample is caused by the war, men in Ukraine are conscripted, so they are currently serving in the armed forces of Ukraine. The average age of the subjects was 42.7 years. Among the respondents, 27.7% indicated that they had experienced potentially traumatic events during the war (for example, loss, witnessing violence, occupation, etc.), 6.2% have a disability. The survey was conducted in 2024 in the Volyn region. The questionnaire consisted of 15 questions. This publication will analyze the answers to the following questions: How can you assess the level of work load now? Has the workload increased over the past year?

First of all, we analyzed in which service sector the respondents work (Figure 1).

Most specialists in the field of mental health work in the fields of education (48,4%), social protection (31,8%) and health care (11,4%). The smallest number of such specialists was found in non-governmental organizations (2,8%) and culture (1,0%). Other 4,5% the field of services to which they belong is not specified. This obtained percentage distribution generally demonstrates a typical situation regarding the availability of mental health specialists in the spheres of state activity.

Figure 1 shows the general results of the answers to the question “How can you assess the level of work load now?”

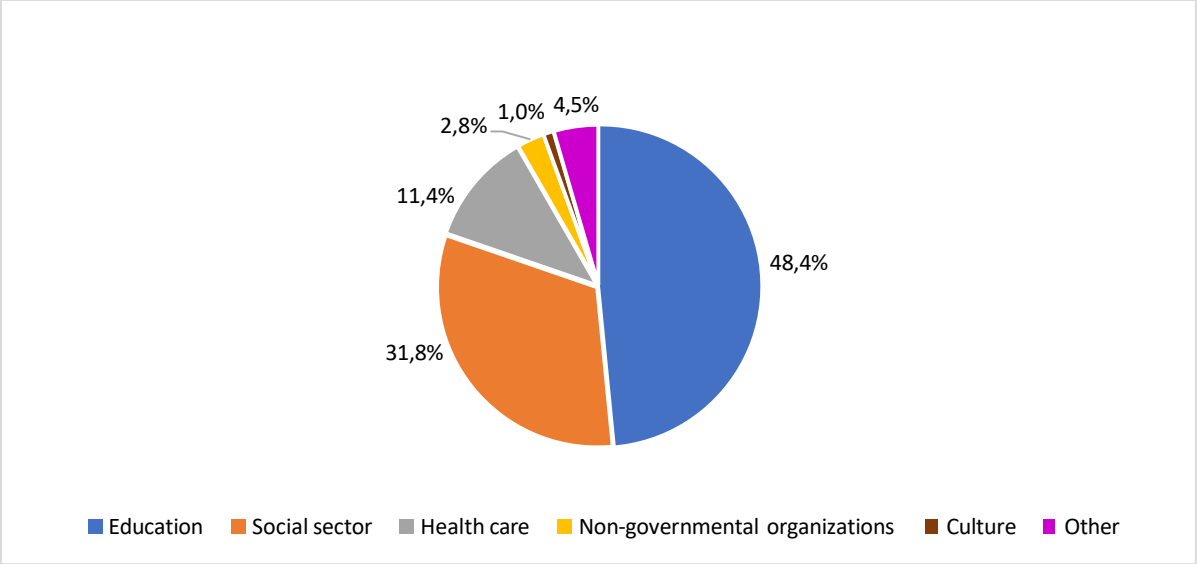

Figure 1. Service industry where mental health workers are employed

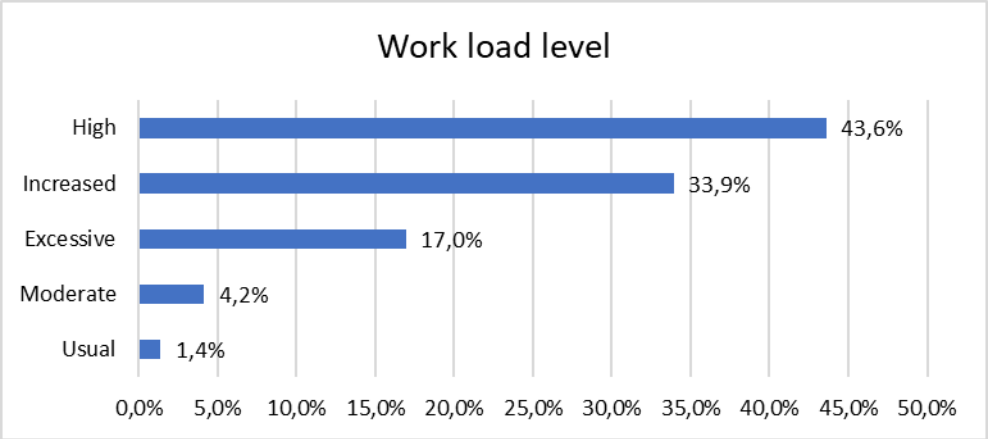

Figure 2. Level of work load of mental health workers

More than half of the interviewed workers in the field of mental health noted that the workload at work is high (43,6%), increased (33,9%) or excessive (17,0%). Only a small number of interviewees mentioned a normal (1,4%) or moderate (4,2%) work load.

For a more detailed analysis of the obtained data, an assessment of the workload of mental health specialists in Ukraine in war conditions in various areas of service provision was determined (Figure 3). The analysis was performed using mean values.

Specialists in mental health in the field of culture experience the greatest work load (M=4,33). Perhaps this is related to the growing interest in the use of art-therapeutic methods of psychological rehabilitation and relating, as well as groups of informal psychosocial support (Kim, Chung, 2023; Lim et all., 2024; Liu et all., 2024).

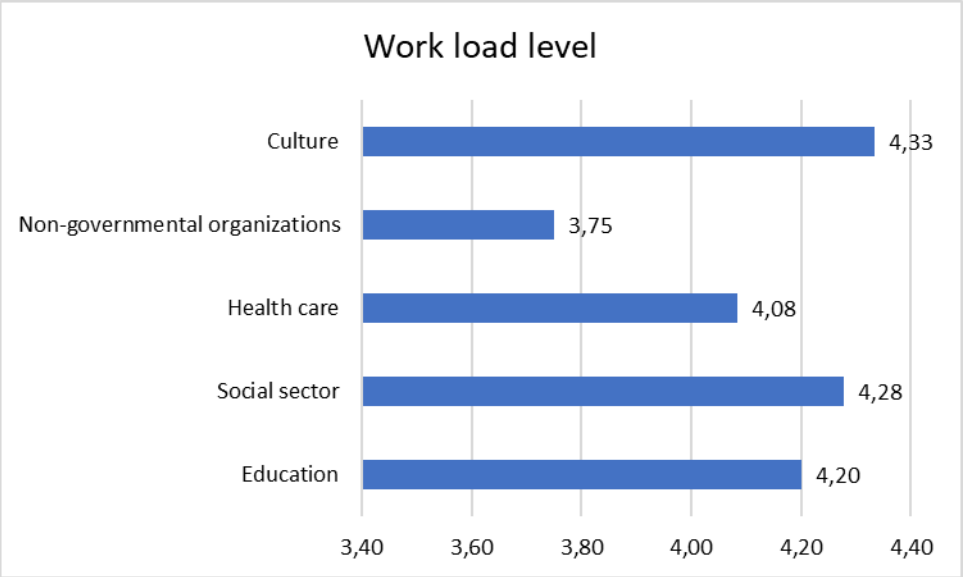

Figure 3. Level of work load of mental health workers in different service industry (according to the average value)

A high level of workload was noted by mental health workers in education (M=4,20) and social protection (M=4,28). Such a situation may be associated with significant stigmatization of mental health services in Ukraine. People are afraid to seek psychological help directly and try to get it through education or in a complex when they seek social assistance (Danilevska et all., 2023). less compared to other areas, but still with an emphasis on increasing the workload in the field of mental health, it is noted in health care (M=4,08) and non-governmental organizations (3,75).

Figure 4 shows the general results of the answers to the question "Has the workload increased over the past year?"

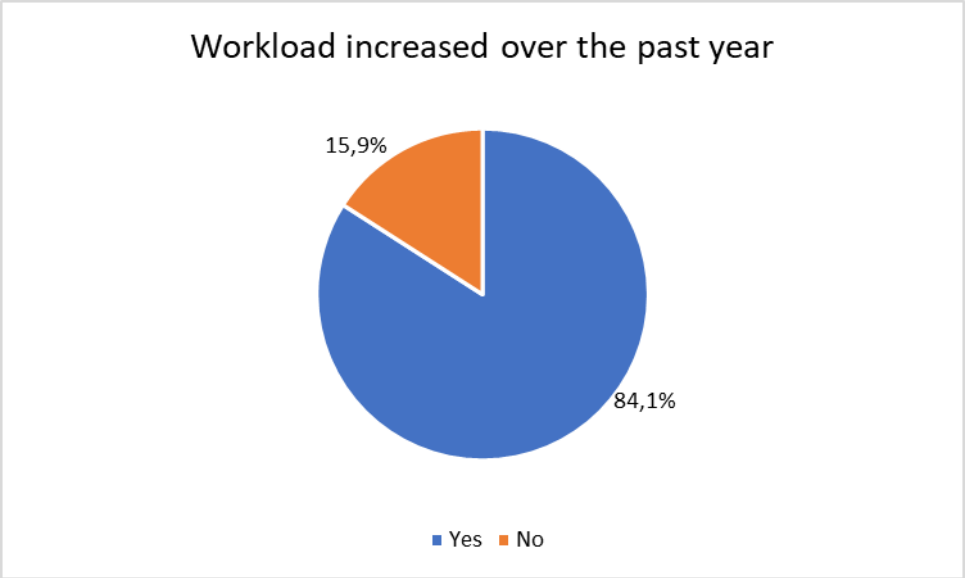

Figure 4. Workload increased over the past year

Overall, 84.1% of mental health providers say their workload has increased significantly in the past year. While 15,9% claim that no such changes have taken place.

Further analysis provided for the identification of features of the increase in work load during the last year by service provision spheres, for this, average values were calculated (Figure 5).

Over the past year, the greatest workload has increased for mental health workers for social sector (M=0,91) and non-governmental organizations (M=0,88). In sectors education (M=0,8), health care (M=0,83) and culture (M=0,67).

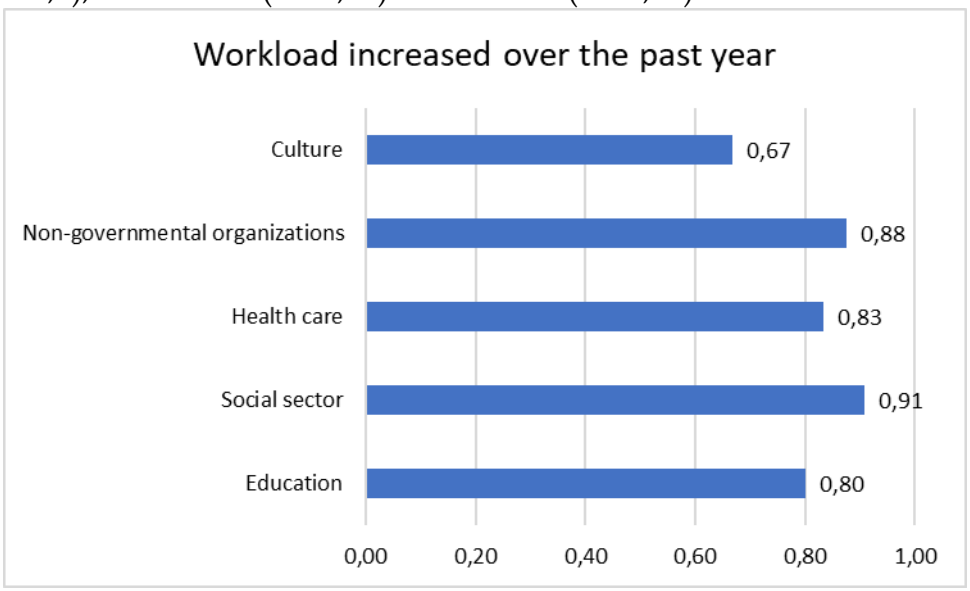

Figure 5. Workload increased over the past year in different service industry (according to the average value)

One of the primary stressors for mental health workers is the overwhelming demand for psychological services. The war has led to a surge in mental health issues among the population, including post-traumatic stress disorder (PTSD), anxiety, and depression (Karstoft et all., 2024; Tucker et all., 2024; Raccanello et all., 2024). Therapists and counselors are dealing with heavier caseloads than ever before, often without adequate resources or support systems. This situation can lead to burnout, compassion fatigue, and secondary traumatic stress, where professionals experience trauma symptoms through their clients' narratives.

