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Andrushko V. Z. **Forecastmethod application recommendations for head of the border service department in taking decisions**

Management decision is one of the most important management processes. Its efficiency depends largely on the success of the organization. Head of the Border Service of State Border department has to be aware of reasoning technologies, adoption, implementation, which are the crucial matters for organization in a complex operational (combat) situations. One of the most important parts of developing management solutions is forecasting.

Developing prognosis is relatively complex and lengthy process. It consists of several stages:

1. Pre (research program).
2. Construction of the input (base) model intensity by means of system analysis.
3. Data collection of forecast background.
4. Construction of time series of indicators.
5. Construction of a series of hypothetical (previous) search models.
6. Construction of hypothetical models of regulatory intensity.
7. Assessment of the validity, accuracy, validity (verification) forecast.
8. Developing recommendations for management decisions on the basis of a comparison search and normative models.
9. Analysis (examination) of prepared forecasts and recommendations, as well as bringing them considering the comments and report manager.
10. Before prognostic orientation based on a comparison of materials already produced new data on the forecast projected background and a new cycle of research.

Recommendations for planning are based on forecasting. Closest prediction is tigtlyconntcted with planning. Plan and forecast are mutually complementary planning stagesof a great importancefor the plan as a top-level management unit boundary.

The place of forecasting among other management tools has been set up. Based on the conventional concepts of control theory military units and law enforcement agencies, prediction plays a key role in the management sytem as a unifying link between objectively necessary functions of preparation and implementation of appropriate solutions.

Recommendations for the head of the border servicedepartment isbased on prediction models which use artificial neural-fuzzy network model of the intensity of checkpoints of the State Border Guard Service of Ukraine. The main concerns are related to the work with information (data) and planning border shifts and are based on the results of the forecast.

Keywords: forecast, recommendations, neural network planning.

Garkusha S.A. Gulevatuy D.Y. **Problematic issues of interaction during the antiterrorist operation**.

This article analyzes the interaction of problematic issues that have arisen during the antiterrorist operation (ATO), disclosed the basic forms and principles of joint use of force structures, offered promising ways to improve it.

Among the problems that have arisen during the antiterrorist operation on one of the first places you can put a weak interaction of various security forces in a special operation in the fight against illegal armed groups. Objective and subjective reasons, there are many, but perhaps one of the most important is that with the collapse of the USSR unified military organization of the state, was tested in the Great Patriotic War, was divided into two mutually independent parts: the armed forces and the so-called "other forces", which include: Interior Ministry troops (National Guard), the Border Guards (now the State Border Service) and others.

This fragmentation of the military structure of the state has complicated the whole system of military construction as its main principle is violated - the centralization of leadership. This immediately affected when the first serious hostilities during the antiterrorist operation. There were other examples that preceded it. Thus, in March 2014 through the inconsistency in the actions of units of the armed forces of Ukraine , the Ukrainian Security Service, a field of situational group Southern Regional Directorate motorized maneuverable group of the National Academy of the State Border Service of Ukraine more than once there were situations in which the weapon could be used on their own.

Appropriate conclusions from this, as well as of the events during the antiterrorist operation have not yet been done.

These questions have been Litvin N.N. Allerov Y.V., Kirichenko I.A. and others, but due to the large number of problematic issues of interaction during the antiterrorist operation, you must conduct research that will significantly improve its quality. The article aims at: analysis of the state security forces of interaction during the antiterrorist operation and, based on the experience of participation in armed conflicts and conducting antiterrorist operation including other states to determine what should be done to remedy this situation.

Keywords: interaction, antiterrorist operation, forms and principles, legal regulation, armed conflict, coordination.

Ivashkov Y.B, Ivashkova T. A. The foundations of usage of temporary border posts (check points) in conditions of intensified state border protection

The article is dedicated to the investigation of the problem of need for usage of temporary border posts in conditions of intensified state border protection, due to the need to reassess the main issues in the field of national security and the protection of the state border.

According to present conditions, as well as a number of internal and external factors, there is a need to clarify directly the role and place in the system of units of executive authority of the country's border agency. The most dangerous way for our state is involving it in an armed conflict by performing of an open aggression in the eastern and southern Ukraine.

The analysis of the condition of development of the problem in modern scientific researches has been made. A number of legal acts regulating the operational service activity of the units of protection of the State Border have been worked up. The concept of temporary border post and its main objectives have been investigated. It was determined that the temporary border post is designed for independent performance of tasks on the State Border Protection, the control of fulfilling of the rules of a border regime or executing of other tasks in the regions (the areas), as a rule, at the units of the border posts which are located far from the permanent located units of the border guard detachment. It is revealed that the number of the temporary border posts is determined depending on the tasks assigned to it, the characteristics of the area and conditions. There are also tasks: the requirements to the arrangement; provision of weapons, equipment, service dogs; its personnel and the procedure for replacing of the personnel; ways for conducting of classes and educational activities.

Service activity of the temporary border posts is executed by patrolling of the area adjacent to the state border, to settlements, performing of duties in border details of service in some areas (directions), executing of joint activities with police inspectors and representatives of other law enforcement agencies, maintaining of interaction with public formations for protection of public order and the state border, a daily check of the state border line by district inspectors of the Border Service, who are belong to it.

The procedure of monitoring of the movement of persons, vehicles and goods along the line of contact within Donetsk and Lugansk regions has been investigated. The concept and types of block houses as barrier points in a certain place in the area of anti-terrorist operations, which are designed to control the movement of people, vehicles and checking of individuals'documents has been investigated.

Keywords: state border, border regime, State Border Protection unit, a temporary border post, use.

