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**SOFTWARE IMPLEMENTATION OF THE TECHNOGENIC RISK ASSESSMENT METHOD OF AN INDUSTRIAL OBJECT USING THE MONTE-CARLO METHOD**

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**Bojko Tatyana**, PhD, Associate Professor, Department of Cybernetics of Chemical Technology Processes, National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», Kyiv, Ukraine, e-mail: [tvojko@gmail.com](mailto:tvojko@gmail.com), ORCID: <http://orcid.org/0000-0002-9710-8055>

**Abramova Alla**, PhD, Associate Professor, Department of Cybernetics of Chemical Technology Processes, National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», Kyiv, Ukraine, e-mail: [alla\\_abramova@ukr.net](mailto:alla_abramova@ukr.net), ORCID: <http://orcid.org/0000-0003-3475-8584>

**Skladannyi Denys**, PhD, Associate Professor, Department of Cybernetics of Chemical Technology Processes, National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», Kyiv, Ukraine, e-mail: [skl\\_den@ukr.net](mailto:skl_den@ukr.net), ORCID: <http://orcid.org/0000-0003-3624-5336>

**Vavulin Petro**, Consultant on Information and Telecommunication Technologies, Foreign Enterprise «I-AR-SI», Kyiv, Ukraine, e-mail: [lestaxa81@gmail.com](mailto:lestaxa81@gmail.com), ORCID: <http://orcid.org/0000-0001-7299-2262>

The object of research is the industrial risk of an industrial facility. One of the most problematic places is the uncertainty of the initial information regarding the object of study and the lack of a universal methodology that would allow an assessment of technological risks at all stages of the operation of an industrial object. A particularly acute problem concerns potentially hazardous industries.

The analysis of existing methods and approaches to assessing the technological risks of industrial facilities at different stages of their functioning is carried out. It is established that one of the best methods is the Monte Carlo method, which allows to quantify the uncertainty of decisions. The use of the Monte Carlo method for quantitative hazard analysis in order to determine the probability of accidents and accidents, the magnitude of the risk, the magnitude of the possible consequences is justified.

The elements of the theory of reliability for the quantitative assessment of risks are used. A quantitative hazard analysis in accordance with the theory of reliability makes it possible to determine the probability of accidents and accidents, the magnitude of the risk, the magnitude of the possible consequences. Probability methods and statistical analysis are integral parts of the quantitative analysis of hazards and technological risk.

An algorithm is developed to determine the industrial risk of an industrial facility using the theory of reliability. A software package is developed based on the theory of reliability with a combination of Monte Carlo simulation of the system. The developed software package allows to analyze the level of technogenic risk when using various methods of connecting elements of the system, as well as evaluate changes in the reliability of the system when using other components. The program is presented on the example of a system, the components of which are the heaters PVT1-7 (Ukraine) in the technological system of a thermal power plant. The system under study is at the border of an unacceptable and conditionally acceptable level of danger, which gives grounds for the need to take measures to increase the

reliability of the system by increasing the number of backup system elements, or improving their quality.

**Keywords:** technological risk, Monte Carlo method, reliability theory, software package, system reliability.

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# SYSTEMS AND CONTROL PROCESSES

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## DETERMINATION OF PECULIARITIES OF ANALYSIS OF INTEGRATION RISKS IN PROJECTS OF CREATION OF TRANSPORT AND LOGISTICS CENTERS

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**Kovtun Tetiana**, PhD, Associate Professor, Department of Logistic Systems and Projects Management, Odessa National Maritime University, Ukraine, e-mail: [teta.kovtun@gmail.com](mailto:teta.kovtun@gmail.com), ORCID: <http://orcid.org/0000-0002-5410-4783>

**Smokova Tetiana**, Assistant, Department of Logistic Systems and Projects Management, Odessa National Maritime University, Ukraine, e-mail: [smokova.tm@gmail.com](mailto:smokova.tm@gmail.com), ORCID: <http://orcid.org/0000-0002-0688-5677>

**Smrkovska Victoriya**, PhD, Department of Logistic Systems and Projects Management, Odessa National Maritime University, Ukraine, e-mail: [vik\\_smrkovskaia@ukr.net](mailto:vik_smrkovskaia@ukr.net), ORCID: <http://orcid.org/0000-0003-4515-5236>

The object of research is the risk of tearing of integration ties between the participants arising in the projects of creation of transport and logistics centers. The specific features of the concept of «integration project risks» are defined, which include the risks that may affect the integration in the project and lead to disruption of the project as a system by breaking the integration links between its participants.