Moreover, many mental health workers are themselves directly affected by the conflict. They may have lost loved ones, been displaced, or faced threats to their safety. Balancing personal trauma with professional responsibilities adds an extra layer of stress. The blurring of personal and professional boundaries can make it difficult for them to maintain objectivity and provide effective care.

The lack of infrastructure and funding further exacerbates these issues. War conditions have strained Ukraine's healthcare system, making it challenging to access necessary tools, training, and support. Mental health services are often underfunded, and workers may not receive adequate compensation or professional development

opportunities. This scarcity of resources can lead to feelings of helplessness and frustration among professionals committed to aiding others.

To address these challenges, there is a growing recognition of the need for support systems specifically designed for mental health workers. Initiatives such as peer support groups, supervision, and self-care programs are essential. International organizations and local non-governmental organizations are beginning to offer training on coping strategies, resilience building, and stress management tailored to the needs of these professionals.

In addition, promoting a culture that acknowledges and destigmatizes mental health struggles among professionals is crucial. Encouraging mental health workers to seek help when needed can mitigate the adverse effects of their demanding roles. Policy interventions that provide financial support, resources, and safe working conditions are also vital to sustain the workforce during and after the conflict.

In conclusion, mental health workers in Ukraine play an indispensable role in supporting a population grappling with the horrors of war. Recognizing and addressing the psychological challenges they face is essential not only for their well-being but also for the effectiveness of the mental health services they provide. By investing in the support and resilience of these professionals, Ukraine can strengthen its overall capacity to heal and rebuild in the face of ongoing adversity.

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CHAPTER 3. SCIENTIFIC VIEWS ON LAW AND HISTORY

3.1. Archaeology of International Trade in Ancient Egypt (III Millennium BC -III Century BC)

АРХЕОЛОГІЯ ПРО МІЖНАРОДНУ ТОРГІВЛЮ ДАВНЬОГО ЄГИПТУ (III ТИС. ДО Н.Е. – III СТ. ДО Н.Е.)

Перехід людства до осілого способу життя та виробничого господарства в процесі «неолітичної революції" зробив обмін необхідною умовою життєдіяльності людських колективів. Це було пов'язано з тим, що з одного боку, географічна локалізація перших стародавніх цивілізацій обмежувала доступ до необхідних ресурсів, а з іншого, навпаки – ускладнення господарської діяльності збільшило потребу в різних ресурсів. З початку обмін був інститутом знаття цього фундаментального протиріччя осілого виробничого господарства, але у результаті його розвитку сформувалась ефективність спеціалізації у виробництві тих чи інших товарів. Це сприяло подальшому поглибленню розподілу праці, розвитку обміну, що стало умовою кардинального зростання чисельності населення стародавніх цивілізацій, а потім і їх добробуту. Наявність торгівлі в архаїчний період стало поштовхом для формування перших міст, тобто зародженням урбаністичних цивілізацій стародавнього світу. За даними Е. Анаті, стародавнє місто Ієріхон має історію, що перевищує 9 тис. років [1, с. 211–212]. Комунікаційні системи товарообміну, що сформувались на Близькому Сході, в Північній Африці, на Аравійському півострові у подальшому інтенсивно використовувались та розвивались стародавніми імперіями – Єгипетською, Хетською, Ассирійською, Вавилонською, Персидською, Римською. Таким чином міжнародний обмін та його комунікації безпосередньо впливали на цивілізаційні процеси. І вагоме місце в цьому русі займала давня Єгипетська цивілізація. Але як правило історичну спадщину стародавнього Єгипту асоціюють з досягненнями в архітектурі, науці та культурі, при цьому торговельні процеси залишаються на периферії наукового інтересу. Тому на сучасному етапі розвитку історичних досліджень проблематика торговельної політики стародавнього Єгипту набувають особливої актуальності. Дослідження цієї проблеми дозволяє розкрити ще більше сторінок стародавньої історії Єгипетської цивілізації та проаналізувати, яким чином зовнішня торгівля впливала на її розвиток.

Метою дослідження є вивчення ролі міжнародної торгівлі в історії стародавнього Єгипту з використанням досягнень морської археології. Географічні межі включає басейн річки Ніл, Середземноморський басейн, узбережжя Червоного моря. Хронологія роботи охоплює період починаючи з III тис. до н.е. (початок формування організованих форм міжнародної торгівлі в стародавніх східних державах) і III-II ст. до н.е., коли Єгипет інкорпорується у греко-римську цивілізаційну систему.

Джерельна база презентована археологічними джерелами в тому числі зображенням сцен торгових операцій, торгових суден на лапідаріях, в кераміці,

фресках, а також наративною традицією. Особливе місце займають підводні археологічні матеріали на відкритих місцях морських аварій та загибелі торгових суден, що дозволяє реконструювати технології суднобудування стародавніх часів, специфіку товарів, які перевозились морем та річками, основні торгові комунікації стародавнього часу. На сучасному етапі досліджень нам відомо приблизно 2000 локацій морських аварій античності, у тому числі в районі Південно-східного середземномор'я. Тобто регіон торгової активності Египту [2, 74].

Значний обсяг інформації щодо торгових відносин греко-римського світу з Єгіптом міститься в історичних та географічних творах Павсанія, Скілака, Арріана, Страбона [3], Плінія, Псевдо-Аріана. Повідомлення про зародження торгових відносин з Єгіптом та Близьким Сходом можна знайти в ранніх повідомленнях Гомера і Гесіода, Аполлонія Родоського [6]. Так античні автори повідомляли про умови перевезення товарів морем, про порти, навігацію, відстань, на яку перевозились товари.

Історіографію проблематики доцільно диференціювати на дві групи. Перша група це дослідження з історії стародавнього Сходу загального характеру, в яких питання історії торгівлі розглянуто в загальному контексті і друга група праць, які безпосередньо розкривають торговельні контакти Єгипетського царства.

До першої групи слід віднести наукові праці Дж. Робертса [8], А. Море, М. Мієроп [9]. Другу групу складають наукові праці присвячені безпосередньо торговим контактам Єгипетської держави і особливо питанням організації та ведення морської торгівлі та суднобудування. До цього підрозділу історіографії належать праці: Л. Кессона, Дж. Моррісона [10], Б. Ландстрема [19].

Збільшення обсягів надлишкових продуктів сільського господарства, а також примітивного ремесла сприяли формуванню міжнародного більш складних форм міжнародного обміну. Торгівля на теренах стародавнього Сходу набуває значних обсягів у III-II тис. до н.е., про що свідчить такий археологічний пам'ятник шумерської писемності як Ель-Амарнський архів. На даному історичному відрізку торгівля здійснювалась у більшості випадків як обмін товару на товар, внаслідок відсутності універсальних платіжних еквівалентів вартості товару. Системи товарообміну, що сформувались на Близькому Сході ще в додержавний період в подальшому стали основою для структуризації перших імперій III-II тис. до н.е.

Так відсутність в Нижній Месопотамії каміння, будівельного лісу та металів змушувало місцеві землеробські протодержави використовувати надлишки сільськогосподарських виробів як обмінній фонд в умовах мінової торгівлі географічні умови сприяли реалізації цього завдання. Примітивні човни та плоти безперешкодно рухались річками, та вздовж узбережжя. Міста, що утворились на цих маршрутах поступово стверджувались як торговельно-ремісничні центри. Завдяки спеціалізації обміну в Месопотамії стало можливим колосальне збільшення щільності населення, формування міської цивілізації, з великим

обсягом надлишкового продукту. Виробництво цього продукту та його концентрація в містах, які перетворились на адміністративні та релігійні центри було можливим лише при наявності специфічної держави з централізованою професійною бюрократією та державною власністю на основні ресурси – тобто «східна деспотія». У зв'язку з цим виникнення та розвиток стародавніх цивілізацій Сходу міцно асоціюється з домінуванням держави у тому числі в такій важливій сфері як товарний обмін. В стародавніх Східних цивілізаціях дуже часто будь-який товарний обмін здійснювався від імені держави, або його представника. Таким чином стародавні цивілізації створювали навколо себе мережу торгових партнерів. Навіть і державні посередники реалізовували власні комерційні інтереси, сприяючи становленню купецтва. Саме в цей період оформлюється особливий юридичний статус купців, які перетинаючи кордони і території крім торгових функцій виконували роль дипломатів, шпигунів, географів.

Саме у цей період в єгипетських джерелах з'явився термін, який можна трактувати як «продавець». Внаслідок постійних геополітичних зміни і територіальних трансформацій серед державних утворень стародавнього Сходу обсяги товарного обміну постійно збільшувались за рахунок військових контрибуцій та трофеїв. До постійних товарних клієнтів приєднуються Західна Азія, Нубія, Судан. Враховуючи особливу роль держави як організатора і контролера на Сході формуються товарні потоки в рамках політики державної монополії на зовнішню торгівлю. Державні форми організації торгівлі охоплюють Єгипет, Палестину, Вавілон. В цей період єгипетські товари починають проникати на північ – до Егейського моря [9, с. 178-179].

В свою чергу, нові види сировини вплинули на появу нових потреб для збуту та формування нових галузей: зовнішньої і внутрішньої торгівлі. Олово, наприклад, везли з Месопотамії, Афганістану, Анатолії. Мідь з Кіпру тривалий час виступала не лише як важливий компонент виготовлення бронзи, а також в Єгипетській державі цей метал тривалий час виконував функцію еквіваленту при торгових операціях [6, с. 135-137].

Здійснення масштабних торгових зв'язків було можливим лише за умови наявності достатньої кількості кваліфікованих мореходів, професійних купців. Поступово формувались корпорації професіоналів, які спеціалізувались на комерційних операціях. Мешканці Індостану підтримували торгові зв'язки у першу чергу з Месопотамією і Еламом, при цьому це були караванні шляхи і морська комунікація через Перську затоку [9, с. 409]. Наприкінці XV ст. до н.е. помітних успіхів досягла морська торгівля. Приморські міста перетворювались в центри міжнародної торгівлі. Сформувалась стійка система комунікацій по яким рухались такі товари як: слонова кістка з Африки, бурштин з балтійських областей, скло з Фінікії, мідь з Іберії, олово з Корнуолла. Дж. Біб стверджує, що каталізатором розвитку торгівлі у цей період стало поширення бронзи: люди у самих віддалених куточках близькосхідного та північноафриканського регіонів цілеспрямовано виробляли товари для обміну на бронзові вироби. Мореплавці-купці Середземного моря здійснювали далекі

подорожі за межи Гібралтарської протоки в пошуках необхідного для виробництва бронзи – олова [13, с. 312]. У І тис. до н.е. міжнародний ринок обміну природнім шляхом визначив і встановив універсальні еквіваленти торгового обміну – срібло та золото.

