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CONTENTS

MASS PUBLIC TRANSIT PLANNING AND OPERATION: INFORMATION AND ANALYTICAL SUPPORT

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Planning and operation activity on the urban, suburban and intercity transit routes provides the set of tasks to be solved. Problems such as passenger demand estimation and forecasting, the required transit vehicles fleet size and its operational efficiency on the routes particularly are in this set [1]. The complexity of solving these problems are caused by significant amounts of source information to be obtained and analyzed. Such analysis may be performed at the stop, transit network segment or integral transit network levels. As a result of source information analysis and mentioned tasks solving the operational procedures are worked out which allow reaching the optimization of the transit network structure, improving the transit operational management and timetabling design, a long-term transit system development forecasting.

Nowadays applied computer software is widely used for the solution and decision making in planning and operational management of mass public transit systems. The most popular of this software is Hastus (Giro, Canada), PTV Visum (PTV Group, Germany), Trapeze (Trapeze Group, Canada), TransCad (Caliper Corp., USA). All these software are proprietary and users need to pay for its commercial use.

Involving computer-based information-analytical systems in the management process provides more efficient solving of many problems such as:

1) storage and operate information about transit route system and its components: transit-served area, stops and stop points, road and transit network links, available transit modes, passenger vehicles specifications; and so on;

2) assessing and analyzing of transit network development indicators for transit system at a whole and transport modes separately followed by forecasting their development for the future;

3) source data about the demand for public transit, passenger flows and transit fleet performance indicators collecting and processing;

4) initial and final analytical forms preparing and providing for the public transit demand investigations on the transit network and making reports according to their results;

5) calculation and estimation of OD-matrix elements of passenger demand on the stop and transit zones level;

6) passenger level of service assessing on the transit network level based on average time spent by the passenger for a journey in the public transit sys-

tem. Passenger spent time includes pedestrian, waiting and transport component;

7) technical and operational providing of passenger transportations on the routes: trip and round trip cycle time setting, passenger vehicle assignment, frequency setting and timetabling.

To solve the mentioned problems more efficiently the computer software TRANSIT is developed by the transport technologies department of "Zaporizhzhia Polytechnic" National University. TRANSIT software is represented as an information-analytical system (IAS) [2]. It is a desktop application that works under the Windows OS operating system and based on a dBASE-compatible database control system. The application has a file-server architecture with providing multi-user access via the local computer network.

The relational database TRANSIT which includes 14 tables is a core of IAS. All tables are divided by information update level on permanent data (transit service areas, transit modes, passenger vehicles), conditional data (stops and stop points, transit network links, routes, timetables) and strategic data (passenger transportations demand and passenger flows).

Data manipulations (such as input, edit, delete, update) and processing are provided via a user interface. Data input both from the keyboard directly and spreadsheet import is possible. The access rights for administrators and users of IAS are provided.

IAS TRANSIT performs calculations and gives out the analytical forms and reports based on available and processed information. Forms and reports contain the result data about transit network development, operational efficiency and level of service at the transit areas, zones, networks, network links, segments and stop level, demand level which represented by OD-matrixes and passenger flows on the transit network and route links. Developed applied software was used for complex passenger flows investigations on the urban transit network in Zaporizhzhia city (Ukraine) and suburban and intercity routes in the Zaporizhzhia region [3].

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DEVELOPMENT SYSTEMS INTERVAL CONTROL OF TRAIN MOVEMENT

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One main objectives transport is trouble-free and safe transportation goods and passengers. Increasing velocity vehicle, increasing range of transportation, amount transported goods, development new territories continents, emergence fundamentally new vehicles and methods of control are main factors that make research into transport safety relevant. The analysis modern security systems in transport showed existence of reserves increase quality traffic by monitoring critical parameters moving objects, as well by monitoring information management systems and state of human operator while driving.

The urgency problem domain this direction and its growing economic importance due intensification scoping process and compu-?erization of production and automation complex integrated management operation as network processes and individual enterprises and whole sector economy.

Creation and improvement Automatic Control Systems (ACS) transport is one important problems whose solution largely determines level of science and technology. In foreground task creating qualitatively new ACS, providing high reliability, precision control and adaptation. With strengthening control conditions imposed additional requirements for their quality indicators. ACS synthesis problem is seen as problem of deter-?ining structure and parameters model system ensure functioning given quality effects and presence of given constraints. As sources are different ways classifying emergencies in railway transport and characteristics that underlie current research directions.

The aim is improve transportation safety by developing control algorithms critical parameters train, develop human-machine control systems with influence of human factor and improve accuracy processing sensor signals using modern methods filtration.

Management is process systematic effects on object to achieve certain goal. The selection and formulation goals depends on many factors and must meet many different conditions. The task improving quality of governance comes down choosing optimal solution of problem many possible. Quality parameters are functions or functionals relevant targeted functions or functionality. Target functionals considered as function where independent variables are vectors that characterize different op-

tions. Analytical approach problem solving optimal control provides clear result formula, at same time, this means major simplification of management model. The analytical approach used solve simple problems can be formulated with substantial idealization task.