Kupriyenko D. A. **Reasoning models of a graphical interpretations transparency of the state border (for example in the use of auto checkpoints of a contactless review systems and complexes).**

Of the Association Agreement with EU in a state border functional transformation lies in trying to settle his bar'yernosti and kontaktnosti has occurring.

The purpose of the article – to justify graphic models and formal dependences transparency of the state border based on an analysis of state border functions and new ways, technologies to its reasoning. Opportunity to makes a task about "opened but good controlled and protected borders" has been marked for example in the use of cargo throughs the international auto checkpoints.

The scientific newest is a reasoning models of a graphical transparency (linear and in a cover form) and formalisation on its dependences to adjust transparency of the state border.

The practical means of such point of view deal with a different management ranks in a support border security system. It gives a lot of opportunities to search a rational ways to solve and prognoses problems.

The perspectives of future developments in this way can be touched questions of formalisation represented systems in a higher management ranks in a support border security system and practice use of its point to a checkpoints.

Keywords: support border security, state border functions, transparency, a contactless review systems and complexes, technical means of a border control.

Mahas H.A. ***Some views on the improvement of the state border guarding***

The main function of the State Border Guard Service of Ukraine, along with important tasks in the area of fighting operations is reliable security and protection of the state border along its entire length. Events which are taking place in Ukraine and the situation at the state border during the 2014-2015 years indicate about the need to review existing approaches to the construction of the border and ways to perform tasks by bodies and units of the State Border Guard Service of Ukraine.

The Board of the State Border Guard Service of Ukraine decided to implement differentiated approaches to state border protection. The essence of innovation is that the protection of the state border of Ukraine will be carried out in various ways (methods), depending on the socio-political, economic, criminal situation that takes place in the regions. These ways (methods) are: operational, operational -technical, military.

Thus, the effectiveness of the state border protection will depend on an effective building of the state border protection and security system considering existing challenges and threats and optimal use of available resources. This is topicality of the work.

The aim of the article is work of methodical recommendations by governing bodies on the improvement of state border protection by implementing in the operational service activity the new models of the border protection.

The operational model of the state border protection – is the system of operational -service, operational - search, regime activities which are performed by bodies and units of SBS, based on the basic functions of SBGS.

Operational - technical model of state border protection– is the system of operational, technical, regime measures which are carried out in order to show the full overwater situation and immediate detection of violations related to the procedure of swimming, stay, entrance (departure) of non-military vessels and warships in internal waters, territorial sea and E (M) EZ.

Military model of the state border protection is the system of military regime, counterintelligence and operational-search activities aimed primarily at preventing of changes of the State border line, territorial integrity, regime of the state border.

Thus, the operational model of the state border protection should be used at the Ukrainian-Belarusian, Ukrainian-Moldovan areas of border, as well as at the area of the state border with the European Union. Operational - technical model

of state border protection is appropriate to introduce at marine area of the border. Military model should be introduced at the Ukrainian-Russian state border area.

Opportunities of the proposed models of state border protection will provide: appropriate use of existing capabilities; economy of human resources; formation of reserves for increase of efforts on the eastern border of Ukraine.

***Keywords**: border guarding model, state border, monitoring post, border service sector.*

Mahas H.A. Development trends of military struggle in modern conditions

Conditions of contemporary stage of the state building in Ukraine are determined by the influence of a number of negative factors in which humanity has entered the twenty-first century. These primarily include such as increasing trend towards multi-ethnic and multi-religious disintegration of states; aggravation of international economic contradictions; increase of the number of internal armed conflicts of ethnic and religious character, accompanied by massive losses of civilians; numerous human rights violations and abuse of power; proliferation of weapons of mass destruction.

These factors form the wide range of challenges and threats to the national interests of Ukraine, which show the need for balanced public military policy and effective military strategy in the sphere of reform and development of the Armed Forces of Ukraine and law enforcement agencies - the subjects of national security. The implementation of this strategy, as seen, can be based on determination of the trend development of armed struggle in modern conditions, their forecasting in the future, and on this basis - improvement of approaches to defense planning with consideration of actual resource potential of the state.

The forecast of development of armed struggle trend in modern terms, which is one of the urgent tasks of national defense strategy has been worked out in the article on the base of an analysis.

The analysis of the trends of the armed struggle in modern conditions shows that military operations in an increasing degree acquire features of the so-called war of the sixth, and in the near future - the seventh generation. Their most distinctive features are:

widespread use of precision common weapons of air (aerospace) and marine and land deployment, the increase in scale of information and electronic fight;

more attention to the action in the air and space;

the increasing role of the initial period of the war;

acquisition of operations the volume and nature of high maneuvering character with simultaneoussingle performance of interrelated activities by various types of armed forces, types of forces on land, air, space and sea;

transition to adaptive forms of hostilities;

increasingof the ability to quick move on large distances on big groups of troops (forces) and their deployment in short terms;

growth of trends to coalition military operations of states and creation for this purpose international military formations (including the Rapid Reaction Force).

It shows that with the consideration of the mentioned peculiarities in the context of the analysis of trends of development of armed struggle in modern conditions will facilitate to adequate decisions in the reform and further development of the Armed Forces of Ukraine and other military formations.

The mentioned analysis shows that the most relevant areas, which must be performed progressive transformation should be:

creating the optimal structure of the Armed Forces of Ukraine through a combination of administrative - organizational and inter-specific functional (based on joint rapid reaction force) components and providing them adequate capacity to respond to challenges and threats to the national interests of Ukraine;

improving of the system of the Armed Forces of Ukraine and other military formations on the basis of comprehensive information and the creation of integrated automated systems of management and communication;

focus on the equipment of the Armed Forces of Ukraine with precision weapons, combined with the development of intelligence and electronic warfare;

improvement of forms and methods of participation of military formations in the activities of information fighting measures.