З ІІ тис. до н.е. провідне місце займає морська торгівля як найбільш дешевий і зручний вид транспорту. Наприклад морські зв'язки Месопотамії здійснювались через острів Бахрейн у Перській затоці з узбережжям Оману [19, с. 62]. Вважається що саме на цьому острові в ІІІ-ІІ тис. до н.е. знаходилась легендарна торговельна держава Дільмун [20].

Важливим фактором між цивілізаційних торгових контактів стало домінування в Середземному морі флоту мінойської культури, центром якої став о. Кріт. Це була перша в басейні Середземного моря «морська» (талассократія) цивілізація, розквіт якої залежав від панування на морі і морської торгівлі. Мінойська цивілізація виникає у ІІІ тис. до н.е. і на першу половину ІІ тис. припадає її зоряний час. Морська торгівля розширювала можливості особистого вибору, підприємницьких рішень ініціативи.

Слід зазначити, що прянощі, коштовні каміння, фарба для тканин та інші предмети, які гарантували швидкий обіг коштів і великі прибутки завозилися з Індостану та Східної Африки у портах Південної Аравії перевантажувались на верблюдів і транспортувались у торгові міста Східного Середземномор'я звідки морськими суднами перевозились до Аттики, Піренеїв, Аппенін. Завдяки вигідній товарній кон'юнктурі в середині І тис. до.н.е. розпочинається розквіт арабських міст-держав Південної Аравії [14, с.29].

Коли ж центр торгової активності переорієнтувався з Перської затоки до східного Середземномор'я, значно посилилась роль фінікійського узбережжя. Якщо Стародавній Єгипет та держави Месопотамії відзначились у створенні примітивних транспортних засобів, налагодження перевезень як по суші так і по річках, то фінікійці стали лідерами саме а організації морської торгівлі. Вони заклали основу поступового тривалого процесу формування Середземномор'я як регіону, що зв'язав економічно, політично, культурно народи Північної Африки, Близького Сходу, Піренеїв, греко-римського світу. Фінікія виконувала цю роль тривалий час, поки не була підкорена персами у VI ст. до н.е.

Другим стовпом, на якому трималась торгівля починаючи з ІІІ тис. до н.е. – це внутрішньоконтинентальні караванні шляхи. Але користування такими комунікаціями вимагало наявності надійного транспорту. З початку, перші каравани використовували мулів та віслюків, але у ІІ тис. до н.е. відбувається приручення верблюда. Такий «технологічний» крок дозволив прокласти караванні шляхи в Центральну Азію та на Аравійський півострів і таким чином підкорити пустелі людині [6, с. 136]. Африканські каравани рухались від озера Чад та Тімбукту до північного узбережжя материку та від Нилу і Нігера через Судан, купців цікавили Сокото та Кано [12, с.216].

І тис. до н.е. стало часом піднесення організованих сухопутних комунікацій в державах Сходу. В імперії на той час, що виникли – Ассирійська, а потім Перська,

яка об'єднала території від Нилу до Амудар'ї , прогрес сухопутних шляхів сполучення був пов'язаний з реалізацією військово-стратегічних завдань, а також сприяв зростанню товаропотоків. Ассирія, яка стала зразком мілітаризованої імперії, спочатку розвивалась в якості транзитної території Передньої Азії завдяки вдалому географічному розташуванню і відповідно зосередження караванних шляхів. Що на думку істориків пояснює роль і значення Ассирії в стародавній історії [19, с.150-151].

В Месопотамії Царська дорога, з'єднувала перську цивілізацію з Егейським світом і вела каравани до Левантийського узбережжя і далі через Анатолійське плато, слугуючи своєрідним сухопутним мостом, рухаючись яким каравани близькосхідних держав насичували ринок Європи продуктами і ремесничними виробами. Вавілон виконував роль вузлового пункту караванних комунікацій, які проходили не лише через Західну Азію на Схід до Індії та імперії Хань, а ще і на південь. Геродот повідомляє про якісні шляхи споруджені перськими царями, вздовж яких облаштовувались станції – притулки для караванів та мандрівників. Особливої уваги сучасників заслуговувала дорога, що починалась з стародавньої столиці перських царів Суз. Вона була збудована за наказом Дарія Гістапа та її довжина сягала 3400 км.

Будівництво доріг на Європейському континенті було пов'язано з технічними і торговельними досягненнями Мінойської культури. Так на Криті була знайдена археологами перша мощена дорога, яка датувалась початком II тис. до н.е. Культура Криту мала значний вплив на державотворчі процеси народів, що проживали на материковій частині Греції. Серед них у II тис. до н.е. найбільшого успіху досягли ахейці з їх політичним центром Мікени. Пік політичної та економічної сили Мікен припадає на XV-XIV ст. до н.е. чому сприяли інтенсивна торгівля і створення мережі доріг, які зв'язували Мікени з морськими гаванями на узбережжі. Археологічні дослідження дозволяють стверджувати, що вони будувались за єдиним планом робіт [15, с.372].

Таким чином у II тис. до н.е. в результаті поширення осередків стародавніх цивілізацій за допомогою торгівельних контактів на теренах Середнього Сходу, Месопотамії, Єгипту, Малої Азії, Аттики утворилось єдиний цивілізаційний простір. Сформувались передумови для подолання стагнуючого авторкічного розвитку окремих народів и створення системи взаємопов'язаних цивілізацій.

В середині IV тис. до н.е. набуває форм державності стародавньоєгипетська цивілізація. Значну роль в цьому процесі відіграв комунікаційний чинник, а саме роль та значення Нилу для інтеграції господарських зв'язків та поширення міжнародного товарного обміну. Особливість гідрографії Нилу була наступною: течія ріки була спрямована на північ, а вітри дули на південь. Таким чином, забезпечувались надзвичайно сприятливі можливості для судноплавства і відповідно для перевезення вантажу, товарів і сприяло об'єднанню областей у централізовану державу [15, с. 232-233]. На думку істориків-єгиптологів торгові контакти шумерських міст-держав, що здійснювались морським шляхом через

Перську затоку навколо Аравії у Червоному морі прискорили формування єгипетської державності [14, с. 118-119].

Але перші достовірно підтверджені археологічними пам'ятниками відомості про товарний обмін стародавнього населення Єгипту відноситься до мідно-кам'яного віку (халколіт або енеоліт) і охоплює період з кінця V тис. до н.е. і до виникнення держави це 3000 тисячні роки до н.е. Мова йде про археологічні відкриття 1894–1895 рр. в Нагаді, що відповідають хронологічно добі до династичного часу та початку Раннього царства. До числа археологічних знахідок, що підтверджували товарні зв'язки Єгипту з іншими народами відносять мушлі, обсидіан, лазурит, асфальт, ліванський кедр, кераміка, слонова кістка. Мушлі з Червоного моря зустрічаються на території Єгипту ще з часів енеоліту. Вони слугували матеріалом для виготовлення прикрас. Обсидіан (вулканічне скло) також використовувалося для ювелірної справи. Тривалий час проблема походження обсидіану залишалась відкритою. Так археологи Франкфорт та Уайнрайт доводили, що обсидіанові предмети були кавказького походження. І лише лабораторні дослідження А. Лукаса довели, що більшість знайденого в Єгипті обсидіану, має абіссинське походження [16, с. 113-123]. Лазурит у порівнянні з обсидіаном у до династичному Єгипті мав більш широке поширення, але і він йшов як правило на виготовлення прикрас. Основним постачальником цього матеріалу був Бадахшан (територія Афганістану) [17, с. 202]. На зв'язок Єгипту з Палестиною вказує знахідка невеликої кількості асфальту в Мааді, який завозився з регіону Мертвого моря. Одним з доказів товарних зв'язків населення Єгипту з сірійським узбережжям Середземного моря є знайдені у Бадарі залишки кедру, кипарису, алеппської сосни. Зазначені породи деревини використовувались для суднобудування, будівництва невеличких культових споруд, виготовлення меблів. У той же час археологічний матеріал підтверджує самостійність розвитку металургії в до династичний період, але при цьому імпортувалась мідна руда та олово, або захоплювались території поблизу Єгипту з наявністю мідних руд.

В період історії Давнього царства (приблизно 3000–2800 рр. до н.е.) зовнішня торгівля, у тому числі єгипетська ще не знала грошей і фактично міновою, або взагалі необхідні предмети і сировина добувались за допомогою військових експедицій. У першу чергу єгипетську державу цікавили мідні рудники і тривалий саме мідь виконувала роль еквівалента багатства. Характер торгівлі суттєво не змінився і у часи Середнього царства (2250–1700 рр. до н.е.), у зв'язку з появою нового важливого товару – бронзи. Але все рівно обмін вимагав універсального еквівалентного механізму вартості. Тривалий час функції валюти виконували крім міді та бронзи – зерно, худоба, одяг, срібло, золото.

В добу Нового царства (1580–1070 рр. до н.е.) помітно розширюється географія сполучень і асортимент товарів. Давньоєгипетська цивілізація характеризувалась вмінням та навичками з будівництва різних типів торгових суден. Судна будувались в долині р. Нил, а потім у разобраному вигляді транспортувались до узбережжя Середземного та Червоного морів, де знову

збирались та спускались на воду. Це давало можливість державним торговим агентам єгипетських фараонів підтримувати торговельні зв'язки з Сирією, Критом, східним узбережжям Африки, імпортуючи цінні породи деревини, слонову кістку, метали, рабів. Хотілось би окремо зосередитись на вартісному еквіваленті, що діяв в економіці Стародавнього Єгипту. Історичні джерела давньоєгипетського періоду повідомляють про одиницю обміну під назвою «шетіт», яка виконувала функцію оцінки продажу будь-якого товару. Один шетіт відповідав визначеній кількості чи вазі коштовних металів і фактично відігравав роль безготівкового розрахунку. В подальшому шепіт вийшов з користування і його замінив – «дебен» (кільце). Відбувався обмін товарів еквівалентної вартості у дебенах. В часи правління фараона Рамзесів додалась ще одна одиниця розрахунку – «кедет». В різні історичні періоди змінювалось співвідношення цих стандартів. За часів XVIII династії один дебен дорівнював 91 г срібла, а кедет – 1/12 дебена, тобто 7,1 г При XIX та XX династіях кедет складав 1/10 частку дебена – 9,1 г коштовного металу [15, с. 61]. Крім того використовувались шумерські, а потім і вавилонські срібні бруски – секлі, а ле також для безготівкових розрахунків. Лише з VII ст. до н.е. з початком карбування в Лідійському царстві класичної монети гроші стають обов'язковим елементом торгових операцій на зовнішньому та внутрішньому ринках.

Особливе місце в торгових операціях Стародавнього Єгипту займали інші африканські держави і союзи племен. Серед найбільш цінних торгових партнерів Єгипту слід відзначити царство Куш (потім Меріотське царство на території сучасного Судану). Єгипет починаючи з III тис. до н.е. здійснював з царством Куш періодичний обмін товарами. Всі контакти здійснювались завдяки Нилу – водній комунікації, що зв'язувала країни. Форми організації зовнішньої торгівлі Мерое (Куш) з Єгиптом в той період були достатньо консервативні, за даними Філострата навіть на початку III ст. до.н.е. переважав натуральний обмін [16, с. 315]. Це був так званий «німий» торг. Мероїтські купці розкладали власні товари у визначеному місці, а купці з Єгипту залишали власні продукти та речі в кількості, що на їх думку відповідало вартості товарів куширів. Але поступово товарообмін змінився на відкриту єгипетську експансію і у II-I тис. до н.е. під владою Єгипту опинилась частина території Кушу в районі першого нільського порогу [17, с. 250].