Improving quality automated systems implemented as analytic and algorithmic methods. The analytical approach improve quality control actions used when designing ergatic system "adaptive correction device operator action rolling". Applying analytical methods allow formula to get algorithm device, but mathematical model and operator of device is significantly simplified. To simplify model "human operator" was presented linear stationary dynamic link system, which does not take into account operator's ability to adapt and extrapolation. To simplify analysis adopted scheme consistent correction.

When designing complex systems used multivariate algorithmic methods improve quality of management. Based on requirements in area of transport security algorithms were functioning systems and devices that are allowed carry out synthesis block diagrams. Optimization management held in structure designed systems and devices.

An important aspect is safe movement trains movement interval regulation. With an ever increasing density trains on railway should use reliable modern systems interval regulation of movement. As part study developed useful model that solves this problem with use of modern technology.

The system interval regulation movement trains (SIRMT) relates to field of railway automation, and can be used on locomotives, multiple units rolling stock in order increase safety regulation trains and systems of interval regulation using air.

For prototype was accepted existing systems of interval regulation movement trains using satellite navigation systems. The disadvantage existing systems is lack ability control integrity of structure while driving and determining velocity and location Unhook when uncoupling train.

This deficiency reduces reliability and safety of train control. The essence development is determine coordinates beginning end of structure without terminal devices with an integrated locomotive safety device (CLUB) in determining optimal speeding locomotive considering distance to obstacles and monitoring compliance; in determining minimum interval in order increase traffic; in calculating actual speed of train according signals from receiver satellite navigation systems; possibility deciding on emergency brake, interoperability club with an automatic brake control (South), ability control integrity train by organizing additional channel.

When using interval adjustment trains is achieved by continuous monitoring location of train with required accuracy, increase traffic

through more accurate, compared with systems interval regulation of movement, built on floor automation devices, positioning train, increased safety by continuous monitoring interval continuous monitoring integrity rolling stock.

Interval adjustment system solves problem trains increase safety and traffic flow by continuous monitoring location of train control intervals between trains and integrity warehouses. Our studies allow develop technical devices and algorithms intended improve safety of transport. System advanced safety vehicle "monitoring system moving objects", "SIRMT". The proposed concept allows work to develop such technical devices "Device adaptive correction actions of operator vehicle", "Device control dangerous convergence of trains traveling in same direction".

The block diagram devices and systems ensure safety. The system Interval traffic regulation will increase traffic on railway, which will significantly increase economic efficiency transport. Using appliance detect dangerous convergence trains will organize an additional level control for safety of rail transport on major highways. Using device to low-density, not electrified sections of railways significantly improve traffic safety.

Currently, railroad is not possible to abandon floor SCB devices and switch completely system interval traffic control built on basis satellite navigation systems implies possibility unpredictable failures in past. However, use SIRMT together with underfloor devices SCB will provide an increase in traffic, while maintaining high reliability of rail transport.

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ANALYSIS OF THE USE OF BIG DATA TECHNOLOGIES IN RAILWAY TRANSPORT

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Nowadays, more and more new technologies and innovations fill the world. Since people want their goods to be delivered faster, with quality, with the ability to track, companies must come to introduce various technologies to satisfy both their needs and consumers. And with such a breakthrough, people have to process more and more the amount of information received as requests on the Internet, the logic the behaviour of these users, GPS signals from cars for the transport company, data taken from sensors, information about the transaction of all bank customers, information about all purchases in a large retail network, etc.

Given the development of digital systems, these trends have led to the emergence of a fundamentally new direction - Big Data processing technologies, which are structured and unstructured data from huge volumes and diversity, as well as methods for processing them, which allow structurally analyzing information.

When using Big Data, VVV is usually remembered - three attributes or Properties that big data should have. First of all, it is Volume - volumes (data are measured by the value of the physical volumes of documents). Velocity - data is regularly updated, they require constant processing. Variety - diverse data can have heterogeneous formats, be unstructured or partially structured. The following is an analysis the use of Big Data technologies for transport by various companies in different countries of the world.

An interesting example in solving this problem is the experience of DHL - the largest company in implementation of logistics services the field of international transportation. It implements such an approach in which a daily optimized delivery planning is used based on a dynamic routing system. This system recalculates routes according to current needs and traffic conditions. It also reduces costs and improves CO_2 utilization, for example by reducing mileage. At the same time, sensors mounted on vehicles become a new source of critical information (Jeske, Gruner, WeiS, 2014) [1, 2].

One of the leading countries that successfully use this promising technology is the United States. The well-known American company Transmetrics, which offers analytical tools for the transport industry, declares that a large expeditionary company can reduce the empty cargo space in its trailers from 47% to 18%. Thanks to the implementation of Big Data

technology, the savings reach $ 400 million and 5.5 million litters of fuel per year. And the cost of loading decreased by 25%.