One of the most problematic places is to identify integration risks in the pre-investment phase of the project, in the process of qualitative and quantitative risk analysis. However, integration risks are hardly taken into account when designing transport and logistics centers. Particular attention is paid to logistical and project risks. Integration risks combine the features of both logistics and project risks and can lead to negative consequences for a logistics project.

The study used qualitative risk analysis methods, namely Pareto analysis and ABC analysis, which allowed the project participants to be divided into groups with large, medium and low integration ties. Taking into account the number of transactions performed between the participants made it possible to determine the power of integration links. The combination of the results of the ABC analysis and the determination of the integration capacity is the basis for the creation of a matrix of integration potential of the project participants.

In the course of the work, a qualitative risk analysis was carried out according to the proposed sequence of the project of creating a transport and logistics center. The use of quality management tools and the integration potential matrix developed by the authors made it possible to identify the many project participants who have the greatest impact on project integration.

The use of the proposed approach to qualitative risk analysis of the integration gap between project participants at the beginning of the project will allow the identification of participants with high integration potential. extremely negative consequences.

**Keywords:** project of transport and logistics center, integration of project participants, integration risks, qualitative risk analysis, matrix of integration potential of participants.

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## GENESIS OF TECHNOLOGIES AND WAYS TO IMPROVE DESIGN AND CONSTRUCTION OF TOWED UNDERWATER SYSTEMS FOR SHALLOW-WATER AREAS

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**Blintsov Volodymyr**, Doctor of Technical Sciences, Professor, Vice-Rector for Scientific Work, Admiral Makarov National University of Shipbuilding, Mykolaiv, Ukraine, ORCID: <http://orcid.org/0000-0002-3912-2174>, e-mail: [volodymyr.blintsov@nuos.edu.ua](mailto:volodymyr.blintsov@nuos.edu.ua)

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**Kucenko Pavlo**, Junior Researcher, Admiral Makarov National University of Shipbuilding, Mykolaiv, Ukraine, ORCID: <http://orcid.org/0000-0002-7316-0211>, e-mail: [arcadia.blacksea@gmail.com](mailto:arcadia.blacksea@gmail.com)

The object of research is the design technology of towed underwater systems for shallow waters. The subject of research is ways to increase productivity and reduce the cost of designing and manufacturing towed underwater systems.

During the research, the methodology of system approach, methods of structural analysis, mathematical modeling and 3D-design, additive technologies of manufacturing structures of towed underwater systems are applied.

A systematic analysis of the laws of development of the technologies of designing towed underwater systems is performed. The perspective directions of their further development are formulated as a necessary condition for increasing the efficiency of design works on the basis of modern designing tools and ensuring competitiveness in the market of marine equipment. It is proposed to supplement the traditional stages of designing such systems with three new stages that embody the current trends in the creation of marine technology. The genesis of the technologies of designing towed underwater systems is developed as a scientific and methodological basis for their further development in the direction of increasing the efficiency of design works and reducing the cost of time and financial resources. It is theoretically substantiated the feasibility of developing technologies of design of towed underwater systems by introducing into the project practice three technologies:

– technologies of information modeling of the basic steady and transient modes of towed underwater systems on the basis of system approach, supplemented by the criteria of cost estimation for their construction and operation;

– technologies of the building information modeling as an information support for the design, construction and further operation of the generated towed underwater system;

– additive technology of production of elements and units of the towed underwater system based on the results obtained from the previous technologies as an effective way to reduce the total costs of financial and time resources and reduce the cost of created towed underwater systems.