Keywords: *armed conflict, development trends.*

Mysyk A.B., Bratko A.V. **Analysis of the conditions useing reserves in the protection and defense of the state border of Ukraine.**

This article describes how to determine the methods of operation or special events to find and eliminate agents, sabotage and reconnaissance groups and gangs of the enemy, as well as factors that influence the effectiveness of the reserves to find the perpetrators.

All kinds of special events which held by reserves of the border guard service depend on the action of the enemy, tasks which performed, the presence and capabilities, has consistently held closely together one with another, usually complex not only for goals, but also ways of action .

The situation in the zone of the antiterrorist operation indicates that sabotage and reconnaissance groups reinforced by the enemy tanks, armored personnel carriers and infantry fighting vehicles. The possibility of the frontier units by fire support in the area of contact with the enemy is very limited if they attacked by the several sabotage and reconnaissance groups opponent.

Keywords: conditions of the operational professional activities, methods of actions, special events, reserves.

Mykhailenko O. V. ***Simulation of the criminal activity at the state border***

The emergence of new and the strengthening of traditional threats to national security at the state border has been noticed recently. It requires the intensification of different areas of the State Border Service of Ukraine including

operational activities. The simulation allows to significantly increase the quality and productivity of the investigators and operatives.

The need for new methods in managing the operational and investigative units is particularly evident in the criminal analysis.

The following definition has been done: "a model refers to a thought or a material system that is provided and that by displaying or reproducing the object of the study can replace it so that its study will give us new information about this object."

The above definition allows to point up: a) the main types of the simulation: material and mental, prospective and retrospective, b) the possibility to reproduce the object (phenomenon) as a whole or only some of its properties while using the models; c) the possibility to receive the necessary information about the test object, phenomenon, process indirectly.

The simulation is used in criminal analysis in the following cases:

1) when the object existed in the past and it no longer exists at the time of the study (e.g, criminal event, the criminal case);

2) when the object may exist in the future;

3) when the object really exists at the time of the study, however, it is either too difficult, or even inaccessible to knowledge;

4) Where a learning process occurs either too quickly or, conversely, too slow.

Various ways of implementing the simulation can provide the following types of it: material (objective); imaginary (ideal, speculative); logical-mathematical and cybernetic; information and computer etc.

Considering the nature of criminal analysis the most promising is the modeling based on fuzzy logic. The use of given models, in addition to the existing ones, provides: use of quality indicators; taking into account the inaccurate, approximate information about the meaning of signs; use of the knowledge of experts in the form of fuzzy inference rules; getting more qualitative assessment of the object tested in the criminal analysis.

Keywords: *simulation, fuzzy inference, crime analysis, crime on the border.*

Onyshchuk S. V. **Methodology predicting illegal activities in state border crossing points outside**

The difficulty of forecasting illegal activities at the state border crossing points outside driven by a large number of factors that affect the implementation of illegal activity. Most of these factors is difficult to assess and describe quantitative indicators, however, they can be described by qualitative indicators. One way of solving this problem is the use of mathematical models based on fuzzy logic. In previous studies the mathematical model prediction illegal activities in the area of responsibility of State Border seized using fuzzy logic. There was a need to develop methods of forecasting illegal activities in the area of responsibility of State Border seized using mathematical models based on fuzzy logic.

The paper presents an algorithm using methods of forecasting illegal activities in the area of responsibility of State Border seized using fuzzy logic, which includes the following steps:

1. Formulation of the problem prediction.

2. Creating a system of fuzzy logical inference.

2.1 The choice of input, intermediate and output variable.. Building a hierarchical tree fuzzy logical inference.

2.2 Determination of membership functions of input and output variable, Defuzzification method.

2.3 Forming the base rules.

2.4 Setting model.

3. Application of fuzzy logical inference.

3.1 Determination of parameters of input variables.

3.2 Introduction input data in the system fuzzy logical inference. Getting results forecast.

Under the procedure proposed implementation stages of the algorithm. The novelty of the methodology consists in the author proposed fuzzy model tuning procedures using immune optimization algorithms and determine the parameters of input variables. Using this technique makes it possible consideration during the forecasting quality indicators, inaccurate and approximate information, knowledge experts on border surveillance.

Keywords: prediction of, fuzzy logic, illegal activities, state border.

Servatyuk W, Polischuk M. ***A structure of the illegal armed formations and feature of their tactic of actions is on the southeast of Ukraine.***

Successful implementation from the defensive (guard) of state boundary is impossible Government boundary service of Ukraine of tasks without the proper knowledge of opponent, his tactic of actions, structure and organization.

In modern domestic scientific literature, devoted actions in the conditions of the armed conflicts and special operations much is spared attention different forms, methods of conduct of the armed fight and constituents of the system of providing of boundary safety. Thus, on the modern stage of study of smell of powder of the soldiery formations and law enforcement authorities on southeast Ukraine research of structure and tactic of actions of the illegal armed formation which became the main opponent of soldiery and limbs of the law, spared scientists not enough attention.

The purpose of the article is determination of general structure and tactic of actions of the illegal armed formations in the boundary districts of southeast of Ukraine.