An example of solving this problem is the experience of UPS, one of largest American international logistics companies. This company uses radar to track cargo, and then collects and analyzes the performance of multiple sensors to monitor vehicle conditions and driver behaviour. And then it uses mobile CRM data to monitor delivery and customer service. To optimize routes and reduce costs, the company introduced the ORION system - one of largest systems in the world based on the results of mathematical theory of operations research. To solve problem of constructing the optimal route, this system uses cartographic data, data on departure and arrival points, sizes and required delivery times [2, 3].

The largest US rail company, Union Pacific Railroad, is also successfully using this technology. So, thermometers, acoustic and visual sensors and other sensors were installed on each company's staff, the data from which are accumulated in the processing center. This center also receives data on weather conditions, the state of brake systems, GPS coordinates of trains. The developed model allows you to track the condition of the wheels and the railway track and to predict the derailment of trains for several days. This time is enough to quickly fix the problems, to avoid damage to the train and delays of other trains. As a result, the company managed to reduce the number of derailments by 75% [2, 3].

Also successful is the experience of other countries. The Italian company Trenitalia saves € 100 million a year using Intelligent Analytics and IoT to manage repairs. In Saudi Arabia and Sao Paulo, the Canadian rail company Bombardier built monorails for trains, which are 25% lighter and 10% less in energy costs than traditional metro rolling stock. Taking into account the use of advanced software on railways and analysis of variables, including hundreds thousands of them, such as the condition of roads and the level passenger demand, a carrier in the Netherlands sends more than 5 thousand trains a day, increases operational efficiency by 6% and saves about € 20 million per year.

An analysis the possibilities of using this technology on domestic railways showed the following. Maybe Ukraine lags behind the advanced countries in level of digitalization the transport industry, but it shows a very good speed in changing the approach. For example, there is an intention to consistently implement a program with the speaking title "Digital Railway". It includes the use of industrial IoT technology, Big Data and more. This implies that the warehouses will be sealed by installing special sensors on the containers. They will be able to transfer information about the goods to

tax and customs services. This will allow monitoring the movement of goods throughout train and going to electronic document management.

Given the large untapped potential in practice, there are numerous obstacles to the implementation of solutions using Big Data technology. However, at present, more than ever, railways should take into account a large number of external factors when solving this problem - to understand the consequences of changes in weather conditions, possible traffic jams, restrictions on transport hours, maintenance schedules and many other factors.

Thus, the use Big Data technology for the transportation of goods will help to make a breakthrough in the technological development of country, as well as save money, facilitate and improve transportation technology.

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THE OPTIMIZED CARRYING STRUCTURE OF A HOPPER CAR FOR TRANSPORTATION OF PELLETS AND HOT AGGLOMERATE

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Effective operation of the transport industry requires innovative transportation means. As far as rail transport constitutes the basic segment of transportation process, special requirements should be set for modern train designs. Particularly, it refers to carrying structures.

One of the most widely-used types of cars in service for industrial enterprises is a hopper car for transporting pellets and hot agglomerate (700°C). Besides, hopper cars are used for transportation of bulked materials which do not require protection from weather. These cars are discharged on both sides of the track through discharge doors.

Operational loading and heat loads from the transported cargo on the carrying structure of a hopper car damage the body elements. It requires appropriate technical service and repair, which leads to additional expenses. Moreover, damages in the carrying structure of the body can threaten the traffic safety.

An important issue for the prospective hopper car design is optimization of the bodies [1 – 3]. It may increase the material capacity, while ensuring the required carrying capacity, for the appropriate prototype car designs. Such a solution favors lower costs for construction and operation of cars, thus improving the transportation efficiency.

To study a possibility to optimize the carrying structure of a hopper car, the authors made the strength calculation with the finite element method in CosmosWorks [4]. A 20-9749 hopper car manufactured by Ukrspetsvahon (Ukraine) was taken as a prototype car.

The calculation made it possible to conclude that the carrying elements of the car body had a considerable reserve capacity. A lower material capacity of the carrying structure of a hopper car can be achieved by optimization based on the appropriate reserve capacity.

Optimization of the carrying structure of a hopper car was conducted with one of the most prospective and innovative methods – optimization by reserve capacity. The material capacity of the body can be reduced by applying circular tubes for the carrying elements.

An optimized model for the carrying structure of a hopper car was designed by the results of the research (fig. 1, 2).