The practical importance of the work is to confirm the efficiency and industrial perspective of the proposed technologies, which was obtained as a result of their partial introduction into the design and production practice when creating the towed glider project.

Further research is planned to be conducted within the framework of the pilot project «Single Information Space for the Processes of Design, Construction and Operation of towed Underwater Systems», as well as by expanding the use of additive technologies during the construction of towed underwater systems.

**Keywords:** towed underwater system, information modeling, additive manufacturing technology, marine technology.

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## REPORTS ON RESEARCH PROJECTS

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### SYNTHESIS OF SETS OF NON-SYMMETRIC TWO-OPERAND TWO-BIT CRYPTO OPERATIONS WITHIN THE PERMUTATION ACCURACY

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*Lada Nataliia*, PhD, Department of Information Security and Computer Engineering, Cherkasy State Technological University, Ukraine, ORCID: <http://orcid.org/0000-0002-7682-2970>, e-mail: [Ladanatali256@gmail.com](mailto:Ladanatali256@gmail.com)

*Dzyuba Viktoriya*, Senior Lecturer, Postgraduate Student, Department of Economics, Finance, Accounting, Mathematical and Information Sciences, Cherkasy branch of the private higher educational institution «European University», Ukraine, ORCID: <http://orcid.org/0000-0003-1655-0333>, e-mail: [viktoriya.dzyuba15@gmail.com](mailto:viktoriya.dzyuba15@gmail.com)

*Breus Roksolana*, Assistant, Department of Information Security and Computer Engineering, Cherkasy State Technological University, Ukraine, ORCID: <http://orcid.org/0000-0001-5281-2017>, e-mail: [skay1986@ukr.net](mailto:skay1986@ukr.net)

*Lada Serhii*, Specialist of first category, Department of Information Technology of the Operations Center, Telecommunication Systems and Information Technologies, Department of the State Emergency Service of Ukraine in Cherkassy region, Cherkasy, Ukraine, ORCID: <http://orcid.org/0000-0002-2306-9081>, e-mail: [Raphaello1986@gmail.com](mailto:Raphaello1986@gmail.com)

The object of research is the processes of building operations for cryptographic protection of information, as the requirements for information security are constantly increasing. Increasing the stability of

cryptographic transformations directly depends on the complexity and variability of the crypto algorithm. It is possible to increase variability by increasing the range of crypto operations. Significantly increasing the number of crypto operations is possible through the synthesis of asymmetric operations. This paper is devoted to the creation of methodological support for the synthesis and analysis of sets of two-operand two-bit cryptographic operations with precision permutation. The conducted researches are based on the results of a computational experiment, which consists in the synthesis of two-operand two-bit crypto operations based on single-operand, with the subsequent search for pairs of operations of direct and correct inverse crypto transformation on the basis of complete search. In the course of the computational experiment, pairs of two-operand operations were presented, represented by tuples of four single-operand operations. The formalization of the results provided a mathematical representation of operations, suitable for practical implementation. To simplify the complexity of practical implementation, the synthesized operations are divided into 24 sets of 24 operations. Separation of operations occurred due to the use of templates of tables of truth of sets of operations with precision to permutation of operands. It is established that the entire set of operations can be constructed with the precision of permutation based on the use of the template of any operation. In addition, the analysis of the synthesized sets showed that the sets of symmetric and asymmetric operations do not intersect. 20 sets of asymmetric two-operand two-bit operations, as well as 4 sets of symmetric operations are obtained. Further investigation of each synthesized set of asymmetric crypto operations will allow for the relationship between the operands of the operation and between the operations as a whole. The use of synthesized asymmetric operations will improve the reliability of crypto algorithms for streaming encryption of information by significantly increasing the variability of cryptographic transformations. In turn,

the use of synthesized sets of operations will simplify practical implementation in computer cryptography.