In the structure of the illegal armed formations it is possible de bene esse to select the followings constituents: fugleman and one (a few) his helpers which carry out the role of «staff» (as a rule leader from local inhabitants or criminal environment, and also among them there can be geared-up persons from a number former servicemen or employees of law enforcement authorities); group of guard of fugleman which accompanies him and guards on stands; group of secret service

and network of secret service agents (the last can be from local inhabitants and not included directly in the illegal armed forming); liaisons; group of diversions and terror; pointers.

At the beginning of escalation of the armed conflict on the southeast of Ukraine of tactician, hits, in the basis made the actions of small on a quantity detachments, which carried out attacking small soldiery groups, separate servicemen and limbs of the law, soldiery columns on march, military objectives, administrative buildings of organs of power, economic objects and others like that. Farther with escalation of the armed conflict, when separate collisions outgrew in battle actions detachments united in the large enough formations a quantity 500-600 persons for the decision of scale and difficult combat missions. In these terms of tactician of actions of hits got around the actions of regular troops.

For achievement of the destructive aims the illegal armed formations are able to operate various methods and methods. It is thus necessary to take into account a sticky social and political wicket in a region, which extremists operate at. In such difficult terms, from the side of organs guard of state boundary differential approach is needed in relation to co-operating with the soldiery and law-enforcement formations and to strict certain places and roles of boundary subsections in the system of defensive (guard) of state boundary and counteraction the illegal armed forming in the conditions of the modern armed conflict.

Keywords: *illegal armed formations, structure, tactic, guarding the state border.*

Androshchuk A.S., Berezensky R.V. **Methodological approaches introduction of information technologies in road transport military formations and law enforcement**

One of the main tasks of ensuring the activities of military forces and law enforcement agencies is the carriage of goods, personnel, weapons and equipment. As practice shows, to effectively address these issues need to apply modern information technology and developed on the basis of their automated systems in the automotive and other transportation modes. In road transport, military units and law enforcement agencies, including the technical operation of the subsystem should be substantial quantitative and qualitative changes of information support service processes, which should lead to the next.

1. Shut computerization level solutions traditional accounting and analytical, planning and management tasks workflow.

2. New information technologies applied not only to large but also small vehicles, repair and maintenance of the car unit.

3. The most important trend will be the transition from the use of computers for solving important, but often isolated problems to the creation of integrated information systems car unit.

4. Expand the traditional range of problems that can be solved with the use of information technology.

5. There will be improvement and change in the methods and mechanisms of decision-making.

6. Begin the transition to a network computer technologies.

7. The transition will begin car unit on the innovative software and hardware.8. Expand the distribution use vehicle computer.

9. Adequate information systems that will be used, it is necessary staff development.

Transportation system for traffic management should be in constant development and correspond to the level of command and control system and rear. In this case, the main defining component of the process of information management today is intellectualization, based on the highest form of information – knowledge. It is the intellectual component of information is now becoming the determining factor in improving governance. Therefore, at the present time is paramount intellectualization control systems of troops (forces) and weapons as the fastest and most economical way to increase the state's military potential.

There is a need to develop scientific and methodological support project and program management of information technology (systems) in road transport military forces and law enforcement agencies.

Keywords: information technology, motor vehicles, military units, law enforcement agencies.

Babii Yu. O., Kravtsov I. Yu., Rishchynska A. M. Analysis of methods of adaptive amplitude-phase compensation of barriers

The article deals with the study of existing methods of adaptive processing of signals in superhigh frequency range.

We have determined that according to the quality criteria being used there are three widespread methods of management of adaptive aerial grating: the method of transformation of estimation of correlation matrix of berries; modified algorithm of occasional search; correlation method. The analysis of these criteria from the point of view of practical realization of schemes of adaptive barrier compensators testifies that the correlation method which is based on the usage of procedure of the fastest descent is the most spread in adaptive gratings designated for work in radar systems and communications systems.

The modification of correlation method concerns the method of minimum of root-mean-square mistake regarding the presence of main and supporting inputs in the system. This method is the most convenient method of automated regulation of vector coefficients. To estimate a signal in such system we pass the signal of supporting input through adaptive filter and calculate it using the signal of main input. Optimal vector of weight coefficient is chosen according to two main quality criteria.

We have found that these methods of accelerated coincidence of correlation adaptation algorithms in aerial gratings are divided into two types.

The first type includes the methods of enhancement of coincidence connected which are connected with coincidence coefficient change in every adaptation chain. They are based on the usage of universal algorithms of linear algebra while constructing the wide class of matrices with the particular location of own values and are characterized by extreme coincidence speed regardless of

matrix order. But the necessity of accurate estimation of own values of correlation barrier matrix does not allow them to reach appropriate speed to ensure a significant level of adaptation acceleration.

The second group includes the method of adaptation acceleration with the use of preliminary processing of input signals. This method is carried out by the device of preliminary processing. At the output we can receive, ideally, uncorrelated signals which powers are equal to own values of correlation matrix. But practically the adaptation process lasts for some chains. Besides, this method requires considerable complication of processing scheme which is not very good for a case with a great number of channels.

Our study showed that the usage of methods which are based on correlation signal processing is the most prospective in adaptive systems of space and time filtration. Particularly we can outline its modifications connected with changes of coincidence coefficient and preliminary processing of input signals.

Keywords: amplitude-phase compensator, adaptive processing, quadrature regulator of complex transmission coefficients, balance amplitude-phase detector.