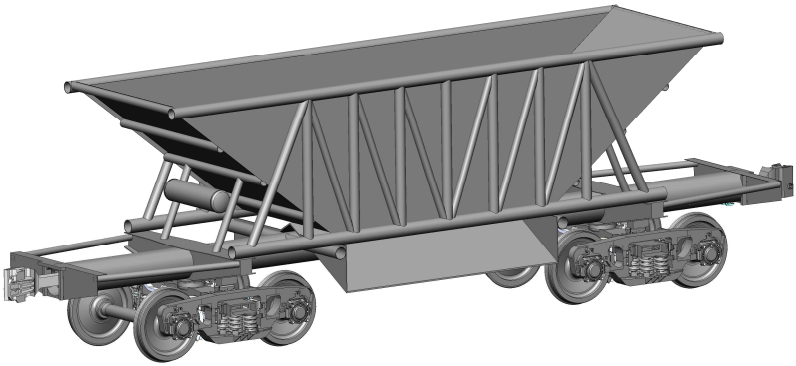

Fig. 1. Optimized model for the carrying structure of a hopper car

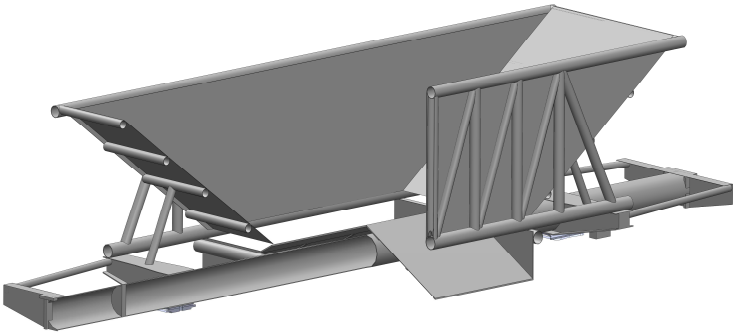

Fig. 2. Carrying structure of a hopper car

The dynamic loads on the car body at shunting impacts were defined by mathematical modeling.

It was established that accelerations on the carrying structure of a car at shunting impacts (the greatest operational loading) were 42.4 m/sec^2 (4.3 g).

The capacity of the carrying structure of a hopper car of circular tubes was defined by the finite element method.

And the maximum equivalent loads in the carrying structure of a hopper car were about 270 MPa; they were concentrated in the contact area between the center sill and the body bolster, and did not exceed the admissible values [5 – 7]. The maximum displacements in the carrying structure of a hopper car emerged in the discharge doors and accounted for about 5.2 mm. The maximum deformations were $5.7 \cdot 10^{-5}$.

The research into vertical dynamics of the optimized carrying structure of a hopper car showed that the car run can be assessed as excellent according to the regulations.

The research encourages construction of innovative hopper cars and improvements in rail transport efficiency.

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MATHEMATICAL MODELING OF LONGITUDINAL LOADS FROM A RAIL TRAIN WITH A NEW CONCEPT COUPLER MECHANISM

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Effective operation of rail transport as a leading transport industry is based on implementation of innovative rolling stock. And competitive rolling stock implies better engineering-and-economic performance, and also interoperability under certain operational conditions [1 – 3].

As known, one of the most heavily loaded structural units of a train is the automatic coupling device. In operation this unit bears considerable longitudinal dynamic loads achieving 3.5 MN (at shunting impacts). Besides, operational loads greatly impact tracks of main-lines (at braking, taking off, etc.).

A typical automatic coupling device SA-3 ensures coupling of cars and locomotives, places them at a certain distance from each other, and transfers longitudinal forces in trains intended for the 1,520-mm gauge. Nowadays there are modernized models of the device.

It should be mentioned that one of its basic shortcomings is a high cost subject to a great amount of structural elements, such as coupler and absorber).

It requires new models of couplers in service. And they must receive and absorb impact loads, and meet the strength requirements for the carrying structures of rolling stock. It furthers a higher operational efficiency of rolling stock, and decreases costs of unplanned repairs.

Use of the concept coupler mechanism instead of the typical coupling device can decrease the longitudinal dynamic forces in a train under operational modes, including braking ones (Fig. 1). And kinetic impact energy is converted into the viscous force energy. The viscous force is formed by displacement of viscous liquid through the throttle openings of the piston by the principle of hydraulic damper operation. And a brake spring returns the system to its initial state.

It should be mentioned, that the concept coupler mechanism can be implemented for the rail transport means with closed-section center sills. For instance, the engineering solution can be used for trains with carrying elements of circular tubes.

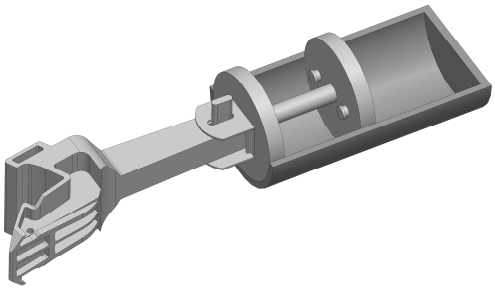

Fig. 1. Concept coupler mechanism

The implementation of the concept coupler mechanism was substantiated with calculations by the method in which the force was defined in the coupler by imaginary division of a train in two parts.

It was considered that a train consisted of 40 cars of the model 12-7023. The 2TЭ10B model was taken as a locomotive. The train developed 60 km per hour.

The mathematical modeling provided made it possible to define, that under a typical interaction between the locomotives and cars, the acceleration on the cars was about 1.2 m/sec^2. Taking into account the viscous resistance coefficient generated by the concept coupler mechanism, the acceleration was about 0.8 m/sec^2.

Therefore, use of the concept coupler mechanism makes it possible to decrease the longitudinal loading of the train by almost 30% comparing to that under a typical interaction pattern between the locomotive and cars.

