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MANAGEMENT OPTIMIZATION OF CARGO TRANSPORTATIONS IN LAND-WATER COMMUNICATION
ОПТИМІЗАЦІЯ УПРАВЛІННЯ ВАНТАЖОПЕРЕВЕЗЕННЯМИ В НАЗЕМНО-ВОДНОМУ СПОЛУЧЕННІ

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Стаття присвячена дослідженню проблемам оптимізації транспортно-технологічних систем при транспортуванні вантажів в наземно-водному сполученні. Здійснюється аналіз існуючих теоретичних і методичних підходів до оптимізації, розглядаються її основні етапи.

Formulation of the problem. The main task of transport is the time accuracy, high quality and complete fulfillment of the needs of the national economy and the population. The most important element in the development of technology for the transportation of goods is the choice of the transport-technological systems. Each of such system can be represented as the form of the typical operations, formed into blocks, the main of which are: cargo, cargo-concentration points, transport network, rolling stock, loading and unloading facilities, logistics process participants, packaging [1]. The main factors determining the choice of transport-technological systems are local technological processes occurring in all parts of the transport system, having a quantity of features and depending on the type of cargo, mode of transport and its structure, branch characteristics, the state of the elements of the logistics process [2].

For the successful functioning of the transport and technological system for the transport of goods, it is necessary that heterogeneous logistical technologies can be brought together in a single technological process, in which unified logistics principles and requirements must be observed [3, 4].

Analysis of recent research and publications. The problems of optimization of transport-technological systems, as shown by the analysis of scientific publications, are given increased attention [1-5].

The purpose of the article. A systematic analysis of the problems of goods transports indicates the need for research to develop and implement technical, technological, economic, legislative, organizational decisions and measures to create uniform general conditions of transportation through the territory of Ukraine. Among the extremely important should be noted:

1. Ensuring the speed of movement of goods.
2. Development of logistic plans of transportation in transport-technological systems in the land-water combination.
3. Create a transport infrastructure that meets high standards for the effective functioning of the above multimodal transport, container terminals, freight distribution centers modernization of warehousing and others.
4. Ensuring the conditions and terms of execution and bypass export-import and transit cargo that operate in the EU.
5. Reduced rates of fees for controls at border crossing points of Ukraine.

6. Develop and implement a coordinated operational planning of cargo handling centers, which interact sea, river, road and rail transport.

7. Development and implementation of information technology for tracking, monitoring and analysis of transportation through Ukraine.

With this in mind the necessity of cargos delivery development design methodology based on the principles of optimality, effectiveness, reducing resource costs, shortening delivery.

Introduction. The problem of cargo-transportations optimization in ground-water communication system has been extensively discussed and referred comparatively rarely. However, even in the countries that have reached very high levels in terms of cargo transport planning and management the problems of cargo transportations, transport still exist.

The main disadvantages of freight transport are: lack of intermodal solutions, lack of a single cargo clearance service, lack of information systems for cargo transportation, imbalance of supply and demand. The problem is especially urgent due to the growth of the cargo transportation market and transport services [3].

Results and discussion. Optimization comes from latin *optimus* - the best, which means finding the most beneficial balance between mutually exclusive characteristics. To achieve the research goal, an analysis of scientific papers was carried out, the results of which are given in table 1.

Table 1

List of research terms

Term	**Definition of optimization (disambiguation)**		**Literary source**
1	**2**		**3**
Optimization	The process of maximizing profitable characteristics, relationships (for example, optimization of production processes and production), and minimizing costs. Optimization problems are formulated if given: criterion / criteria of optimality (economic, technological, etc.); variable parameters, the change of which allows to influence the efficiency of the process; mathematical model of the process; restrictions related to economic, technical, technological, constructive and other conditions.		Мала гірнича енциклопедія: у 3 т. / за ред. В. С. Білецького.— 2004.— ISBN 966-7804-14-3.
Economics and business	Optimality, in economics, including:		
	1)	**Profit**: It is a standard economic assumption (though not necessarily a perfect one in the real world) that, other things being equal, a firm will attempt to maximize its profits.	Jack Hirshleifer; Amihai Glazer; David Hirshleifer (2005). Price theory and applications: decisions, markets, and information. Cambridge University Press. ISBN 978-0-521-81864-3. Retrieved 20 December 2010.
	2)	**Utility**: It is a measure of preferences over some set of goods (including services: something that satisfies human wants); it represents satisfaction	Jack Hirshleifer; Amihai Glazer; David Hirshleifer (2005). Price theory and applications: decisions,