**Keywords:** computer cryptography, asymmetric crypto operations, multiple operations, variability of crypto algorithms.

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## DEVELOPMENT OF A METHOD FOR COMPRESSING IMAGES ON THE BASIS OF JPEG ALGORITHM

page 32–34

*Fedorchenko Ievgen, Senior Lecturer, Department of Software Tools, National University «Zaporizhzhia polytechnic», Ukraine,*

*e-mail: evg.fedorchenko@gmail.com, ORCID: <http://orcid.org/0000-0003-1605-8066>*

*Oliinyk Andrii, PhD, Associate Professor, Department of Software Tools, National University «Zaporizhzhia polytechnic», Ukraine, e-mail: olejnikaa@gmail.com, ORCID: <http://orcid.org/0000-0002-6740-6078>*

*Stepanenko Alexander, PhD, Associate Professor, Department of Software Tools, National University «Zaporizhzhia polytechnic», Ukraine, e-mail: alex@zntu.edu.ua, ORCID: <http://orcid.org/0000-0002-0267-7440>*

*Korniienko Serhii, PhD, Associate Professor, Department of Software Tools, National University «Zaporizhzhia polytechnic», Ukraine, e-mail: kornienko.zntu@gmail.com, ORCID: <http://orcid.org/0000-0002-5435-0773>*

*Kharchenko Anastasia, Software Developer, Zaporizhzhia, Ukraine, e-mail: kharchenko.13.08@gmail.com, ORCID: <http://orcid.org/0000-0002-4313-555X>*

*Laktionov Valerii, Software Developer, Zaporizhzhia, Ukraine, e-mail: wyknait@gmail.com, ORCID: <http://orcid.org/0000-0002-0147-5257>*

The problem of image optimization, namely the reduction of the physical size of the image by minimizing image quality as little as possible, is considered. The object of research are methods for processing and compressing images. When analyzing the methods, one of the biggest problems was discovered, which consists in the fact that when solving the problem of image processing and compression, the studied methods allow to achieve the slightest loss in quality, but as a result, the compression ratio is significantly reduced. To overcome this problem, it was decided to develop a modification of the JPEG compression algorithm. The proposed modification consists in additional quantization of the spectrum after a discrete cosine transform, and then the resulting spectrum is fed to a Huffman encoder, which makes compression even more efficient. A method is obtained for solving the image optimization problem, which allows one to obtain an image with a smaller size and a large compression ratio while maintaining optimal quality. This is due to the fact that the proposed method has a number of features, as the original color image can have 24 bits per point, in particular, the ability to set the compression ratio. Thanks to this, it is possible to obtain a signal-to-noise ratio of 54.2 dB at a quality factor of zero. Compared with the well-known LZW algorithm, which is much better, as a result of which it allows to get a processed image with a much smaller physical size. The assessment of image quality, depending on the parameters of the task. It is shown that for problems of small and medium dimensions, the developed method provides minimal quality loss. The results of solving the problem for a specific example demonstrate the advantage of the developed method over existing ones. The results can be successfully applied to solve the problem of optimizing image size while maintaining maximum quality.

**Keywords:** compression method, image optimization, JPEG algorithm, image quality, image size.

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**DEVELOPMENT OF AN INTELLIGENT SUBSYSTEM FOR OPERATING SYSTEM INCIDENTS FORECASTING**

page 35–39

*Lakhno Valeriy*, Doctor of Technical Science, Professor, Department of Computer Systems and Networks, National University of Life and Environmental Sciences of Ukraine, Kyiv, Ukraine, e-mail: [lva964@gmail.com](mailto:lva964@gmail.com), ORCID: <http://orcid.org/0000-0001-9695-4543>

*Sagun Andriy*, PhD, Associate Professor, Department of Informatics, Information Security and Documentation, Cherkasy State Technological University, Ukraine, e-mail: [avd29@ukr.net](mailto:avd29@ukr.net), ORCID: <http://orcid.org/0000-0002-5151-9203>