Besides, the authors considered the use of elastic frictional interaction instead of viscous interaction.

However, such a pattern for the concept is rather complicated than the first one, and requires some additional elements for generating dry friction force under contraction/tension of the elastic element.

As far as the piston rod of the concept in operational modes bears considerable loads, the authors conducted strength calculations by the finite element method with a spatial model of the adapter with a rod as its component. The graphical works were conducted in SolidWorks. The calculation was implemented in CosmosWorks environment [4, 5].

Isoparametric tetrahedrons were taken as finite elements. The model consisted of 3,792 units and 15,554 elements. The maximum size of an element in the model was 30.8 mm, and the minimum size – 6.16 mm. The percentage of elements with a ratio of sides less than three was 96.9, and more than ten – 0.03.

The loading on the adapter was taken equal to N = 1.2 MN. The structural material was the steel 09G2S. And the maximum equivalent stresses in the adaptor were 269.2 MPa, displacements – 0.5 mm. The maximum deformations were $1.16 \cdot 10^{-3}$. Thus, the adapter capacity was provided [6 – 8].

The research conducted may decrease the longitudinal dynamic efforts and improve the performance characteristics of rolling stock. The results of the research encourage stating the design requirements for innovative rolling stock units at car building enterprises.

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MOTIVATION OF STAFF AS INCREASING MANAGEMENT EFFICIENCY IN UKRAINE

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The process of personnel management, like any other management process, includes such components as: planning, organization, motivation and control. Personnel management is a single system, and it is difficult to determine the importance of one or another of its components, but with increasing market competition, the function of staff motivation becomes more and more important. Personnel motivation is the process of using internal and external incentives to encourage employees to engage in active activities to achieve one's own and organizational goals. Motives are the internal driving forces of a person that influence the way and results of its activity.

In the context of market relations, the importance of creating a special approach to personnel management is growing. Today, when many processes of theoretical and practical aspects of enterprise organization are being rethought, personnel are the most important resource potential that ensures production efficiency, competitiveness and firm position on the market. Effective use of human resources requires the use of various ways of motivation.

Problems of motivation of work of the personnel of the enterprises were investigated in the works of both domestic and foreign scientists. Significant contribution to the development of theory and practice of motiva-

tion of work has been made by such scientists as G. Gilbraith, A. Maslow, E. Mayo, L. Porter, A. Smith, F. Taylor, as well as domestic specialists such as I. Vernadsky, M. Volsky, T. Stepanov, I. Franko, G. Tsehanovetsky and others.

The main purpose of the process of motivation is to get the most out of the use of available manpower, which allows to increase the overall efficiency and profitability of the enterprise.

Invisible to the naked eye, the process of losing an employee's interest in work, his or her passivity brings tangible results, such as staff turnover. The enterprise manager suddenly discovers that he has enough time to investigate all the details of any case performed by subordinates, which, in turn, do not show the slightest initiative. The consequence is a decline in the efficiency of the company.

In order to prevent the loss of potential profits, the manager should maximize the return on his subordinates. In order to effectively manage human resources, the manager must first pay attention to the parameters of the work entrusted to subordinates, changing those that may affect the psychological states of the performers, thereby motivating or demoting them. Properly designed work should create intrinsic motivation, a sense of personal contribution to the production. As a human being is a social being, for example, a sense of involvement can cause her deep psychological pleasure.

Human capital is the most important aspect of successful entrepreneurial activity that successfully utilizes factors of production and maximizes their returns. For the entrepreneur, the manager should be clear that it is the people, carefully selected staff, who have passed certain stages of development, will be able to successfully perform production and organizational tasks, to form creative and productive teams, to optimally use capital, equipment, information and material resources.

In Ukraine there are the following problems of work motivation at enterprises:

1. Failure to take into account the individuality of each person, making the manager unable to identify those factors that affect the improvement of workers' work.

2. Managers do not pay attention to improving the psychological climate in the team.

3. Absence of a direct dependence of the size of the premium on the concrete results of work of employees of structural divisions of the enterprise. As a result, it ceased to perform its main - stimulating function, and turned into a simple allowance for a salary [1].

Recently, however, Ukrainian companies have been practicing staff incentives in original ways. For example, in the company "BBH Ukraine"

according to the results of the six months the most successful employees are given cash bonuses, 10 liters. beer, a Swiss watch, or a two-week trip abroad. In addition, within six months, such employees may not answer management calls after 6:00 pm or adhere to the dress code. For employers, such a measure is forced. This is due to the fact that to keep management personnel of domestic companies only money and bonuses becomes inefficient [2].

Material incentive systems that are thought through are based on comprehensive monitoring of employees' economic interests, taking into account their working and living conditions, marital status, working skills and are an effective mechanism for combining staff material interest and productivity.

Effective work motivation may also include the establishment of "health centers" for workers with the necessary equipment, adoptive parents, financial assistance, and cash payments to families with children with disabilities. Sometimes, companies allow engineers to use spare parts, which promotes creative thought. There are also forms of promotion such as one-off bonuses for anniversaries or holidays, low pay or even free legal aid, opening preschools, financial assistance for staff members to continue their education, giving a day off during the week, working in the summer for undergraduate and graduate students, assistance and counseling for people of retirement age.