Term		Definition of optimization (disambiguation)	Literary source
1		2	3
		experienced by the consumer of a good. The concept is an important underpinning of rational choice theory in economics and game theory: since one cannot directly measure benefit, satisfaction or happiness from a good or service, economists instead have devised ways of representing and measuring utility in terms of measurable economic choices.	markets, and information. Cambridge University Press. ISBN 978-0-521-81864-3. Retrieved 20 December 2010.
	3)	**Economic efficiency**: It is, roughly speaking - a situation in which nothing can be improved without something else being hurt. Depending on the context, it is usually one of the following two related concepts: Allocative or Pareto efficiency: any changes made to assist one person would harm another. Productive efficiency: no additional output can be obtained without increasing the amount of inputs, and production proceeds at the lowest possible average total cost.	Heyne, Paul (2008). "Efficiency". In David R. Henderson (ed.). Concise Encyclopedia of Economics (2nd ed.). Indianapolis: Library of Economics and Liberty. ISBN 978-0865976658. OCLC 237794267
	4)	**Pareto optimality**, or Pareto efficiency, a concept used in economics, game theory, engineering, and the social sciences.	Tomoiagă, B.; Chindriș, M.; Sumper, A.; Sudria-Andreu, A.; Villafafila-Robles, R. Pareto Optimal Reconfiguration of Power Distribution Systems Using a Genetic Algorithm Based on NSGA-II. Energies 2013, 6, 1439–55.
Other		Optimality theory, in linguistics, a model proposing that observed forms of language arise from the interaction of conflicting constraints. Optimization (role-playing games), a gaming play style.	Shoemaker, P.J.H. (1991) "The quest for optimality: A positive heuristic of science?" Behavioral and Brain Sciences 14: 205-245.

** Personal completion*

Mathematical optimization: is the theory and computation of extrema or stationary points of functions, that is, choosing the best option from the set of possible ones; the process and the fact of developing optimal solutions; the process of bringing the system to the best (optimal) state; is found out, which state of the system under study will be the best from the point of view of the requirements imposed on it (the criterion of optimality) and consider such a state as a goal; is the selection of a best element (with regard to some criterion) from some set of available alternatives [4].

In the same context, the term "sub-optimization" is also used - in cases where an optimum is sought by any one criterion of several in the vector optimization problem. There are following types of optimization: Pareto optimality, vector optimization [8].

Engineering optimization is the use of optimization techniques to aid the engineering design process [9].

Product optimization is in business and marketing, methodologies for improving the quality and desirability of a product or product concept [13].

Management optimization is the process of searching for and making optimal decisions. Problems of optimal control: optimization of the final state of the control object. The final state of the object is investigated and optimized, which way the object came to this state is not taken into account. Tasks of this type have spread in the systems of organizational and socio-economic management. Such problems are solved using the methods of mathematical programming (the method of investigating operations) [14].

Optimization of the dynamics (transition) of the state of the control object: the trajectory of the transition process is considered, and the result is of no interest. These tasks are most applicable in engineering and in the management of technological processes. They are solved based on the calculus of variations, using methods such as the maximum principle of Pontryagin, Bellman, and others [15].

Optimization in information technology, or program optimization, improving software to make it work more efficiently or use fewer resources. Compiler optimization: improving the performance or efficiency of compiled code. An asymptotically optimal algorithm that is at most a constant factor worse than the best possible algorithm for large input sizes. Search engine optimization and image search optimization: in internet marketing, methodologies aimed at improving the ranking of a website in search engine listings [14].