Borovik O.V., Borovik L.V., Traskovetska L.M. **Research performance efficiency of information and telecommunication systems "Hart 1" on the basis of simulation modeling methods**

Activation of illegal activities at the state border, much of remoteness and units of the State Border Guard Service of Ukraine (SBGS), their flexibility, comprehensive application of heterogeneous capabilities, extensive involvement of the local population of the border, a sharp change of scenery make high demands on speed control and induced improving the security system at the state border of Ukraine. To this end, the State Border Guard Service of Ukraine created a central data storage in organs and units deployed border information and telecommunication systems (ITS) and systems for various applications; provided the exchange of information between them and the central data warehouse, etc. The development of telecommunications networks and information systems in SBS today is an objective necessity, which is implemented based on global trends in the construction and integration of networks, facilities and services.

Information and telecommunications system of border control "Hart-1" functions as part of an automated decision support system that border and is designed to reduce the time to check people and their passport documents at crossings and to improve the quality of border control. The experience of SBS determines the need to study characteristics (values of) the effectiveness of the operation of ITS.

In this paper the features of ITS research functioning of the State Border Guard Service of Ukraine "Hart-1" and describes the scientific and methodical nature of the problem of modeling the operation of ITS by applying methods of simulation.

Keywords: information and telecommunication systems, simulation, workstation, efficiency, method.

Borovyk O. V., Levkov V. V. **Evaluation of the use of electric power through the use of the potential of erenewable energy sources for technical means of border**

At the border guards of Ukraine in general and dividing lines, in particular as well as in the definition and implementation of measures to prevent armed aggression is an urgent issue of building an effective layered system of monitoring the situation. Means Border Protection (MBP) are elements of such a system. With MBP undertaken both search time (early) detection (recognition, identification), tracking (locating, guidance) purposes, but, if possible, photos and video-facts offenses.

Although in recent years has increased and improved quantity and quality of the park of MBP (including through implementation of international technical assistance), today marked insufficient level of usage. Thus one of the main causes of downtime is MBP instability or lack of electricity. This is due to scheduled and unscheduled prevention and recovery work on general-purpose electrical set limit energy consumption, and as a result of deliberate damage (destruction) of offenders (aggressors) existing networks of centralized power.

Established that the State Border Guard Service of Ukraine significant portion (about 65%) power supply systems (electrical equipment in border infrastructure), which is used to power the park MBP characterized by considerable physical and obsolescence, and currently served in a timely operation of two or more times and should be replaced. This resource does not allow qualitatively and fully solve the problem assigned to border units.

Thus, the existing difficulties electricity outline the need to improve the reliability of power supply MBP to at least the minimum level. Hypothetically, this can be done by using the potential of renewable energy sources. It is therefore important task is to assess the effectiveness of ways power supply of means of border protection, including through the use and potential of renewable energy sources.

In the article on the land border service department "resort" Odessa frontier conducted military-technical assessment of effectiveness of electric power systems permanently stationed technical means of border with different ways of obtaining energy. Determined that both technical and militarily application of electric power systems that are energy potential of renewable energy is more efficient than traditional systems, i.e. systems of the central industrial network or battery (gasoline or diesel) power station.

Keywords: electric power systems, means of border protection and performance evaluation, mathematical model, renewable energy.

Hashchuk M. P. **Application of methodology of multicriterion choice for optimization of vehicle park composition**

Quality improvement of possibilities of forming of composition of parks of transport vehicles it can be attained only with introduction of going near optimization, first of all, with introduction of ideology of multicriterion optimization.

Plenty enough of researches in this direction does not result in the substantial improvement of the state of businesses: researchers directed effort, mainly, on the attempt of improvement of already existent scientifically-methodical vehicle without that, to understand reasons of the facts marked higher and choose more effective approaches.

The aim of this article is exposition of results of scientific research in relation to introduction of the new for industry forming of composition of park of transport vehicles of multicriterion methodical approach.

Thus, methodological bases for this introduction exist already - the general chart of formalization and decision of tasks of multicriterion optimization is worked out, the specific methods of their decision are worked out, but the worked not enough out is remained by the area of researches in relation to taking into account of features of concrete subject industry, her properties, requirements and limitations during realization of general methods of multicriterion optimization. It follows notices, that taking into account of specific of forming of parks of transport vehicles at conducted multicriterion optimization of possible variants of composition it is worked out obviously not enough.

Keywords: vehicles, forming part of the park of vehicles, border guards, additional information, decision.

Holovnia S.B. **Technique of estimation of technical efficiency of transport means of border detachment**

The author has developed the technique which allows us to determine the level of technical efficiency of transport means of border detachment. The article concerns the approach of determination of the particular reliability level of transport means of border detachment in order to find out indices of reliability of transport means. Also the author supposes that determination of reasons of possible decrease of technical efficiency level and he explains how to make appropriate management decisions for improvement of technical.

Operation and service activity of border detachment units is characterized by dynamics and fast changes of surrounding. Timeliness of reaction upon situation changes within the area of border detachment is ensured owing to supply of border units with reliable and highly mobile means of transport. Capabilities of transport means to stay in the state of permanent availability is realized by functioning of the system of technical maintenance of transport means.

The efficiency of technical maintenance of transport means is determined by its capability to maintain and restore vehicles and to ensure specified level of mechanical availability of transport means in the case of optimal time spending, labour expenditures and costs. It is necessary to have appropriate technique in the order to determine and correct the level of efficiency of the system of technical maintenance of transport means of border detachment. This technique will allow us to maintain mechanical availability of transport means at the specified level and to optimize costs of technical maintenance.