Therefore, staff motivation plays an important role in managing a business, as each employee has their own needs and interests and wants to be satisfied at least sooner or later.

However, in general, domestic enterprises use insufficiently effective methods of motivation. Thus, in the system of labor motivation of most domestic enterprises there is no flexibility and objective differentiation of motivational processes, which causes feelings of injustice, dissatisfaction, and significantly demotivates staff in the course of fulfilling their functional duties.

Thus, improving management effectiveness is at the forefront of the overall management system and depends on many levers of influence, including the introduction of a flexible and objective system of work motivation.

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USE OF ALTERNATIVE REFRIGERATING AGENTS IN REFRIGERATION EQUIPMENT OF AIR CONDITIONING PASSENGER WAGONS

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Passenger transportation is one of the main activities of railway transport. In the issues of operation of the passenger wagon fleet, the direction related to the provision of comfortable passenger travel conditions is relevant. For this purpose appropriate life support systems, which include air conditioning, are used, which directly ensures the creation and maintenance of comfortable conditions in the passenger car by the installation of air conditioning. One of the working systems of an air-conditioning installation is a cooling system that lowers the temperature of the passenger compartment by cooling it with a refrigerating machine and supplying the ventilation system to the wagon. Refrigerant R12, which has been used in refrigeration equipment for passenger car air conditioning for many years, is recognized as an ozone depleting substance and its production and use is currently prohibited. Therefore, it is quite important to determine the possibility of using pure (simple) alternative refrigerants in the operating equipment of air conditioning units for passenger wagons.

When selecting the most efficient alternative refrigerant for this type of refrigerating machine, the following parameters must be taken into account: thermodynamic (specific cold capacity, operating pressures and temperature in the system, refrigeration coefficient); safety (environmental friendliness, non-combustibility, non-toxicity); economic (cost and spending).

In chemical composition, refrigerants can be classified as follows: chlorofluorocarbon (CFC) R11, R12; hydrochloride (HCFC) R22; hydrocarbons (HCF) R134a, R407C, R410A; natural refrigerants (HC) R600 - butane, R290 - propane, R717 - ammonia, R718 - water.

Currently, such alternatives to the CFC and HCFC refrigerants are HCF refrigerants such as R407C, R134a, and R410A [1, 2].

Refrigerant R134a is a pure homogeneous substance (tetrafluoroethane), and refrigerants R407C and R410A are not azeotropic mixtures of refrigerants in which each component has its own special properties.

Advantages of using refrigerant R134a in refrigeration systems: absence of temperature sliding, phase transitions (evaporation and condensation) occur at a constant temperature; stable support of the necessary parameters of overheating and cooling; possibility of refueling of the refrigeration system of the machine when the refrigerant leaks; the possibility of refilling the refrigeration system with both gaseous and liquid refrigerants.

Investigation of the characteristics of MAB-II passenger car air conditioning installation when using alternative refrigerant R134a instead of refrigerant R12 was performed on the basis of heat calculations of a one-stage compression chiller according to the following parameters: volume describing the piston V_h; effective compressor power N_e; heat flow in the capacitor $Q_{k.}$.

The volume describing the pistons of the V_h compressor determines the geometric characteristics of the piston compressor.

The effective power of the compressor N_e consumed on the shaft of the compressor determines the power of the motor on the drive of the compressor N_{em}.

The heat flow in the condenser Q_k calculates the area of the heat transfer surface of the capacitor F_k.

According to the set temperature, the cycle of the refrigerating machine in the l_gp-i diagram of the refrigerant R134a is constructed. The diagrams and tables of saturated and superheated refrigerant vapor determine the parameters at the characteristic points of the refrigeration cycle, which are necessary for the thermal calculation and study of the characteristics of the refrigerating machine. On the basis of the obtained data, a comparative analysis of thermal calculation indicators was performed with the characteristics of the refrigerating machine equipment of the MAB-II passenger wagon air conditioning unit when using the refrigerant R134a, working cold capacity 35671W, with an ambient temperature of 36^0 C , 70% relative air humidity in the middle of the wagon with 24^0 C, relative humidity of 50%, temperature of the refrigerating machine (boiling point $t_{suc}=20^0$ C, suction temperature $t_{suc}=20^0$ C, condensation temperature $t_c=50^0$ C, supercooling temperature $t_s=45^0$ C).

The volume describing the pistons of the compressor V_h, when applying refrigerant R134a at operating mode, is 79% of the volume describing the pistons of the compressor type V of the MAB-II. The power

of the motor of the compressor type V when using refrigerant R134a in the operating mode is 87%. The area of the heat transfer surface of the condenser when using the refrigerant R134a is 83% of the area of the heat transfer surface of the condenser MAB-II.

Conclusions. MAB-II passenger car air conditioning units use a single-stage compression refrigerated steam refrigerant machine designed for R12, which is recognized as an ozone-depleting substance, and its production and use is currently prohibited.