З поширенням єгипетської експансії (до X ст. до н.е.) влада Кушу змушена була визнати васальну залежність від фараонів і торговий обмін трансформувався в товарну данину. Ні одна інша провінція єгипетської імперії не могла зрівнятись з Кушем в кількості та асортиментом товарів, що поставлялись до метрополії. В першу чергу це золото і срібло, яке надходило з південно-східної пустелі та Нубії. В античних джерелах згадувалось географічне місце Ваді Аллакі. З цього приводу Геродот писав: «На південному заході Ефіопія – остання населена країна на землі. Ця країна багата золотом, в ній живуть величезні слони, а також ебеновє дерево. Люди там надзвичайно великого зросту, красиві і довгожителі» [17, с. 114]. Крім того в значних кількостях надходили бавовна, слонова кістка, шкіри леопардів,

жирафів, гепардів. Щорічні поставки данини з Нубії супроводжувались пишними церемоніями, зображення яких залишились на гробницях єгипетських намісників Куша. В Бейт ель Вали, в храмі Рамзеса II згадується золото в кількості 29 кілець та 8 мішків з злитками, діорит, граніт, мідь, залізо, коштовні каміння [18, с. 304].

У даному випадку, Єгипет як отримувач великих обсягів африканських екзотичних товарів, займався їх подальшою реалізацією вже як власних у східному Середземномор'ї. На південь до Мерое єгиптяни, ввозили срібний та глиняний посуд, бронзові вироби, скло, оливкову олію, вино. В добу VI династії Єгипет експортував до Нубії мед, одяг, ароматичні масла, косметику.

Торгові комунікації з Єгипту до Мерое зосереджувались на Нилі. Морський шлях вздовж східно-африканського узбережжя залишався сезонним внаслідок панування несприятливих мусонів. Але слід враховувати у той період Нил не був судноплавним по всій своїй довжині. Численні пороги робили вільне судноплавство неможливим і це вимагало будувати обхідні канали. Крім того Нил створював довгі закрути, які збільшували час перевезення товарів, тому конкурентом річного шляху виступав караванний шлях, який контролювали нубійці. Зацікавленні в підтримці торгівлі з Єгиптом.

Відродження Єгипту як суверенного учасника міжнародної торгівлі в другій половині IV ст. до н.е. ставши центром еллінської державності в Північній Африці при династії Птолемеїв. Відомий дослідник економіки античного світу М. Ростовцев окреслює два типи економіки характерних для цього історичного часу. Це централізована економіка східних сатрапій і полісна економіка [18]. Птолемеї будучі продовжувачами традицій державної монополії на засоби виробництва, характерної для східних централізованих монархій встановили тотальний контроль за всіма сферами економічного життя Єгипту. В тому числі була встановлена державна монополія на отримання основної частки від комерційних операцій. З цього приводу Страбон зазначав: «Ще зовсім недавно ледве 20 кораблів наважувались перетнути Аравійську затоку, щоб вийти за межи протоки; тепер відпливають великі флоти навіть до Індії та Ефіопії, звідки привозять до Єгипту найбільш цінні товари, а звідси знову розвозять в інші краї; тому стягуються подвійні мита – ввезення та вивезення; на коштовні товари і мита великі. Країна також користується монополіями; лише одна Александрія є величезним складом таких товарів та відправляє їх до інших країн». Власну столицю Александрію Птолемеї перетворили на джерело прибутку, збудувавши торговий флот і гавані з товарними складами. Страбон звертає увагу, що частина портових споруд знаходилась у особистій власності єгипетських царів. До таких споруд відносились штучно створена царська гавань і острів Антіродос з двома гаванями.

Головними експортними товарами Єгипту у цей період стали пшениця та папірус. В цій сфері інтереси Єгипту перетинались з інтересами держав Північного Причорномор'я. Птоломеї, повністю контролюючі єгипетську комерцію, також встановили державну монополію на караванні шляхи і збували власну продукцію в Центральній Африці, Кашгарії, на Тибеті і кордонах Китаю

[18, с. 594-596]. При цьому держава забороняла вивезення з Єгипту рабів, а всі купці та судновласники повинні були реєструватися [18, с. 1246].

Після завоювань на Сході Александра Великого трансформується система грошового обігу. Значні обсяги перських золотих монет даріків була перекарбована на грецький зразок і введена у грошовий обіг на величезних територіях. В III ст. до н.е. на Сході та Єгипті домінували дві монетні системи: драхма Александра, яка відповідала афінському стандарту і була поширена в Афінах, Македонії, на Близькому Сході, Пергаме, Каппадокії. І фінікійська система, які підтримував Єгипет Птолемеїв і острів Родос [6, с. 67]. До еллінізму Єгипет ця держава обходилась взагалі без власної грошової системи. Монети іноземного карбування потрапляли в Єгипет, але виконували скоріше роль еквівалента багатства ніж механізму торгівлі. Але наприкінці IV ст. до н.е. все змінюється. Птолемей І з 305 р. до н.е. запроваджує карбування золотих статерів, срібних тетрадрахм та мідних оболів, завдяки чому Єгипет покінчив з бартерною торгівлею. Грошовий обіг Птолемеїв стало інструментом зовнішньої зовнішньої політики, який був спрямований забезпечити перевагу єгипетських комерсантів на близькосхідних ринках.

Таким чином участь Стародавнього Єгипту у міжнародній торгівлі базувались на принципах державної монополії з елементами військових контрибуцій і васальної данини від підкорених народів. І лише після включення Єгипту в елліністичний світ наприкінці IV ст. до н.е. поклало край бартерній торгівлі у зв'язку з початком карбування власної монети і створення фінансової системи. Але все рівно східна модель господарювання залишалась домінантою у птолемеївському Єгипту, яка полягала в збереженні та вдосконаленні різних форм державного контролю на грошовим і товарним обігом.

В Стародавньому Єгипті розташування більшості поселень вздовж берегів Нилу сприяло висуванню річкового шляху в лідери місцевих торгових комунікацій. Нил робив доступною будь-яку провінцію Єгипту та оточуючі країни торговим та іншим господарським справам. Річка та мережа навколишніх каналів створювали безкоштовну загальнодержавну транспортну магістраль для всіх підданих фараонів. Одночасно Нил дозволяв оперативно здійснювати державний контроль за місцевою номовою знаттю. Саме завдяки Нилу Єгипет підтримував жваві торговельні та дипломатичні контакти з державами на території сучасного Судану, Ефіопією. Навіть після формування політичної монополії римської держави в Північній Африці у І ст. до н.е. судноплавство по Середньому та Верхньому Нилу, до районів І порогу залишалось поза контролем римської адміністрації і повновласними господарями там були єгиптяні та мероїтські царі. Нил тривалий час залишався основним торговим шляхом по якому екзотичні африканські товари потрапляли на середземноморський ринок. Стосовно столиці Кушської держави Мерое Страбон робив наступне спостереження. «Переваги розташування міста багатоманітні; по-перше, площа його омивається двома морями: на півночі так званим Єгипетським морем, на півдні – Марейським озером, яке має назву Мареотіди. Озеро наповнюється водою

нільських каналів та проток. Через ці канали вивозиться значно більше товарів, аніж з моря [3, XVII, I, 7]».

На острові поблизу першого порогу – в місті Елефантина (сучасний Асуан) діяла митниця і знаходився перевалочний пункт руху товарів з півночі на південь та з півдня на північ. Елефантина перетворилась на торговий центр, де нубійці обмінювали на єгипетські товари власну продукцію так і товари придбані у племен, що жили на півдні. Для безпеки торгового шляху по Нилу в Елефантині розміщувався єгипетський гарнізон. Пізніше на нільському маршруті з'явились ще два торгово-перевалочні пункти у Сіене та Ієре Сикаміне [19, с.30].

Але вже у III ст. до н.е., з вивченням місцевої гідрографії Червоне море поступово набуває популярності як зручна комунікація. Через порти Червоного моря почати відвантажувати товари, які раніше доставлялись з Екваторіальної Африки в країни Середземномор'я транзитом через Куш і Єгипет, про що свідчили Страбон та Плінiй.

Стимулом для розвитку морської торгівлі між внутрішньою Африкою та Єгиптом за часів правління Птолемеїв стали живі слони. Для Птолемеїв слони були цікавим товаром з точки зору військової справи. Власними силами подолати довгий шлях з Кушу до Єгипту величезні тварини не могли. Тому за наказом Птолемея II на Червоному морі спеціально збудували порт Терон, з якого слони та інші африканські товари потрапляли до Александрії, а потів і в інші країни. Після відкриття Теронського порту морська торгівля між Єгиптом та Мерое за обсягами обійшли річкову та караванну торгівлю перетворившись на основну.

Розглянемо основні маршрути в Середземному морі, що зв'язували Єгипет з іншими державами регіону. Основні морські маршрути перевезення товарів сформувались ще у II тис. до н.е. Це комунікація, що зв'язувала Малу Азію та Крит з Єгиптом та проходив в прибережних малоазійських водах. За повідомленням Діакона Марка тривалість цього маршруту не перевищувала 11 днів. Шлях, що з'єднував Єгипет з приморськими містами Палестини та Сирії вважався одним з найстародавніших і ним користувались з часів мікенської цивілізації. Слід відзначити, що ці маршрути окрім навігаційних перешкод періодично знаходились під контролем піратів. Особливо загрозливим вважався час з середини VI ст. до н.е. і до II ст. до н.е., коли на цій комунікації діяли пірати-долопійці з о Скірос з якими було покінчено лише в 476 р. до н.е. військовою експедицією Кімона [19, с. 215].

В класичну та еллініcтичну добу південний торговий шлях використовувався як правило для поставок єгипетського зерна в Аттику, до Афін, потім до Риму. Найбільший розквіт цього шляху припадає на III ст. до н.е. Не лише зерном славилась торгівля Єгипту у той час. Значним попитом користувались єгипетський папірус, льняні тканини, слонова кістка. В свою чергу Єгипет імпортував оливкову олію з Аттики, вино з Фасосу, деревину з Малої Азії, мідь з Кипру [20]. Особливе місце в єгипетському імпорті відігравало срібло, яке йшло на карбування монет.

Зростання економіки античного світу вимагало все більшої кількості різноманітних товарів і це вплинуло на формування нової торгової комунікації в якій Єгипту відводилась ключова роль. В нових умовах Єгипет став з'єднавчим ланцюгом торгових маршрутів Червоного моря, Перської затоки, Індії. Першим хто розпочав освоєння цього маршруту став Скілак Каріандський, який пройшов з Перської затоки до Індії у 518–516 рр. до н.е., про що згадує Страбон [3].

Ми не можемо не згадати експедицію Неарха, одного з полководців Александра Великого, кораблі якого у 325–323 рр. до н.е. здійснили дві подорожі з знайти зручний морський шлях, що з'єднав би Близький Схід та Індію.

Перший з негоціантів, хто пройшов весь шлях від Єгипту через Червоне море до Індії став Евдокс з Кізику. Страбон зазначає, що Птолемей VIII після того, як у берегів Єгипту знайшли після аварії індійське судно з живим матросом і той погодився показати прямий морський шлях до Індії, наказав Евдоксу з метою імпорту ювелірних прикрас відправитись до загадкової країни. І це стала перша відома морська експедиція єгиптян до Індії [3, II.3.5].

Вагомим фактором, що впливав на морські подорожі до Індії стало відкриття приблизно у 100 р. до н.е. грецьким навігатором Гіппалом мусонних вітрів в Індійському океані, що дозволяло торгові сполучення між Єгиптом та Індією перетворити на регулярні. Тому що до Гіппала подорож з Єгипту до Індії досягала двох років. Найбільш зручним часом року для подорожі до Індії вважався вересень, коли дули північні вітри. Маршрут проходив вздовж узбережжя Червоного моря перші три доби, потім судна йшли відкритим морем тримаючи курс на Барбарікон (сучасний Карачі). Псевдо-Арріан повідомляє, що основним видом товарів, які перевозились цим маршрутом були коштовні прикраси та оброблені коштовні каміння [7]. Страбон зазначає, що від портів Червоного моря щороку до Індії здійснювали перехід до 120 суден, а згідно Плінія суми торгівлі з Індією сягали 55 млн. сестерціев [19, с. 101].