The offered technique establishes the connection between values of technical availability and expenses on maintenance of specified level of availability. Such

connection will allow to determine conformity and expediency of financing of technical maintenance of border detachment. Obtained results can be used during the procedures of estimation of mechanical availability of transport means of border detachment and efficiency of functioning of the system of technical maintenance of transport means of border detachment. As a result of the research we offered the technique estimating efficiency of the system of technical maintenance of transport means of border detachment. The given technique allows to determine timeliness of supply with spare parts, quality of repairing works by service technicians, expediency of number of technicians regarding transport means being maintained, level of reliability of transport means, etc. Complex consideration of indices of technical maintenance system is possible as a result of using enhanced coefficient of technical application.

Keywords: technique of evaluation of technical efficiency, efficiency coefficient, refusal index, transport means.

Zherdev M, Kredentser B, Kuzavkov V. **Summary diagnostic method for digital radio electronic blocks of units autonomous diagnostic systems**

Modern objects of radio electronic armament (REA) are the difficult technical systems, and consist of association of blocks of different physical execution and setting. A timely exposure over and removals of reasons of refuses of digital blocks in place of exploitation REA brings to the increase of quantitative descriptions of reliability and cost cutout on exploitation of technique. This circumstance determines the necessity of realization of the quality diagnosticating. The task of diagnosticating of digital blocks is laid on the systems of the technical diagnosticating. Quality the performance of objective of diagnosticating depends on the methods of diagnosticating, adequacy of diagnostic model of object and methodology of realization of diagnosticating, use of the special programmatic vehicle systems.

Development of microelectronics and information technologies requires from designers and producers of the modern automated systems of diagnosticating (ADS) of development of new methods of receipt and treatment of diagnostic information for determination of the technical state and localization of defective radio electronic component in a digital block. Automated system of diagnosticating of blocks REA is component part of the system of technical service. It is totality of facilities, objects of diagnosticating and performers, that is needed for realization of diagnosticating on the rules set by technical documentation. The systems of diagnosticating are developed on the stage of planning, provided on the stage of production, supported on the stage of exploitation REA. However this approach not always is executed. An analysis showed that to the existent systems of the technical diagnosticating built on the basis of existent methods (methodologies), inherent substantial defects. Therefore such systems are ineffective, and does not answer modern requirements.

During exploitation existing and created new standards REA next contradictions were clearly determined:

between the real economic feasibilities REA and by the low level of their realization from after to insufficient efficiency of ADS;

between the level of requirements that is produced to ADS, and impossibility of them to satisfy, using the existent methodological vehicle of receipt and treatment of diagnostic information;

between a limit cost of ADS and high requirements to her descriptions.

These circumstances resulted in that ADS in existing REA can not provide localization of disrepair within a radio electronic component (REC). As a result, today created and the difficult functions, not economical, much contour system of technical service and repair of REA, that results in the considerable losses of time on control of the technical state and localization of disrepairs.

The conducted analysis allowed to ground effective direction of development of ADS and finish telling fundamental possibility of her construction on the basis of the use of DP receipt and treatment of diagnostic information.

On the basis of undertaken scientific studies in area of diagnosticating of digital blocks REA the new methods of receipt and treatment of diagnostic information are worked out. The aim of the article are decisions of scientific task of development of the generalized methodology of diagnosticating of digital blocks REA by facilities of ADS built on the basis of offer new methods.

Keywords: diagnostic model, test, algorithm

Levchunets D.O. **Radar signals detection based on the wavelet and signal convolution analysis**

In information extraction systems such as: radar, radio navigation, and similar to them one of the main tasks is to assessing whether there is signal at the receiving side. At present there are many methods to solve this problem. Among other things the special feature of wavelet analysis caused by the opportunity to make an interpretation of data. It is essential to establish theoretical bases for the correct interpretation of the input signal.

The task of identifying useful signals always been the cornerstone of information extraction systems. As a result, a large number of methods and algorithms for detection were created. However, recent advances in digital technology gave an opportunity to work in the high frequencies. Which resulted in the use of broadband and ultra wideband radar signals.

Detecting radar signal distorted by noise using Fourier analysis methods can lead to inaccurate estimation of the distance to the object of observation. This is due to the use of time-frequency filter which performs segmentation of the input data by using windows with constant duration. Within which the signal is considered stationary. Window size change distinction between the frequencies by changing the number of samples. Wavelet transform serve as an alternative to the time-frequency representation.

This paper presents the method of radar signals detection based on an convolution analysis of wavelet and signal. Using wavelet apparatus for solving the signal detection problem provides the developer ат opportunity to choose due to the flexibility of the transformation. However, further development of the theory of wavelets that presented in this paper allows to avoid the uncertainty in parent

function selecting that lead in outlined framework. Expediency of exact conversion signal to the wavelet rather than vice versa are proved.

Theoretical principles of the method and its advantages are grounded. the feasibility of the signal detection problem solution are highlighted. Such as described its future prospects.

Keywords: *radar, wavelet convolution, detection, analysis.*

Minyaylo P. V. **Simulation of linkage based on central straight-line slider-crank mechanism in SolidWorks**

The main aim of the research – to simulate the mechanisms and test their kinematic parameters.

The simulation of straight-line mechanisms and dwell mechanisms on the basis of slider-crank mechanism in SolidWorks is viewed. Straight-line mechanisms, which are widely used in modern engineering, describe the rod curve that in a particular area is close to a straight line, which provides a dwell of the final link of mechanism. Graphs for the kinematic parameters of dwell mechanisms are shown.

According to recommendations all the simulation parameters were adjusted to get the highest quality of modelling results.

For comparison the diagram of moving outer link of mechanism which is built on Delphi environment is represented.

From all the diagrams the presence of phase of motion and phase of stop of outer link of mechanism is visible.

As seen from the results, the use of modern CAD/CAE systems such as SolidWorks, allows you to check all the necessary parameters based on computer models of mechanisms and significantly simplify experimental study of physical models of mechanisms and machines.