Alternatively, it is possible to use both mixed and one-component pure (simple) alternative refrigerants, but preference is given to pure refrigerants.

The study and analysis of the characteristics of the refrigerating machine of the MAB-II passenger car air conditioning unit when applying the refrigerant R134a under operating temperature conditions gives grounds for the possibility of using this refrigerant in the existing refrigeration equipment, since it has a slight deviation of the performance of its refrigerating passports data.

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FEATURES OF RESEARCH RESULTS OF LIQUID CARGO IN A RAILWAY CISTER DURING MOVEMENT

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When moving liquid-filled rail tankers, fluid fluctuations can adversely affect the smoothness and safety of traffic or create overload in a heavy-duty wagon. Therefore, the study of fluctuations of liquid cargo in the boilers of railway tanks during movement is of great theoretical and practical importance.

The load of the elements of the tank structure during the operational interactions largely depends on the behavior of the liquid cargo. The levels of operational overflows of tank boilers for different cargoes, taking into account their specific properties, can give a 0.1 - 0.5 boiler radius, which leads to additional loads on the boiler and its fasteners with the tank frame, as well as affects the running quality of the wagon.

Studies of the dynamics and interaction of liquid tank boilers have evolved in two directions: determining the parameters of fluid oscillation during train movement on a track section and the occurrence of hydraulic fluid shock during train collisions and transient train modes. Widespread methods of estimating the fluctuations of the fluid and the load of the tank boiler by conducting studies on physical models and tank structures [1, 2, 3, 4, 5, 6, 7].

One of the methods of recording the transverse oscillations of liquid cargo in the boiler involves the use of a pendulum design. The "pendulum" repeats the transverse oscillations of the liquid load in the boiler, which can be caused by dropping from the wedges of 4 wheels on one side of the wagon. Figure 1 shows a tank for conducting liquid load oscillations during movement [7].

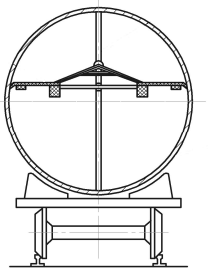

Fig. 1 Tank for testing

Determination of the parameters of the own transverse oscillations of the fluid in the boiler of the tank wagon is performed by dropping four wheels on one side of the wagon from the wedges (wedge size 30x300x60 mm). Carrying out of the wagon at different levels of filling it with liquid cargo showed that at the water level in the boiler of 1.5 m and the accepted initial conditions, the transverse oscillations of the liquid load in the boiler died down after 5 minutes. As the level of liquid load in the boiler increases, the frequency increases and the amplitude of the transverse oscillations of the liquid in the boiler decreases.

Table 1

The volume of cargo, depending on the level of overflow

№	The diameter of the boiler, mm	Full volume of the boiler, m^3	Load capacity, t	% of incomplete filling	The volume of incomplete filling, m^3	Volume of filling, m^3	Weight of cargo, t	Height of incomplete filling, mm
1	3000	136,9	120	3	4,11	132,8	132,8	205
2	3000	136,9	120	5	6,95	130,0	130,0	290
3	3000	136,9	120	7	9,58	127,3	127,3	370
4	3000	136,9	120	23	32	114,9	115,0	650

Fluid load oscillations are studied by a device based on a liquid level indicator. The principle of operation of the device is to convert the gain of the sensor resistance into an electrical signal (Fig. 2).

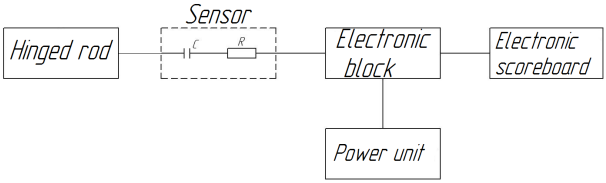

Fig. 2. Structural diagram of measurement of the process of fluctuation of liquid cargo level indicator

Fluid load oscillations are investigated during the dynamic train tests of a 8-axle tank wagon with different speeds. The tank boiler is filled with water with a maximum fill of 650 mm. Two sensors with electronic units are installed on the valves of the safety valves.

To determine the possible maximum values of the amplitudes and frequencies of fluid oscillation in motion at different speeds, the upper possible boundaries of the zone with a coefficient of confidence of 0.95 were constructed (the probability that the possible limits cover a given percentage of points: 85, 90, 95%). As an example, upper confidence limits are combined with the correlation field of the individual values of the experiments on the basis of which they were constructed (Figs. 4, 5). In Fig. 4 shows the dependence of the magnitude of the fluid oscillation amplitude on the speed in the race. In Fig. 5 the dependence of the frequency of fluid oscillations on the velocity.

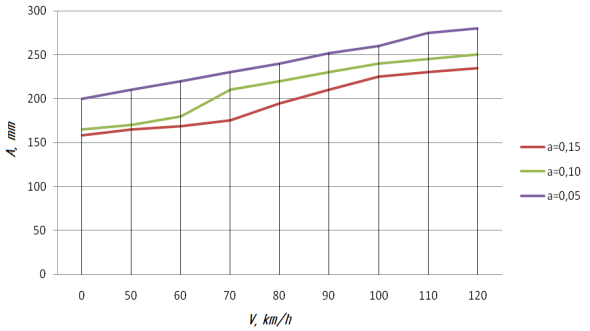

Fig. 4.