Economics and business is the choice of all possible options for using the resources of those that gives the best results. Often described in the form of maximization of the objective function. Determination of the values of economic indicators at which the optimum is achieved, that is, the optimal, best state of the system. Most often, the optimum corresponds to the achievement of the highest result with given resource costs or the achievement of a given result with minimal resource costs [15].

Solution optimization is a process of many factors, enumerations that influence the result. The optimal solution is the most effective of all alternative solutions chosen by any optimization criterion. Since the optimization process is expensive, it is advisable to apply it in solving strategic and tactical tasks of any subsystem of the management system [16].

In practice, the term optimization is often used as a synonym for improvement. There are examples such as cost optimization, optimization of organizational (staff) structure, optimization of business processes (BP), and optimization of workflow. Proceeding from the stated goal of scientific research, we will consider the optimization of business processes, and we will understand the optimization of transport-technological cargo systems (TTCS) in land-water communication as a change in the structural elements and methodological approaches to the organization of the transportation process with the aim of increasing its efficiency and effectiveness [10].

The following processes are the most advantageous for priority optimization: 1) often recurring; 2) costly; 3) lengthy in time; 4) those processes where execution time is the most critical parameter; 5) management. As a result of the implemented measures, the following results should be obtained in the system-object of optimization:

1) all the processes and operations to be carried out during the transport of goods in land-water traffic must be accelerated;

2) the TTCS management process should be simplified and cheaper, and its efficiency improved;

3) productivity and effectiveness of BP should improve;

4) transparency, flexibility and controllability of the TTCS should increase;

5) side effects and results can also be obtained, such as creating additional jobs, obtaining a positive environmental result, etc.

This can be done only, when the processes are already organized, that is, described (regulated) and executed as described. The regulation of activities is the development, harmonization and implementation of internal rules of work in the daily activities of the system under investigation. That is, documents (protocols) describing who is responsible, for what, who, what, when and how to do, as well as the monitoring mechanism, that this is done exactly the same way, and reaction to the violation, if done wrong. Eventually, the processes become manageable, predictable and controlled. This is the basis for all further improvements. Without this phase, most improvements will not work or give the desired result [11].

The regulation of the operations, procedures and processes to be performed is necessary in cases where:

1. There are conflicts between employees, subdivisions, or enterprises participating in the TTCS, which are repeated in connection with a certain range of issues (problems);

2. Processes are tied to specific performers, when some of them are hidden, not fixed as an algorithm of actions, or when the description is not detailed enough;

3. There is an unreasonable increase in the quantity of employees (participants and intermediaries of TTCS) and the costs of its maintenance, while reducing the effectiveness of the BP as a whole;

4. It is impossible to implement an effective system for automation of operations and procedures;

5. There are regularly occurring situations that require manual management - managers with such a BP organization are mainly engaged in solving current problems without paying attention to strategic tasks.

6. There are failures in terms of time, lengthy agreements, questions left unresolved. Practically in every process, where there are repeatable, identical failures and problems, it is possible to identify a work site for which no one answers, or this issue was not explicitly discussed, or there is a dispute, a decision on which is not accepted.

7. There are difficulties in scaling or replicating the business;

8. When managing the process of cargo transportation as a seamless TTCS, functions appeared that were not previously available, and now they are needed, for example, planning, budgeting, operations control procedures, that is, when the freight traffic management system is transferred to a new level. When there is no common system, each executive publishes many orders, orders and plans that cover part of the executors - participants of the TTCS. All these regulatory documents contradict each other; as a result, it is not obvious which task is the first priority. In the end, the part or the entire documentation array is simply ignored. All this in the end increases costs and generates malfunctions [12].

Properly conducted procedure of regulation will allow receiving a positive effect, which should be expressed in the following:

1. Improving the interaction and creating horizontal links between the enterprises participating in the transportation process, when it is clearly understood (and understood by all participants equally, who is responsible for what, and who is responsible for the transported cargo at what time - all this reduces quantity of conflicts.