Але тепер час розглянути еволюцію стародавнього єгипетського суднобудування. До 330-320-х рр. до н.е. воно мало самобутній характер і лише після включення Єгипту в еллінський світ відбувається заміна єгипетських технологій в суднобудуванні на грецькі та карфагенські.

Можна сміливо стверджувати, що у повсякденному житті, релігії стародавніх єгиптян води Нілу, Червоного моря відігравали важливу роль. Про це свідчать археологічні пам'ятники, малюнки, тексти. Спеціалізований словник Jones за 1988 р. дев'яносто типів суден у давньоєгипетській мові [11, с. 1-2]. До наших часів збереглось велика кількість графіті, рельєфів, моделей кораблів. Так на керамічних сосудах культури Нагада II (приблизно 3500 – 3200 рр. до н.е.) вже присутні зображення кораблів. Рельєф з гробниці принцеси Ідут V династії (2494 – 2345 рр. до н.е.) розповідає про використання папірусних човнів. Наративні джерела, що включають фольклорні матеріали, угоди про фрахт, митні реєстри формують загальну картину значення суднобудування і морських комунікацій для торгового обміну Стародавнього Єгипту.

Першим з істориків, хто фундаментально розпочав досліджувати проблематику суднобудування та судноплавства у Стародавньому Єгипті став Ш. Боре. Результатом його досліджень, у тому числі археологічних пам'яток стала наукова праця «Etudes de nautique égyptienne: l'art de la navigation en Egypte jusqu'à la fin de l'ancien Empire» (Мистецтво навігації у Стародавньому Єгипті до кінця Давнього царства), яка була видана у 1925 р. І якщо Ш. Боре міг спиратися лише на небагатий на той час археологічний матеріал, то вже наприкінці XX ст. внаслідок інтенсивних археологічних досліджень на узбережжях Червоного та Середземного морів, а також в долині Нілу були знайдені не лише фрагменти, а навіть уцілілі зразки човнів та кораблів різних періодів. Найбільш ранні знахідки єгипетських кораблів археологами датуються 2950 р. до н.е. – Раннє царство. Найбільше число знахідок – 14 залишків кораблів відноситься до 2650 р. до н.е. Раннього царства і цей масив знахідок географічно розташований в місті Абідос. Максимальна кількість знахідок кораблів відноситься к періоду 800 – 50 рр. до н.е. – 64 одиниці. Більшість знахідок була сконцентрована в районі Фоніс-Гераклеї. При цьому повністю змінився суднобудівний тип. Єгипетський тип судна замінюється еллінсько-римським [11, с. 3].

Виходячи з археологічних даних першими плавзасобами на Нилі були плоти з папірусу. Перші зображення дерев'яних кораблів успадкували від папірусних плотів серповидну форму корпусу – з високо піднятими носом та кормою. Така форма конструкції корпусу залишалась характерною для давньоєгипетського суднобудування до початку IV ст. до н.е. Суднобудування в Давньому Єгипті формувалось на річковому судноплавстві, тобто застосування плоскодонного типу судна. В Єгипті традиції річкового суднобудування були настільки впливовими, що при побудові і морських суден майстри звертались до річкових аналогів, адаптуючи їх до морського застосування. Таким чином тривалий час в єгипетському суднобудування переважав плоскодонний тип конструкції корабля. Декілька слів про характеристику деревини, яка йшла на будівництво суден давнього часу. Наприклад, у Середземномор'ї з достатніми запасами лісу місцеві жителі традиційно використовували для кілю корабля – дуб чи кипарис. На обшивку бортів йшла сосна, для шпангоутів – в'язь, який мав високу пружність та еластичність. Інші елементи корпусу корабля виготовлялись з кам'яного дубу або оливкового дерева. Яка ж місцева деревина була доступна єгипетським корабелам. Як правило, найбільш поширеним матеріалом виступала акація, сикомор, тамариск, персея, ююба.

Нільська акація з давніх часів була основним будівельним матеріалом для кораблів. В автобіографії Уни, який жив у часи правління фараона Пепі I (VI династія, 2232 – 2283 рр. до н.е.), повідомляється про будівництво вантажних суден «сехет» і «сатч» з акації. Довжина цих суден складала 32 м. Писемні джерела знаходять і археологічне підтвердження. Всі фрагменти конструкцій кораблів, знайдених у Ліште (приблизно 1950 р. до н.е.) зроблені з акації та тамаріска. З акації було збудовано 80% суден Пізнього царства (664–332 рр. до н.е.), а також греко-римського періоду [11, с. 5–6].

Особливе місце в технологіях давньоєгипетського суднобудування відводилось дереву сикомора, яке пов'язано з міфом про Осириса та Ісиду. Корабель з сікімору згадується в релігійних текстах. У Гераклеї був знайдений човен з сікімору, що хронологічно відносився до IV ст. до н.е. Також ця порода деревини застосовувалась і для побудови звичайних вантажних суден, про що свідчать залишки корпусу судна з Матарії (V ст. до н.е.). Згідно з храмовими джерелами з сікімору будувались великі баржі для транспортування обелісків будівництва храмових споруд та палацових комплексів [20, с. 128–133].

Таким чином давні єгиптяни змогли технологічно пристосувати місцевий ресурс для суднобудування, але характеристики місцевої деревини значно поступались імпортним породам, що змушувало місцевих корабелів проявляти зразки технічної винахідливості. Імпортна сировина, а саме ліванський кедр, кипарис, алеппська сосна використовувались як правило для будівництва кораблів фараона і морських суден. Таким чином морська торгівля Єгипту в плані суднобудування залежала від імпортної складової і в структурі єгипетського імпорту корабельна деревина займала провідне місце.

В Давньому Єгипті уважно ставились до збереження ресурсу морських суден. Так с 1980-х рр. на єгипетському узбережжі Червоного моря археологи знайшли залишки розвинутої портової інфраструктури з часів Давнього царства, які обслуговували морські експедиції в Пунт та Індію. Наприклад у Мерса-Гавазісі, Айн-Сохне, Ваді-ель-Джарфе були розкопані підземні галереї, в який здійснювався ремонт суден і де вони зберігались. Археологи вважають порт у Ваді-ель-Джарфе, який збудували за часів правління фараона Хеопса найбільш стародавнім портовім об'єктом подібного призначення.

Таким чином єгипетська цивілізація формуючись навколо річкової комунікації – Нилу, розвивала ремесло суднобудування, яке пройшло еволюцію від папірусних човнів до оригінальних конструкцій морських суден. Але з інтеграцією Єгипту з IV ст. до н.е. у еллінсько-римську систему торгівлі на стапелях місцевих верфей зайняли місце класичні середземноморські типи суден.

Таким чином перехід людства до виробничої економіки створили об'єктивні умови з розвитку товарного обміну виробленими продуктами, а часом і спеціалізованими товарами і поступово цей обмін став необхідною умовою існування цивілізації. Внаслідок зростання інтенсивності руху людей формуються і перші комунікації, які в подальшому починають відігравати економічну, військову і управлінську функції.

Починаючи з V тис. до н.е. водна комунікація (річкова, морська прибережна) відіграють центральну роль у формуванні стародавніх цивілізацій річкового типу, до яких відносилась і давньоєгипетська. На базі торгових відносин здійснювався не лише обмін товарами, відбувались інтенсивні контакти між населенням стародавніх держав, що приводило до взаємного збагачення культурним, технологічним досвідом. Використання морських і річкових комунікацій сприяло процесу створення перших імперій в історії людства. І такий історичний приклад надав Давній Єгипет. Влада якого використовувала Нил та

узбережжя і моря для просування власного політичного впливу над сусідніми народами за допомогою торгового обміну.

К середині II тис. до н.е. завдяки інтенсивному торговому обміну сформувалось єдиний цивілізаційний простір, який охоплював Єгипет, Месопотамію, Палестину, Малу Азію, Мінойський Крит.

Весь історичний проміжок часу існування давньоєгипетської держави, до падіння останніх Птолемеїв у I ст. до н.е. зовнішня торгівля знаходилась під управлінням державних органів і була підпорядкована інтересам зовнішньої політики держави. Тому цей фактор слід враховувати, коли досліджуєш географічні напрями торгівлі єгиптян та їх торговельних партнерів.

Географічне розташування Єгипту, наближення до основних центрів Східної та Східно-африканської торгівлі створювали об'єктивні умови розвитку суднобудування в Єгипетському царстві. Але дефіцит класичних порід деревини змушував єгиптян знаходити оригінальні замінники і таким чином забезпечувати власними суднами торговельні експедиції як по Нилу так і по Середземному та Червоному морях. А з IV ст. до н.е. морська торгівля єгиптян поширюється на Перську затоку та Індійський океан.

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CHAPTER 4. TRAINING OF SPECIALISTS IN MODELING, PROGRAMMING AND CONTROL OF MECHATRONIC COMPLEXES

4.1. Fundamentals of Mechatronic Complexes and Training of Specialists in the Field of Mechatronics Today

Mechatronic systems consist of three main components:

1. Mechanical components: these are various mechanisms, motors and gearboxes that perform physical work. For example, in industrial robots, mechanical arms perform manipulations with objects.

2. Electronics: these are controllers, sensors and other electronic elements that provide data processing and control of mechanisms. They are responsible for obtaining information from the environment and making decisions based on this data.

3. Software: these are algorithms that implement management strategies and data processing. Programming ensures the integration of mechanical and electronic components into a single system [1–10].

Let's consider each component of mechatronic systems in more detail:

1. Mechanical components. Mechanical elements are the basis of mechatronic systems. They provide the physical structure and functionality, performing mechanical work. The main mechanical components include:

- motors – used to convert electrical energy into mechanical energy. They can be of different types: direct current, alternating current, stepper and servo motors. Each type has its own advantages depending on the requirements for accuracy, speed and power;
- reducers – reduce the speed of rotation of motors, increasing the torque. They are necessary for optimizing the operation of mechanical systems, in particular in works that require high positioning accuracy;
- sensors – measure physical quantities (temperature, pressure, humidity, position, speed, etc.) and transmit this data for processing. For example, optical sensors can be used to determine position or distance;
- actuators – perform physical actions based on commands received from the controller. They can be electrical, hydraulic or pneumatic;
- structural elements – include gears, shafts, bearings, frames and other mechanical parts that ensure the structural integrity and functionality of the system.

Functions and importance of mechanical components: mechanical components ensure the performance of the main functions of mechatronic systems. They allow the conversion of electrical energy into mechanical work, provide accuracy and control over movements, as well as interaction with the environment. Without reliable mechanical elements, the system will not be able to operate efficiently and safely.

2. Electronic components. Electronics are the heart of mechatronic systems, providing information processing and control of components. The main electronic components include:

– microcontrollers – these devices are the "brains" of mechatronic systems, they process data from sensors and give commands to actuators. Popular microcontrollers, such as Arduino, PIC and STM32, are widely used in education and development;

– sensors – include a variety of devices that can measure various physical quantities. For example, accelerometers measure acceleration, and temperature sensors – temperature. This data allows the system to respond to changes in the environment;

– analog and digital circuits – are used for signal processing, voltage changes, filtering and signal amplification. These elements are necessary to ensure the correct operation of sensors and actuators;

– power supplies – provide stable power supply for the entire system, converting voltage and providing the necessary current for all components.