The perspective of further investigation we consider in the dynamics of linkage based on central straight-line slider-crank mechanism.

Keywords: simulation, straight-line mechanisms, dwell mechanisms, dwell time, dwell accuracy, coupler curves, CAD, SolidWorks, SolidWorks Motion.

Podolian O. Y., Gerasymyuk O. V. **Prospects for the use of hydrogen as a fuel for vehicles departments of the state border**

At the present stage of development of the autotechnical provision system of the Border Guard Service has become quite urgent, regarding the question of automobiles selection with high fuel efficiency and environmental friendliness for the border guard units. Best values of these parameters represent automobiles with combined (hybrid) power plants.

Decision regarding border guard units equipment with vehicles having hybrid power plants requires careful study. This is due to the high cost of the "hybrids" themselves and what concerns creation and establishment of the operating system.

On the other hand, the results of analysis of an automobile operation with a hybrid power plant show that its efficiency directly depends on the type of fuel.

Thus, today there is no consensus among experts on the best type of energy for vehicles, which are used in order to provide realization of border protection units' tasks. Therefore current situation determines the relevance of this article.

This publication deals with motor properties of hydrogen as one of the options for alternative fuel vehicles with hybrid power plants based on reciprocating internal combustion engine.

The survey results indicate significant advantages over other hydrogen fuels, in particular, in terms of energy content (specific heat of combustion), boiling point, diffusion coefficient and so on. After comparing hydrogen-air mixture with gasoline-air mixture, the first one is considered to have more advantages such as lower limit of fire and flame extinction distance, faster flame front propagation, that requires less energy to fire. All of them confirm the availability of using hydrogen as the main energy source for hybrid power plants based on reciprocating internal combustion engines (excluding engines with external fuel mixture formation).

The results obtained are intended for use in evaluating the effectiveness of the vehicles with hybrid power plants by border guard units.

Keywords: hydrogen, vehicles, motor properties, hybrid power plant, fuel economy, border guard units.

Roizman V. P., Klepikovskyi A. V., Karpenko A. V. ***Thermostating of quartz resonance system with the use of Peltier thermoelectric modules***

The article substantiates scientific and methodical approaches to improvement of methods of thermostating of piezoelectric elements with the use of Peltier semi-conducting elements. We have found that the possibility of operative electronic management of temperature, high constructive reliability, small overall sizes are considered to be the advantages of Peltier thermoelectric modules as opposed to air and liquid cooling systems. The disadvantages include, first of all, their large weight and emergence of clearly expressed resonance frequencies. While designing the radio-electronic knots we offer to take into consideration mechanical properties of modules, namely resonance frequencies, and to take additional measures for prevention of their coincidence with those which are not desired.

In the article we used the electrical analogue method to calculate resonance properties of Peltier thermoelectric elements. The obtained correlations gave us the possibility not only to determine own resonance frequencies of Peltier thermoelectric elements but also estimate different frequency correlations in case of many-stage constructions. If we use Peltier elements of hardness management, we can choose different temperature regimes. But if we cannot achieve or forecast the emergence of undesired resonance, temperature changes can compensate it.

In the article the authors made a conclusion that resonance frequencies of stages depend on mechanical hardness between them nonlinearly. If we change hardness of each stage or material intentionally, we can regulate (if necessary) frequency of own fluctuations of each stage. It means that they it will shift them this or other way with the purpose to prevent from coincidence of own fluctuation

frequencies of an item with forced fluctuation of a bearer and to avoid resonance phenomenon and further item destructions.

Quantitative estimation of mechanical effect of thermoelectrical elements showed that harmonious interior mechanical fluctuations have been amplified resonance frequencies at the level of 20 dB. We admit that it is very important for the work of electromechanical resonance systems.

Keywords: thermoelectric modules, Peltier elements, quartz resonator, piezoelectric resonator, thermostating, own frequency, frequency synthesizer.

Sivak V.A. **Investigation ofthe possibility of new information technologies introduction inthe improvement inoperational safety of vehicles in the border guard units**

This article reveals familiarization and comparative analysis of possibilitiesof classical and new information technologies, namely neural networks andfuzzylogicelement.

To maintain the operability and functionality of vehicles and preventing failures and malfunctions that lead to emergency situations, and quite often road accidents, the whole complex of organizational measures is conducted in the border guard units. However, very topical issuesremain the implementation of new information technologies in the research of solutions to the problem of maintaining the safe operation of vehicles in the border guardunits.

The purpose of this article is a review and comparative evaluation of the opportunities for the introduction of new information technologies, exactly of neural networks in the solution of problems of increasing operational safety of vehicles in the border guardunits.

Tendencies in the development of intelligent control systemswere revealed.Areas of the most effective use of modern information technologies were scrutinized.

It is shown that real examples of the application of intelligent technologies in safety systems of the vehicle movement can be found in models of almost all the leading companies of the world. Besides, successful development of diagnostic tools based on fuzzy logic is also knownin medicine, aviation and space technology, oil and gas equipment. In addition, the article provides examples of using neural networks and elements of fuzzy logic in studies of Ukrainian and foreign scientists in the field of vehicles.

It is determined that one of the main advantages of neural networks is that they are based on relatively simple, often the same elements (cells) that mimic the activityofthebrain neurons-"formalneurons".It was found that based on the characteristics of task management systems and assemblies for vehicles, the implementation of neural networks in theformofneuroemulatoris optimalaccording to the Kharkiv scientists.