*Khaidurov Vladyslav*, PhD, Senior Researcher, Institute of Engineering Thermophysics of the National Academy of Sciences of Ukraine, Kyiv, Ukraine, e-mail: [allif0111@gmail.com](mailto:allif0111@gmail.com), ORCID: <http://orcid.org/0000-0002-4805-8880>

*Panasko Elena*, PhD, Associate Professor, Department of Informatics, Information Security and Documentation, Cherkasy State Technological University, Ukraine, e-mail: [lena.pa@ukr.net](mailto:lena.pa@ukr.net), ORCID: <http://orcid.org/0000-0002-0510-7742>

The object of research is a subsystem for prediction server platform's incidents, which operates on the basis of the Windows OS family. One of the most problematic places when planning measures to prevent the harmful effects of network attacks such as dDOS, hardware failures etc for the server system is to obtain an effective model for predicting incidents of the operating system.

In the course of the research, methods of formation and research of the time series, exponential smoothing, elements of the theory of machine learning based on the method of group accounting (GMDH) are used. To obtain accurate and reliable forecasts of the operation of the intellectual subsystem for forecasting incidents, elements of the theory of heuristic self-organization and a specific implementation of this theory, the GMDH, are used. An algorithm is obtained and a software implementation of an intelligent system

for predicting incidents of operating system operation and the main characteristics of its operation is developed. This became possible as a result of the analysis of the constructed model of the intruder, the system log of security incidents and the use of the GMDH. A mechanism is proposed for generating a sample of OS incident events based on the Windows system event log. The testing of the proposed forecasting system based on test samples allows to state that the forecasting results obtained with various settings of the machine learning system and parameters (degree of the reference polynomial, number of variables in the characteristic polynomial model, number of selection series) are satisfactory. As a result of applying the created algorithm for forecasting incidents of OS operation, it is shown that the use of a large number of polynomial models in GMDH allows one to obtain a forecasting system that is qualitatively superior to systems based on classical regression models and methods. Due to this, a much more accurate forecast can be obtained than the classical regression methods or the method of exponential smoothing, compared with similar methods. The percentage of false calculations using GMDH is less than 4%.

**Keywords:** time series, forecasting subsystem, machine learning, polynomial model, method of group accounting of arguments.

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**SYSTEM AND ANALYTICAL RESEARCH OF THE DEVELOPMENT OF TRANSPORT AND TECHNOLOGICAL SYSTEMS OF RAILWAY FERRIES**

page 40–42

*Kazymyrenko Yuliia*, Doctor of Technical Sciences, Associate Professor, Department of Information Control Systems and Technologies,

*Admiral Makarov National University of Shipbuilding, Mykolajiv, Ukraine, e-mail: u.a.kazimirenko@gmail.com, ORCID: <http://orcid.org/0000-0002-7120-8226>*

**Drozd Oxana**, PhD, Associate Professor, Deputy Director for Organizational and Educational Work, Kherson Branch of the Admiral Makarov National University of Shipbuilding, Ukraine, e-mail: oksanadrozd183@gmail.com, ORCID: <http://orcid.org/0000-0002-0135-8659>

**Yeholnikov Oleander**, Lecturer, Department of Automation and Computer-Integrated Technologies, Mykolaiv College of Transport Infrastructure of the Dnipro National University of Railway Transport named after academician V. Lazaryan, Ukraine, e-mail: alegolnikov1990@gmail.com, ORCID: <http://orcid.org/0000-0003-1033-3573>

**Morozova Hanna**, Senior Lecturer, Department of Information Control Systems and Technologies, Admiral Makarov National University of Shipbuilding, Mykolajiv, Ukraine, e-mail: amorozova711004@gmail.com, ORCID: <http://orcid.org/0000-0002-0547-6564>