Functions and importance of electronic components: Electronics provide intelligence to mechatronic systems, allowing them to collect data, analyze information and make decisions. Thanks to electronic components, systems can respond to changes in the environment and execute complex control algorithms. This makes them extremely flexible and adaptive.

3. Software. Software is a critical element responsible for the logic of mechatronic systems. It includes:

– operating systems – provide a basic platform for the programs that control the system. Embedded systems often use lightweight versions of Linux or RTOS (Real-Time Operating System);

– control algorithms – include mathematical models and methods that determine how the system responds to input data. This can be simple control (PID controllers) or complex algorithms that use machine learning;

– user interfaces – allow operators to interact with the system. This can be a graphical interface, web applications or mobile applications;

– data acquisition and analysis systems – software may include tools for collecting, storing and analyzing data received from sensors [11-20].

Functions and importance of software: software is what gives mechatronic systems their "intelligence". It converts data received from sensors into control commands for actuators. Without appropriate software, mechanical and electronic components will not be able to work harmoniously, which will lead to system failures.

It is also necessary to consider specific examples of mechatronic complexes in various industries, because it is mechatronic complexes that are widely used in various fields, from industry to medicine. Here are some specific examples that illustrate the diversity of their use:

1. Medicine: Surgical robots – da Vinci (da Vinci Surgical System) – the da Vinci surgical system is one of the most famous examples of mechatronics in medicine. It consists of three main components: the surgeon's workstation, the patient module and the video system. The surgeon sits at a console that has controllers to control the instruments. The system transmits the surgeon's movements to robotic instruments that operate with high precision. Video cameras provide real-time 3D images, allowing the doctor to see the surgical field in high detail. This allows complex surgeries to be

performed with minimal incisions, reducing the risk of complications and the recovery time of patients.

2. Industry: Robotic Systems – Collaborative Robots – Cobots, or collaborative robots, are integrated into production lines and work alongside people. They are equipped with sensors that allow them to safely interact with people. They perform routine tasks such as assembly, packaging and quality control of products. They can adapt to changes in the production process thanks to built-in learning algorithms. The use of cobots increases productivity, reduces the risk of injuries to workers and allows tasks to be performed with high precision.

3. Automotive Industry: Autonomous Vehicles – Tesla Autopilot – the autopilot system in Tesla cars is one example of the use of mechatronics in automotive transport. It combines mechanical elements, electronics and software. The system uses cameras, radar sensors and ultrasonic sensors to collect information about the environment. It is able to automatically change lanes, control speed and even park without driver intervention. This opens up new horizons for road safety, reduces accidents and increases driving comfort.

4. Agriculture: Harvesting robots – Agro-robots – the use of robots in agriculture for harvesting crops, such as berry or vegetable harvesting robots. These robots are equipped with sensors that help determine the ripeness of fruits. They can precisely harvest without damaging plants and fruits. They reduce the need for manual labor, increase harvesting efficiency and reduce costs.

5. Home technologies: Smart home devices – Smart vacuum cleaners (e.g. Roomba) – robot vacuum cleaners use mechatronics to automate the cleaning process. Equipped with sensors for navigation, they are able to detect obstacles, identify contaminated areas and adapt their cleaning trajectory. They reduce the burden on humans by providing the ability to automate everyday tasks [37–40].

Mechatronic systems are being actively implemented in various fields, improving efficiency, safety and convenience. From surgical robots to smart home devices, these technologies are changing the way we live and work, which emphasizes the importance of training specialists in this dynamic and innovative field.

It is the successful integration of mechanical, electronic and software components that is the key to the effectiveness of mechatronic systems. Each of these elements performs unique functions that interact with each other, providing a high level of automation and control. Training specialists who can design and implement these systems is critically important for the development of modern technologies and in the training of future specialists in modeling, programming and controlling mechatronic systems.

Training specialists in the field of mechatronics is a complex and multifaceted process that requires a combination of theoretical knowledge and practical skills, as well as an integrated approach. The main aspects that should be considered:

– Technical subjects: students should study mathematics, physics, engineering mechanics, electrical engineering and programming. These subjects form the basis for understanding the principles of mechatronic systems. In particular, mathematics allows

you to model physical processes, while physics provides knowledge about the laws of motion and force.

- Practical skills: it is important that students have the opportunity to work with real projects, using modern tools and software. Laboratory work, internships in industry, participation in competitions and project work help to gain practical experience.
- Interdisciplinary approach: mechatronics requires knowledge from different fields. Therefore, it is important that curricula ensure the integration of subjects such as automation, robotics and computer science.

Let's take a look at the curricula: what subjects are studied; what skills are developed.

Having analyzed the curricula, we can say that different countries have different approaches to training specialists. For example, in the USA, the emphasis is on practical aspects of training, while in Europe more attention is paid to theoretical foundations. Countries that successfully implement mechatronics programs often provide students with access to modern laboratories and research projects.

The training of mechatronics specialists varies significantly depending on the country, university and education system. Let's consider several countries that have strong programs in this field and compare their curricula, emphases and approaches.

1. Germany – is one of the leaders in the field of mechatronics due to its strong engineering tradition. Programs are usually interdisciplinary, combining mechanics, electronics, computer science and automation. Focused on practical training and cooperation with industry. Examples of universities: Technical University of Munich (TUM) and Technical University of Dresden. Specificity: strong emphasis on practical laboratory classes and projects in collaboration with industry; students undergo internships at leading companies.

2. United States of America – Mechatronics is often studied as part of broader engineering programs (e.g. mechanical, electrical or computer engineering). Programs cover a variety of disciplines such as robotics, automation and control systems. Examples of universities: Massachusetts Institute of Technology (MIT) and University of California, Berkeley. Specificity: emphasis on research and innovation; students participate in projects that may receive funding from industrial partners.

3. Japan – famous for its robotics industry, and mechatronics training programs reflect this. Study of computer modeling, automated systems and artificial intelligence. Examples of universities: University of Tokyo and Osaka University. Specifics: high emphasis on integrating cutting-edge technologies, such as IoT and artificial intelligence, into curricula; students participate in real-world projects in partnership with Japanese companies.

4. European Union – in EU countries such as Sweden, the Netherlands, Italy, mechatronics programs are quite diverse. Project-based learning methods and interactive learning approaches are often used. Examples of universities: Luleå University of Technology (Sweden) and the University of Twente (Netherlands). Specificity: focused on sustainable development and environmental aspects of

mechatronics; use of an interdisciplinary approach to learning, including aspects of economics and management.

5. Ukraine – mechatronics programs are also growing, but they are often less structured compared to leading countries. Programs usually combine the basics of mechanics, electronics, automation. Examples of universities: Igor Sikorsky Kyiv Polytechnic Institute and Lviv Polytechnic National University. Specificity: focused on theoretical aspects with insufficient emphasis on practice; internship systems are often not as developed as in other countries [24–36, 41].

In turn, mechatronics curricula typically include a wide range of subjects that provide students with the necessary knowledge and skills to work in this interdisciplinary field. Here is a more detailed overview of the core subjects and skills developed during the course of study.

1. Core subjects.

1.1. Mechanics – fundamentals of mechanics, static and dynamic mechanics, mechanics of materials. Skills – understanding the principles of mechanical systems, analysis of forces and moments, design of mechanical elements.

1.2. Electronics – fundamentals of electronics, analog and digital circuits, microprocessor systems. Skills – design and analysis of electronic circuits, understanding the operation of various electronic components.

1.3. Programming – fundamentals of programming (C/C++, Python), algorithms, data structures. Skills – development of software for controlling mechatronic systems, writing scripts for process automation.

1.4. Automation and control – control theory, automated control systems, robotics. Skills – design and implementation of automatic control systems, use of control algorithms (PID, Fuzzy Logic).

1.5. Sensors and actuators – types of sensors (optical, ultrasonic, temperature) and actuators (electrical, pneumatic, hydraulic). Skills – Selection, connection and calibration of sensors and actuators for integration into mechatronic systems.

1.6. Real-time systems – principles of operation of real-time systems, embedded systems. Skills – software development for embedded systems, task execution time management.

2. Additional subjects.

2.1. Mathematics and physics – linear algebra, differential equations, classical mechanics. Skills – mathematical modeling of mechatronic systems, analysis of physical processes.

2.2. Computer graphics and CAD systems – basics of computer graphics, design in CAD systems (AutoCAD, SolidWorks). Skills – creation of 3D models of mechanical structures, visualization of projects.

2.3. Engineering economics and management – basics of project management, engineering economics. Skills – project cost estimation, resource management in mechatronic projects.

3. Practical training.

3.1. Laboratory work – performing laboratory practices that include designing and testing mechatronic systems. Skills – developing practical skills in working with real devices, debugging systems.

3.2. Project activities – working on projects that include developing, implementing and testing mechatronic solutions. Skills – teamwork, project management, critical thinking and a creative approach to solving problems.

3.3. Internship – in-depth training in real conditions at enterprises or research institutions. Skills – applying theoretical knowledge in practice, adapting to the conditions of working in a team [37–40].

Therefore, the training of mechatronics specialists varies depending on the country, educational institution and educational culture. It is important to note that in leading countries the emphasis is on integrating theoretical knowledge with practical skills through internships and research projects. While in Ukraine and some other countries there are still problems with the implementation of such approaches, the development of this field continues to grow.

Mechatronics training programs provide a comprehensive approach to training specialists who are able to work at the intersection of mechanics, electronics and programming. Mastering the basic subjects and developing practical skills are critical for a successful career in this dynamic and innovative industry. Qualified specialists can significantly influence the development of new technologies and improve existing solutions in various fields.

4.2. Fundamentals Modeling and Programming of Mechatronic Complexes

Modeling is an important step in the design of mechatronic systems, as it allows you to visualize the operation of the system, identify potential problems and optimize solutions. The main modeling methods include:

1. Systems based on mathematical models: mathematical equations describe the behavior of the system under certain conditions. This allows you to conduct simulations and evaluate how the system responds to different input data.

2. Numerical methods: often used to solve complex problems that cannot be solved analytically. These methods allow you to conduct numerical experiments, which helps to understand how the system functions in different scenarios.

3. Simulation software: tools such as MATLAB/Simulink, SolidWorks, ANSYS allow you to create virtual models. This helps reduce development costs and reduce time to market [37–40].

Different modeling methods have their own approaches, advantages and disadvantages. Here is an overview of the main methods.

1. Analytical modeling – involves mathematical models that describe a system using differential equations or algebraic expressions. Advantages: simplicity: allows for obtaining exact solutions for simple systems; speed: models are easily solved mathematically without the need for computer resources. Disadvantages: limitations: not suitable for complex, nonlinear systems; uncertainty: difficult to take into account all parameters and variations in the real world.

2. Numerical modeling – the use of numerical methods (e.g., finite element methods) to solve complex equations describing mechatronic systems. Advantages: flexibility: suitable for modeling complex systems with nonlinear properties; detail: can take into account different operating conditions and material characteristics. Disadvantages: time-consuming: numerical models can require significant computational resources and time; complexity: creating and configuring models can be a labor-intensive process.

3. Simulation modeling – using software (such as MATLAB/Simulink, AnyLogic) to create virtual models of systems and their behavior in real time. Advantages: visualization: the ability to visually analyze the behavior of the system; interactivity: allows you to change parameters and track the impact of these changes on the system. Disadvantages: resource requirements: working with large models requires powerful computers; reliability: results depend on the quality of the model and the correctness of the assumptions made.

4. Control system modeling – involves modeling a control system to assess its effectiveness. PID control or neural network methods are often used. Advantages: increased efficiency: allows you to optimize control algorithms in real time; adaptability: systems can independently adjust their behavior depending on changing conditions. Disadvantages: complexity of implementation: requires in-depth knowledge of control theory and algorithms; testing: requires a lot of time to set up and test models.