The prospects of implementation of neural networks and elements of fuzzy logic in solving the problem of increasing the safety of vehicle operation in in the border guard unitshave been defined.

Keywords: neural network, information technology, fuzzy logic, vehicles, safety of operation.

Sobchenko V. A. **Age structure optimization model of thermal imaging mobile systems park**

During its existence and development the State Border Service has made significant steps aimed at improving the efficiency border control service.

It includes a substantial engineering software state improvement, application of modern communication means, remote control devices, advanced video systems, radar and thermal imaging surveillance, automatic reading systems of passport documents and license plates ,etc. The technology park was filled with new launches, searchlight stations and devices for detecting radioactive materials, and modern vehicle engineering.

As the part of the State Border Service development concept on the period till 2015, due to international technical assistance projects new technical equipment standards of border means, such as mobile thermal imaging systems (MTIS) were accepted and commissioned. Management of the Department repeatedly noted the high efficiency and the need to increase the use of this type of technology in the border security. That may be implemented by increasing the quantity of the State Border Service MTIS park.

One of the pressing issues today is the quantification of the existing developments opportunities of the park MTIC by considering its aging and predicting the possible future structure of MTIC park in different acquisition variants.

The model of optimizing the MTIS park age structure that is based on the linear programming method has been developed in this paper. During the optimization process some equipment must be written off, others should be send for major repair or sale to purchase new standards of technique. The possibility of buying used equipment models at a lower cost is also taken into account.

The offered method allows to optimize both increasing the number of engineering, and reducing technique park. It is necessary to change the optimization terms, remove or reduce working hours and mileage in optimized Park. Objective functions that can be defined in optimal solutions finding may be the minimum value of investments, the number of cars in the park, developments and mileage which is planned.

Keywords: Mobile thermal imaging complex, reliability, linear programming optimization.

Chmyr V. M. Recommendations on improvement of technical and technological indices of exploitation of border division vehicles

As the situation in the east of Ukraine gets more complicated, the tasks of the State Border Guard Service of Ukraine are intensified, we can observe enhancement of efficiency of usage of existing vehicle park. Thus, border units need more vehicles of different types and different designation.

The article concerns the topical scientific and applied problems of substantiation of rationalization techniques of expenses on exploitation of state-financed establishment vehicles, namely those which belong to law-enforcement agencies and military components, on the basis of estimation of their technical and technological indices of usage and maintenance. The general rationalization techniques of material and technical expenses on exploitation of state-financed establishment vehicles have been outlined.

The analysis of scientific literature testifies to insufficient level of examination of this problem and we can make a conclusion that further studies are necessary.

According to the given methodology we have found an appropriate number of vehicles by types and designations within the structure of border division vehicle park. Also we managed to establish flow estimation of efficiency of realization or amortization of particular vehicles; and to calculate costs of maintenance of these vehicles on the basis of technological and economical indices.

Thus, regarding the given methodical approaches to estimation of values of technical, technological and economical indices of vehicles usage we can determine rational characteristics of completing and supplying of border divisions with different vehicles of particular types and designations which are oriented towards fulfillment of combat, combat support and logistics tasks. Also we will be able to determine a number of vehicles and outline accurate conditions of their exploitation and maintenance. Flow diagnostics of these indices ensures correct rational limits of general operation peculiarities, appropriate terms and volumes of repairing of some vehicles. Also it establishes the minimization of costs for vehicle park of border division.

Further we plan to substantiate indices of economical expediency of structure an volumes of repairing works for vehciles of border division using its own means and forces or involving special repairing enterprises.

Keywords: vehicles, techniques, rationalization, indices.

Shynkaruk O. M., Vasylkivskyi M. V., Natochev B. V. Classification of methods of estimation of phase signal jittering in digital chains

The article concerns the classification of methods of estimation of phase signal jittering in digital chains with the purpose of analysis and systematization of estimation principles of states of digital chains.

We have found that existing methods of estimation of phase jittering are divided into three classes: estimation of spectrum of phase jittering; estimation of frequency characteristics of phase jittering by means of digital stripe filters and estimation of frequency characteristics by means of analog stripe filters. The first two methods belong to the group of digital methods of jittering estimation, the third one – to analog ones.

The aim of analog methods of estimation of phase jittering is to determine phase signal jittering with linear encoding. The basis of digital methods concerns analog-digital transformation of input signal including relative time changes of

front emergence. The obtained values of phase jittering are used for determination of maximum value, root-mean-square value or conducting of spectral analysis. Also we have made a conclusion that while using digital methods the separating ability, efficiency and information capability of estimation of phase jittering increase.

Estimation of phase jittering with the use of digiscope and eye diagram is the simpliest one. The other method of estimation of phase jittering is bar graph which ensures use of visual techniques, which are impossible while using eye diagram. One more method of estimation of phase jittering is the design of U-type curve which is given by dependence diagraph of mistake frequency in bits from sampling point location on unit interval.

The spectral analysis is the efficient method of estimation of phase jittering where sources of determined phase jittering appear as peak of continuous curve of occasional phase noise. The spectral methods of phase jittering estimation are accurate and available for estimation of phase jittering of developed devices and searching of complex damages in digital equipment in laboratory conditions.

We have conducted the comparative analysis of existing methods of phase signal jittering in digital chains. It proved that efficiency of phase jittering estimation is affected by the techniques of processing and transformation of jitter signals. Also we used the classical methods of spectral and statistical analysis for estimation of phase jittering. But these methods are not very efficient due to the separating ability, narrow dynamic range, low resistance of obtained estimations of phase jittering.

Keywords: phase jittering, jitter, digital chain, estimation, chain of analog-digital transformation.