The object of research is the development processes of transport and technological systems of railway ferries as complex technical systems. In the course of the study, a systematic approach to solving the scientific and technical problem of increasing the efficiency of maintenance of railway ferry services is used, for which a graphical method is used to analyze the formation of cause and effect ties with the construction of Ishikawa diagrams. According to the most informational criterion, the reserve for accelerating the speed of railcars on railway ferries is selected – a qualitative characteristic of the efficient use of the railway fleet, which directly depends on the reduction of railway outages in the port area, is promising. The research results provide a multifaceted picture that shows the possibility of reducing the time spent on the ship at the port by increasing the technical level of organizational work with rolling stock on access roads and loading them on a ferry. It also affects the state of the material and technical base for servicing rolling stock and the port base for loading ferries, the compatibility of operations of dispatch services and the need for appropriate information support. However, the development of these areas is impossible without ensuring conditions for the reliability of railway automation, automation and telemechanics, as well as advanced training of personnel for their maintenance. The compatibility of operations of dispatch services is implemented through the use of flexible forms of organization of cargo flows with the preparation of an optimal cargo plan for loading a railway ferry. The implementation of information support should take into account the synchronization of the information systems of the railway and port, as well as the relationship of automation with the work of the ferry, constantly updated with new software products. Based on the analysis, a program of measures has been drawn up for the development of transport and technological systems of railway ferries.

The obtained results are aimed at increasing the efficiency, validity and effectiveness of management work on the operation of means of transport and can be used in carrying out research work of other objects of railway-water communication, in particular port railways.

**Keywords:** railway ferries, maintenance, transport and technological system, railway ferry services, system analysis, complex technical systems.

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#### DEVELOPMENT OF ROAD SECTOR'S LEND VALUATION METHOD FOR AIMS OF ASSET MANAGEMENT

page 43–46

**Slavinska Olena**, Doctor of Technical Sciences, Professor, Department of Transport Construction and Property Management, National Transport University, Kyiv, Ukraine, e-mail: elenaslavin9@gmail.com, ORCID: <http://orcid.org/0000-0002-9709-0078>

**Kharchenko Anna**, PhD, Associate Professor, Department of Transport Construction and Property Management, National Transport University, Kyiv, Ukraine, e-mail: anna-x3@ukr.net, ORCID: <http://orcid.org/0000-0001-8166-6389>

**Bubela Andrey**, PhD, Associate Professor, Department of Transport Construction and Property Management, National Transport University, Kyiv, Ukraine, e-mail: bubelaandrey@ukr.net, ORCID: <http://orcid.org/0000-0002-5619-003X>

**Cechuha Oleksandr**, PhD, Associate Professor, Department of Transport Construction and Property Management, National Transport University, Kyiv, Ukraine, e-mail: as000@i.ua, ORCID: <http://orcid.org/0000-0003-1643-6354>

The object of research is the land management processes of the road sector. The studies are based on the use of a multistructure approach, the basic principles of the theory of complex systems and the methodology of AHP (Analytic Hierarchy Process) by Thomas Saaty. The main hypothesis of the study is the application of a multistructure approach to valuing assets, which are not comprehensively evaluated in the study, but are considered as complex objects and are divided into simpler levels, components and elements that can be evaluated separately. The features of the valuation of land of the road sector are considered, and the main stages of the evaluation sequence are identified. It has been established that the land valuation is the main component of the valuation of the asset of the road sector, which is located on it. The results of a theoretical study make it possible to develop an algorithm for valuing land of the road sector for asset management purposes. The developed algorithm has a clear sequence in the formation of the methodology for the land valuation of the road economy, it makes it possible to justify the adoption of managerial decisions regarding the land plot, which are consistent with the goals and correspond to the nature of the tasks of the functioning and development of the road sector. The testing of the developed algorithm is performed on a real example. It is found that the algorithm allows to optimize the process of valuation and management of road assets, which is especially important within limited financial resources. The choice of land valuation options is based on criteria of economic efficiency, based on the main limitations and features of land valuation of the road sector. The results of the calculations can be a weighty basis for the formulation of managerial goals for the assets of the road sector and will form the basis for further scientific studies of the process of valuation of assets under financial constraints.

**Keywords:** asset management, valuation, road sector, land plots.

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