5. Physical modeling – using physical prototypes or scaled models to test a system in real-world conditions. Advantages: Realism: Provides accurate data about the behavior of the system in the real world; Hands-on experience: Allows students and engineers to gain hands-on experience with systems. Disadvantages: Cost: Creating physical models can be expensive and resource-intensive; Limited flexibility: Difficult to make changes after the model is created.

Modeling methods in mechatronics have different approaches that can be chosen depending on the research objectives, available resources and system complexity. Each method has its own advantages and disadvantages, which requires specialists to carefully approach the selection of the appropriate modeling technique for specific tasks. The mixed use of these methods can provide a more comprehensive analysis and optimization of mechatronic systems.

Simulation plays a critical role in the development of mechatronic complexes, allowing engineers to visualize, analyze and optimize their designs before physical implementation. Case studies of real projects show that modeling helps reduce the number of errors at the production stage and improves the quality of the final product. For example, in the automotive industry, structural modeling can prevent accidents associated with incorrectly designed systems. Let's look at some real-world examples of successful use of modeling in mechatronic system design:

1. Designing a cleaning robot

Company: iRobot (manufacturer of Roomba)

Case description: iRobot uses complex models to design its robot vacuum cleaners, including Roomba. The company uses simulation modeling techniques to test navigation algorithms and sensor systems.

Modeling:

– Methods: iRobot uses MATLAB/Simulink software to model motion trajectories and interactions with the environment.

– Process: Create virtual models of homes in which the robot's movements are simulated. This allows Roomba to analyze how it reacts to various obstacles, such as furniture, and adapt its navigation.

Results:

– Significantly reduced prototype testing time.

– Improved navigation performance, leading to increased sales and positive user feedback.

2. Manufacturing Process Automation

Company: Siemens

Case Description: Siemens uses simulation to optimize its automated production lines. With virtual models, companies can plan new production processes with maximum efficiency.

Simulation:

– Methods: Using a computer-aided design (CAD) system and discrete event modeling software (e.g. AnyLogic).

– Process: Creating digital twins of production lines that allow for real-time analysis of system performance.

Results:

– Reduced downtime and increased productivity by 15%.

– Optimized resource utilization, resulting in lower costs.

3. Medical Robot Simulation

Company: Intuitive Surgical (manufacturer of the Da Vinci system)

Case Description: Intuitive Surgical uses simulation to design its surgical robots, allowing for increased precision and safety of operations.

Simulation:

– Methods: Modeling the movement and interaction of instruments with patient tissue using physical simulations.

– Process: creating virtual models of surgical procedures, allowing surgeons to practice operations in a safe environment.

Results:

– Reducing the risk of complications during operations due to improved training of surgeons.

– High precision of manipulations, which increases the overall efficiency of surgical treatment.

4. Automated control systems

Company: Honeywell

Case description: Honeywell uses modeling to develop control systems in industry, which allows them to optimize their operation and increase safety.

Modeling:

– Methods: using numerical methods and software to simulate system dynamics.

– Process: creating models that simulate the behavior of the system under different conditions (e.g., system failures, pressure drops).

Results:

– Improved ability to predict possible emergency situations.

– Reducing system maintenance costs due to early detection of problems.

5. Development of autonomous vehicles

Company: Tesla

Case description: Tesla is actively using modeling to develop its autonomous vehicles. Models allow for the analysis of sensor data and real-time decision-making.

Modeling:

– Methods: Simulating the operation of autonomous driving algorithms in various road situations.

– Process: Creating a virtual environment for testing the autopilot, including various scenarios such as changing weather conditions and the behavior of other road users.

Results:

– Increased road safety due to accurate control algorithms.

– Successful reduction in the number of accidents related to the human factor [15–23].

Using simulation in the design of mechatronic systems allows companies to optimize their processes, reduce costs and increase safety. Real-world examples such as iRobot robots, Da Vinci medical systems, Siemens automated production lines, Honeywell control systems and Tesla autonomous cars demonstrate how simulation has become a critical tool in the development of innovative technologies. This emphasizes the need to train professionals who can effectively use these methods in their work.

In turn, programming is a critical aspect of mechatronics, as it determines how systems interact with their environment. Key aspects of programming:

Programming languages: Students should be familiar with various programming languages, such as C, C++, Python and specialized languages for embedded systems. Each of these languages has its own advantages and specific uses.

Embedded systems programming: This is an important component of mechatronics, which includes the development of programs for microcontrollers, FPGAs and other embedded platforms. Such systems are used in a variety of applications - from automotive to medical devices.

Implementation of projects based on specific programming languages demonstrates how properly written code can increase the efficiency of mechatronic complexes. For example, programming for controlling the movement of a robot may include algorithms that take into account the physical properties of objects.

In the field of mechatronics, various programming languages are used, each of which has its own characteristics and specific applications. Let's consider the most popular programming languages in this field, their advantages, disadvantages and areas of application.

1. C/C++

Features:

C is one of the oldest programming languages that provides low-level access to hardware.

C++ is an object-oriented language that extends the capabilities of C by providing encapsulation and inheritance mechanisms.

Application:

– Used in the development of embedded systems, controllers and robotics.

– Often used in real-time to work with sensors and actuators.

Advantages:

– High performance and memory efficiency.

– Extensive library of ready-made solutions (e.g., ROS – Robot Operating System).

Disadvantages:

– Difficulty in learning, especially for beginners.

– Less safe compared to modern languages (e.g., the danger of buffer overflow).

2. Python

Features:

– A high-level language characterized by simplicity of syntax and readability.

– Has powerful libraries for data processing and machine learning.

Applications:

– Widely used for the development of data processing algorithms, robot control, and sensor data analysis.

– Used for educational purposes due to its simplicity.

Advantages:

– Easy to learn and write code quickly.

– A large number of libraries (e.g., NumPy, SciPy, OpenCV) for working with data.

Disadvantages:

– Lower performance compared to C/C++.

– Not suitable for tasks where real execution speed is important (although built-in modules in C can be used).

3. MATLAB

Features:

– A numerical computing environment that includes a programming language.

– Has advanced functions for modeling, analysis and data visualization.

Applications:

– Used for modeling mechatronic systems, signal processing, control and automation.

– Widely used in academia and research projects.

Advantages:
– Intuitive interface and ease of use.
– Support for numerical methods and algorithms.
Disadvantages:
– Commercial product that requires a license.
– May be less efficient for large systems.
4. LabVIEW
Features:
– A graphical programming language that allows you to create programs by connecting blocks.
– Specifically designed for test and measurement automation.
Application:
– Used in industrial automated systems, for control and monitoring.
– Widely used in scientific research, laboratory automation.
Advantages:
– Visual approach to programming, which makes it easier to understand processes.
– Convenient for rapid prototyping.
Disadvantages:
– High cost of licenses.
– Less versatile compared to text-based programming languages.
5. VHDL/Verilog
Features:
– Hardware description languages (HDL) used to model electronic systems.
– Allow to design digital circuits at the register and circuit levels.
Application:
– Used to design FPGAs and ASICs in mechatronic systems.
– Used in the development of controllers, signal processing.
Advantages:
– Allows to accurately model the behavior of equipment.
– Suitable for designing complex digital systems.
Disadvantages:
– Requires in-depth knowledge in the field of electronics.
– Complexity of syntax for beginners [37–40].

The choice of programming language for mechatronics depends on the specifics of the project, performance requirements and availability of resources. C/C++ and Python are the main languages for developing embedded systems and algorithms, while MATLAB and LabVIEW provide convenience for modeling and automation. VHDL and Verilog are necessary for hardware design. Knowledge of several languages and the ability to combine them in projects are critical for successful work in the field of mechatronics.

Programming is also a critical component in the development of mechatronic complexes, as it provides control and management of mechanical and electronic

elements. Let's consider several specific projects where programming is implemented in various mechatronic complexes.

1. Da Vinci Robotic Surgical System

Project description: The Da Vinci system from Intuitive Surgical is a high-tech surgical robot that allows surgeons to perform minimally invasive operations.

Programming implementation:

– Programming language: C++ for implementing control algorithms.

– Programming: Creation of 3D models and simulations for training surgeons, as well as development of software for controlling instrument movements.

– Functions: Automation of instrument positioning, ensuring accuracy of manipulations through feedback from sensors.

Result: Significantly increased accuracy of operations and reduced risk of complications due to improved software.

2. Autonomous ground robot (AGV)

Project description: autonomous ground robots are used in warehouses and production facilities to transport materials.

Programming implementation:

– Programming language: Python for developing navigation and control algorithms.

– Programming: Use of image processing algorithms for environmental recognition, as well as algorithms for route planning.

– Functions: Autonomous navigation using LIDAR sensors, processing data from cameras, traffic control.

Result: Ensuring efficient logistics at enterprises, reducing labor costs.

3. Production automation system

Project description: Automated production systems are used to optimize processes in industry.

Programming implementation:

– Programming language: Ladder Logic in the PLC (Programmable Logic Controller) environment.

– Programming: Development of control logic for automating various stages of production, including quality control and conveyor control.

– Functions: Monitoring equipment status, machine operation control, implementation of a safety system.

Result: Increased production productivity and improved product quality through automated control systems.

4. Intelligent health monitoring system

Project description: Health monitoring systems are used to monitor physiological indicators of patients in real time.

Programming implementation:

– Programming language: Java for mobile applications, as well as C for embedded systems.

– Programming: Development of algorithms for processing data from medical sensors (ECG, pulse rate) and transmitting them to a mobile application.

– Functions: Analysis of the received data, notification of the user about changes in health indicators.

Result: Increasing patients' awareness of their health status and the ability to respond to critical changes in a timely manner.

5. Robotic manipulator

Project description: Robotic manipulators are used in industry to perform tasks such as welding, assembly and packaging.

Programming implementation:

– Programming language: C++ or Python for control algorithms.

– Programming: Development of programs to control the movement of the manipulator, taking into account dynamics and kinematics.

– Functions: Performing complex movements with high accuracy, processing feedback from sensors for trajectory correction.

Result: Significantly increased efficiency of production processes, reduced human errors [15–23, 37–40].

Therefore, programming is an integral part of mechatronic complexes, ensuring their efficiency and functionality. Real projects such as surgical robots, autonomous ground robots, automated production systems, health monitoring systems and robotic manipulators demonstrate how programming is implemented to achieve specific goals in various industries. The ability to develop and implement software for mechatronic systems is critically important for specialists in this field.

Also important is knowledge of the basics of embedded systems programming, which allows you to integrate software with hardware components. Examples of projects implemented using these languages demonstrate how correctly written code can significantly increase the efficiency of mechatronic complexes.

In addition, an important aspect is understanding the principles of real-time programming, which is critically important for systems that must respond to changes in the environment.

4.3. Fundamentals of Controlling Mechatronic Complexes

Control of mechatronic complexes involves the use of various methods and algorithms to ensure the efficiency and accuracy of the system. Main areas:

– PID controllers: a classic control method that provides stability and speed of response. This approach is widely used in industry where accuracy is required.

– Adaptive systems: algorithms that can learn from previous experience. They are able to adapt to changes in the environment, which makes them especially useful in difficult conditions.

– Machine learning: the latest technologies that allow systems to independently improve their results based on the data received. This may include neural networks for pattern recognition or algorithms for predicting system behavior.

Analysis of the latest achievements in the field of artificial intelligence opens up new opportunities for the development of intelligent mechatronic systems. For example, systems that independently determine the optimal parameters for performing tasks can be used in production lines.

Automatic control systems (ACS) play a key role in the mechanization and automation of various processes in industry, transport, energy and other areas. They can be classified into different types depending on the structure, operating principle and application. In this section, we will consider the main types of automatic control systems and compare their features:

1. Simple automatic control (PID control)

Description: PID (proportional-integral-derivative) systems are used to regulate processes where a setpoint value (e.g. temperature, pressure) needs to be maintained.