2. In obtaining stable results that are not dependent on personalities: with the help of regulatory documents, the optimized system fixes in writing the most efficient way of obtaining the result based on the successful experience of its structural elements - participants in the TTCS.

3. Adjustment of the TTCS participants (staff of employees) quantities of in accordance with the regulations with the revenues received is the basis for arranging an adequate system of motivation. The regulation allows you to see what functions one or another structural element (participant) of the TTCS, to what extent, performs and on what results it influences, its operation, to remove duplicate functions and to assign those responsible for the operations that are missing. This allows you to identify and remove "parasitic links", posts, which do not benefit the system.

4. On the basis of the regulations, automation is implemented quickly and efficiently, for this it is necessary to have already built processes, clearly understand the requirements for the result, and take into account all the important details.

5. As a result of the regulation, the time for managers is freed. In a normally built process, in normal situations, the manager does not participate at all, or participates minimally. The rules also include action algorithms for the main "abnormal" situations, ways to monitor and reflect information about the process, that is, the manager does not directly participate, but everything in the course.

6. As a result of the procedure of regulation, we get the predicted result: the regulation establishes specific, agreed upon with all participants of the TTCS, the timing and mechanism for their tracking. For typical situations, the rules of action are introduced into the rules. All outstanding issues are resolved before the regulations are approved.

7. Formalized regulatory processes allow you to scale or replicate the business, expand the geography of activities, enter new markets, create a set of training materials for each position, increase the transparency of the management system, etc.

8. The regulation allows building the BP from scratch (from the very beginning), as a result of which a unified system of cargo transportation management is being formed.

The most important for the implementation of BP regulation is a control system that will respond to deviations, plan and track the progress of the process and the implementation of the rules, detect, fix and react to faults in a timely manner.

Any managed system (in particular, the TTCS) should develop, improve, orderliness grows in it, and structural organization is optimized. The source, the cause of development are the internal contradictions of the system, and the evolution of the TTS depends on the timely identification of these contradictions, reducing or eliminating their negative impact. Optimization of management, including self-regulation processes for any complex systems, be it a person, a production team or the economy as a whole, is a development condition and a guarantor of effective activity. This applies primarily to the possibility, if necessary; to improve the organizational structure of the enterprise, since a non-optimal management structure is the most common flaw in the production activity of many teams. The organizational structure should reflect the long-term program and the set of the organization's main goals, since the achievement of goals is the basis of joint activity. Finally, the structure must respond to changes in the external and internal environment. The organizational structure is effective only when it contributes to the achievement of the set goals with minimum expenditure of labor and resources. The optimization principle underlies any organizational structure, regardless of the applied criteria of optimality and the current system of restrictions. The order of work to optimize the control system is shown in figure 1.