Advantages: ease of implementation and tuning; high efficiency for linear systems.

Disadvantages: limited capabilities in nonlinear systems; requires accurate process models for optimal tuning.

2. Automated control systems (ACS)

Description: Process control systems (PCS) integrate various automation elements, including sensors, actuators and software.

Advantages: ability to integrate with different process systems; flexibility in tuning for different processes.

Disadvantages: high implementation cost; complexity of tuning and maintenance.

3. Neural Network-Based Control Systems

Description: These systems use machine learning and artificial intelligence algorithms for adaptive process control.

Advantages: ability to learn and adapt to changing conditions; high efficiency in complex, nonlinear systems.

Disadvantages: need for a large amount of data for training; difficulty in understanding and configuring models.

4. Distributed Control Systems (DCS)

Description: DCS are used to manage large and complex production processes, where control is carried out through the distribution of controllers throughout the system.

Advantages: possibility of centralized monitoring and control; high reliability due to distribution.

Disadvantages: complexity in implementation and maintenance; cost of system implementation.

5. PLC-Based Control Systems (Programmable Logic Controllers)

Description: PLCs are used to automate machines and production processes by programming logic.

Advantages: reliability and durability in industrial conditions; ease of programming and configuration.

Disadvantages: Limited capabilities for complex control algorithms; not always optimal for rapidly changing processes.

6. Fuzzy Logic Control Systems

Description: These systems use fuzzy logic to make decisions under uncertainty.

Advantages: Ability to work with incomplete or inaccurate data; flexibility in configuring the system.

Disadvantages: Difficulty in configuring fuzzy logic rules; may be less effective for simple, well-defined tasks [13–23].

Table 2.3.1

Comparison of automatic control systems

System type	Advantages	Disadvantages
PID control	Simplicity, high efficiency	Limited possibility in nonlinear systems
SUTP	Integration with various technologies	High cost, difficult to maintain
Нейронні мережі	Adaptability, high efficiency	Need for big data, complexity of setup
DCS	Centralized control, high reliability	Complexity of implementation, high cost
PLC	Reliability, ease of programming	Limited capabilities for complex algorithms
Fuzzy Logic	Flexibility, ability to work with uncertainty	Difficulty in setting up rules

The choice of an automatic control system depends on the specifics of the tasks, operating conditions and economic factors. Each type of system has its own advantages and disadvantages, so it is important to carefully assess the project requirements to ensure the effectiveness and reliability of the selected system. In modern mechanized and automated processes, a combination of different systems is often used to achieve optimal results.

Thanks to the latest achievements in the field of artificial intelligence (AI), a significant evolution is taking place in the control of mechatronic complexes. AI introduces innovations that increase the efficiency, accuracy and adaptability of systems. Let's consider several main aspects of the impact of AI on mechatronics:

1. Adaptive control. AI provides the possibility of adaptive control, where systems can independently adjust their parameters depending on the operating conditions. This is especially important in dynamic environments where external factors can change quickly.

Example: autonomous robots that use machine learning algorithms to adapt to new obstacles or route changes.

2. Predictive maintenance. AI can analyze data from sensors and determine when maintenance is needed, which can help avoid failures and reduce downtime.

Example: In industrial machinery, AI systems can analyze vibrations, temperature, and other parameters to predict failures.

3. Process optimization. AI algorithms, such as genetic algorithms or particle swarm optimization algorithms, can improve management and planning processes.

Example: Route optimization for autonomous vehicles in warehouses, which leads to reduced travel times and increased efficiency.

4. Complex data processing. AI allows processing of large amounts of data from various sensors, which improves the accuracy of control and decision-making.

Example: In health monitoring systems, where AI analyzes data from medical sensors and provides doctors with real-time recommendations.

5. Improved user interaction. AI-based systems can improve user interaction using natural language and graphical interfaces.

Example: interfaces for controlling robots that allow users to give commands in language or through simple graphical elements, making the system more accessible.

6. Intelligent control systems. AI can be integrated into control systems, allowing for the implementation of complex control strategies, taking into account changes in the environment.

Example: Systems that use computer vision to identify objects and automatically adjust the operation of mechanisms depending on the situation.

Therefore, the introduction of artificial intelligence into the control of mechatronic complexes opens up new horizons for optimization, safety and efficiency. Adaptive systems, predictive maintenance, improved data processing and user interaction are just some of the many benefits that AI can provide. These technologies not only increase productivity, but also change the way people interact with machines, forming a new era in mechatronics.

Based on the above, we will develop recommendations for the training of specialists in the field of mechatronics.

Training mechatronics specialists is critical for the successful implementation of projects in this dynamic and technologically advanced field. The following recommendations are offered to improve the training of future specialists:

1. Integration of theory and practice. Provide more practical classes where students can work with real mechatronic systems. Introduce laboratory work, internships at enterprises and projects that allow students to apply theoretical knowledge in practice.

2. Interdisciplinary approach. Expand curricula to include courses from related disciplines, such as electronics, computer science and mechanics. Create courses that combine knowledge from different fields so that students can better understand the integration of different components of mechatronic systems.

3. Use of modern technologies. Integrate the latest technologies such as artificial intelligence, IoT (Internet of Things) and robotics into the curriculum. Develop courses in programming, data processing and artificial intelligence so that students can work with modern technologies.

4. Development of soft skills. Training of specialists should include the development of soft skills, such as teamwork, communication and project management. Implement trainings and group projects where students can practice these skills.

5. Cooperation with industry. Involve enterprises in the educational process to train specialists who meet market needs. Create partnerships with companies for joint projects, internships and inviting specialists to lectures and seminars.

6. Continuous learning and improvement. Encourage specialists to continuously learn and improve their skills in a rapidly changing industry. Offer short-term courses, webinars and certification programs for professionals.

7. Project activities. Involve students in real projects where they can work on specific tasks. Organize competitions, hackathons and teams to work on innovative projects.

Improving the training of specialists in the field of mechatronics requires a comprehensive approach, including the integration of theoretical knowledge with practical skills, interdisciplinarity, the use of new technologies and the development of soft skills. Cooperation with industry and the involvement of real projects are also important for training competitive specialists who are ready for the challenges of the modern market.

Therefore, the training of specialists in the field of mechatronics is critically important for innovation and the development of modern technologies. Since the industry is constantly evolving, it is important that curricula adapt to new requirements and challenges. This will ensure the country's competitiveness on the global stage and contribute to the successful development of industry, science and technology. Investments in education in this area will be the key to a successful future, which will contribute not only to economic growth, but also to improving the quality of life.

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ANNOTATION

CHAPTER 1. MODERN BASICS OF ECONOMICS, MANAGEMENT AND TOURISM

1.1. Natalia Makhnachova, Vita Bondar PRIVATE-PUBLIC PARTNERSHIP AS A MODERN APPROACH TO THE PRESERVATION OF CULTURAL HERITAGE

The study is devoted to the use of public-private partnerships as a modern approach to the preservation of cultural heritage. The consequences of the war and the damage caused by the destruction of cultural heritage sites are analyzed. It is proposed to develop an effective "bottom- up" approach based on public-private partnerships that will facilitate the integration of local, regional, ethnic and religious diversity into cultural heritage preservation policies. The need to recognize and pay attention to different categories of values of historical and architectural monuments, revealed through the involvement of a wide range of stakeholders, and emphasizing the peculiarities of the landmark, is emphasized.

Keywords: private-public partnership, cultural heritage, "bottom-up" approach, destruction of cultural heritage

1.2. Tetiana Gryniv, Zoryana Skybinska COSTS OF THE ENTERPRISE: CLASSIFICATION, TYPES AND FEATURES OF ANALYSIS, INFORMATION SUPPORT AND IMPACT ON ACTIVITY

The analysis of enterprise costs is an important component of the organization's financial management. The classification of enterprise costs and the areas of their analysis help to assess the efficiency of resource use and track possible ways to optimize them. The main areas of research are the analysis of ordinary expenses, operating expenses and production costs. The main information sources for cost analysis include financial and management reports of the enterprise.

Keywords: costs, production prime cost of products, cost of sales of products, methods of cost analysis, operating activity.

1.3. Yevgeny Podakov, Mykhailo Kozychar INVESTMENT ATTRACTIVENESS AND PROSPECTS FOR FURTHER DEVELOPMENT OF THE HOTEL BUSINESS IN UKRAINE

The hotel business as a component of tourism is one of the most profitable vectors of economic development in every country. This topic is very relevant and promising for Ukraine both during the full-scale invasion and in the post-war period. Currently, this sector of the economy plays a significant role even during the times of martial law in our country. After the end of a full-scale war, a certain increase in tourist demand is expected, but at the same time, it is necessary to attract significant investments in the specified sector of the economy and state support for such business entities. As part of the reconstruction of the hotel business in Ukraine, it is worth relying on the experience of other countries that actually restored their tourism industry after crises, including war.

Keywords: hotel business, tourism, investments, investment attractiveness, state support.

CHAPTER 2. INNOVATIVE AND MODERN FOUNDATIONS OF PEDAGOGY AND PSYCHOLOGY

2.1. Nataliia Kostruba PSYCHOLOGICAL WELL-BEING OF MENTAL HEALTH SERVICE PROVIDERS IN UKRAINE DURING THE WAR

The war affected the psychological well-being of Ukrainians and the system of providing mental health benefits is overloaded. The overwhelming majority of the interviewed mental health professionals noted the increase in work load. The largest load falls on such service areas as: education, social sector and culture. Mental health workers in Ukraine play an indispensable role in supporting a population. So, investing in the support and resilience of these professionals, Ukraine can strengthen its overall capacity to heal and rebuild in the face of ongoing adversity.

Keywords: mental health, mental health awareness, war, psychological well-being, migrants.

CHAPTER 3. SCIENTIFIC VIEWS ON LAW AND HISTORY

3.1. Oleg Morozov, Anastasia Strukulenko ARCHAEOLOGY OF INTERNATIONAL TRADE IN ANCIENT EGYPT (III MILLENNIUM BC - III CENTURY BC)

The paper examines the process of formation and development of international trade exchange on the example of ancient Egypt. Based on the above, the work is structured in such a way that at the first stage the main trends of ancient trade in the Middle East, in the basins of the Mediterranean and Red Seas are analyzed and the place and role of the Egyptian kingdom in this process is determined. Subsequently, the author reconstructs the land and sea trade of Egypt, and a separate section is devoted to the history of shipbuilding in ancient Egypt. The study of the problem is based on the analysis of archaeological sources introduced into scientific circulation.

Keywords: trade, archeology, shipbuilding, customs duties, goods, civilization.

CHAPTER 4. Serhii Onyshchenko, Victoriia Zhyhir, Oleksandr Antonenko TRAINING OF SPECIALISTS IN MODELING, PROGRAMMING AND CONTROL OF MECHATRONIC COMPLEXES

Mechatronics is the integration of mechanics, electronics, computer science and control systems, which allows you to create complex automated systems. It arose in the middle of the 20th century, when new technologies became necessary to automate production processes. With the development of computer technology and electronics, mechatronics became the basis for the creation of robotic systems, drones, medical devices and smart home technologies. In the modern world, mechatronics is an important component of many innovations that ensure efficiency, accuracy and safety.

Given the rapid development of the industry, the demand for specialists with knowledge in all these disciplines has increased. Training specialists in the field of mechatronics not only increases the country's competitiveness on the world stage, but also ensures the successful development of industry, science and technology.

Keywords: mechatronics, modeling, programming, design, automation, control systems, intelligent systems, education, training of specialists.

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