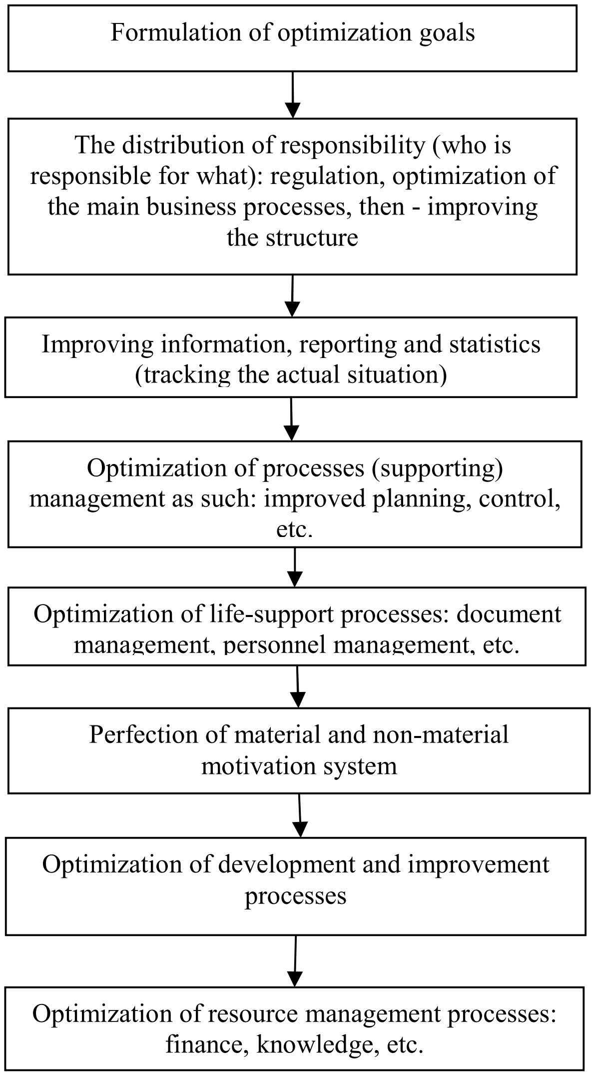

Fig. 1. The main stages of optimization of the control system

Optimization of transportation costs is achieved while maintaining economies of scale and distance. The economies of scale are due to the fact that the larger the cargo, the lower the transport costs per unit of weight. Similarly, more powerful modes of transport - rail and water - are cheaper per unit weight of the cargo being transported, the less powerful modes of transport - automobile and air. The economies of scale are because the constant component of transport costs is distributed to the entire cargo, so that the larger it is, the lower the unit costs per unit of weight. The savings due to the distance of the route are because the longer the route, the less the transportation costs per unit of distance. This effect is also called the descent principle, since unit costs per unit of travel are reduced as the distance to the freight is increased. The economy due to the range of transportation is due to the same reasons as the economies of scale. The longer the route, the greater the distance these costs are allocated, which leads to a reduction in transportation costs per unit of travel.

These principles need to be considered when evaluating alternative transport service strategies. It should strive to maximize the load of vehicles and the maximum length of cargo transportation routes with the obligatory satisfaction of all service expectations of consumers.

Conclusions. Modern forms of transport processes is transport-technological system (TTCS), which bring together local special way physical objects in the system. This system in the current circumstances requires the development of competent and weighted approaches to the optimization of cargo flows.

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Анотація

Стаття присвячена дослідженню проблем оптимізації транспортно-технологічних систем (ТТС) вантажоперевезень в наземно-водному повідомленні. Проведено аналіз існуючих теоретичних і методичних підходів до оптимізації Найважливішим елементом у розвитку технології для перевезення вантажів є вибір транспортно-технологічних систем. З’ясовано, що основними факторами, що визначають вибір транспортно-технологічних систем, є локальні технологічні процеси, що відбуваються у всіх частинах транспортної системи, що мають ряд особливостей і залежних від типу вантажу, виду транспорту і його структури, галузевих характеристик, стану елементів транспортно-логістичного процесу.

Доведено, що для успішного функціонування транспортно-технологічної системи для перевезення вантажів необхідно поєднувати різнорідні логістичні технології в єдиний технологічний процес, в якому мають бути дотримані єдині принципи і вимоги до логістики. Систематичний аналіз проблем транспортування вантажів вказує на необхідність проведення досліджень для розробки і реалізації технічних, технологічних, економічних, законодавчих, організаційних рішень і заходів для створення єдиних загальних умов перевезення по території України. Однак, навіть в країнах, які досягли дуже високих рівнів в плануванні і управлінні вантажними перевезеннями, проблеми вантажних перевезень, транспорту все ще існують.

Виділено основні етапи процесу оптимізації ТТС, виявлено, що оптимізація неможлива без проведення попередньої процедури регламентації бізнес-процесів. Досліджено результати регламентаційних заходів, окреслено напрямки оптимізації ТТС. Проблема оптимізації вітчизняних ТТС вантажоперевезень у наземно-водному сполученні стає особливо актуальною і потребує вирішення у зв’язку із зростанням ринку вантажоперевезень і транспортних послуг.

17.