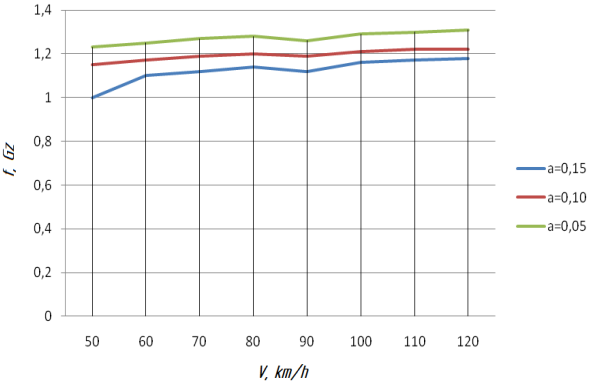

Fig. 5.

Conclusion. The amplitudes of the fluid fluctuations in the tank boiler depend significantly on the speed of movement. The maximum possible amplitude is 327 mm at a speed of 120 km / h. The frequency of oscillation of the liquid in the tank boiler is practically independent of the speed and does not exceed 1.32 Hz.

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INTEROPERABILITY AND DIGITAL TRANSFORMATION OF RAILWAYS

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The complexity of creating a single architectural space or connected trains, railway stations and infrastructure lies precisely in trains. A train is a moving object, consisting of metal parts, located in various environmental conditions and consisting, in addition, of many systems that ensure its movement and create comfortable conditions in it, both for passengers and

for cargo. The trains have very limited possibilities for placing electronic equipment and its power supply. For the most difficult option - passenger, it is still a need to satisfy the client's needs for different types of communications, information connections, services and entertainment. At the same time, train traffic management and safety issues remain a priority.

The accumulated baggage of solutions in the railway industry, from the point of view of IT architecture, therefore consists of various non-integrated solutions based on various technical protocols and approaches. In the case of a mass and economically feasible solution that takes into account the combination and all the requirements, there is a need to offer such an architectural integrated IT solution, which also corresponds to the transport requirements, security and business needs. Trains, wagons and locomotives are expensive and durable products, and they are also equipped with certain combinations for the transportation process in configurations defined by business tasks at various sorting stations with their limited capabilities.

The wired communications network is based on a combination of wired physical connections on Ethernet ISO/IEC and must be provided with version 11801 'CAT' Category 7 Class F cables and associated switches for trains that are not yet equipped with an Ethernet bus or railway communication network (TCN - Ethernet Train Communications Network) with redundant power and RF cables. The design allows standard connection of cars with connectors when sorting and composing trains.

At the car level, the use of radio communications is standardized. The requirement reads as follows: “Solving problems requires a structured approach. In the future, each passenger train should have an MCG, supplying connections to a railway network that supports a wide range of services, which may include passenger Wi-Fi; Femtocells; CCTV systems, including Police and Criminal Evidence (PACE); compatible equipment; TVM; hub for retail; On Train Monitoring Recorder (OTMR) electricity metering; and other systems. The main telecommunication system for controlling the movement of trains is the global system for mobile devices (GSM-R). Where data transmission via GSM-R does not work, train (On-Train) mobile services can be considered as a backup alternative connection in degraded modes in order to maintain control of train traffic. Additionally, the use of positioning systems and space communications is stipulated, the types of antennas placed wireless Internet antennas must support the same Wi-Fi standards as WAP” and many other details of installation, operation, minimum levels of passenger service in different directions, including electronic entertainment facilities and much more.

The essence of this standard, which was put into effect in the summer of 2016, is to build systems based on the IP protocol, which is the basis

for building any Internet, no matter what additional words are added after that (things, semantic, physical, tactile, everywhere, industrial, nano things, etc.), which allows for the long-term and developmental IT architecture of the railway. It must be said that this standard was born after several years of research, study of current practice, calculations and relates exclusively to the conditions of the UK railways. However, as international practice shows, British standardization is one of the best in the world, and we in Ukraine often follow Ukrainian standards without even knowing about their British roots.

Actually, in the British standard, the concept of a unified communication platform shared by all critical systems that are not related to security, the "Connected Train" network, was developed. It is believed that all systems, digital or inherited analog, should be able to exchange data, independently analyze and respond to events that are relevant to them and share this with other systems.

Complicated environmental conditions in rail transport and public safety environments require very reliable solutions. High-speed train networks and equipment there (Trackside) must withstand significant temperature changes, extreme weather conditions, vandalism, shock, and vibration, for example. Besides:

- Energy supply is not as easily accessible on a train as it is, for example, solved in a building, and the on-board voltage range on a train is not typical for other industrial verticals.

- Railway wagons are not intended for large devices for network deployment. Network equipment should use minimal space.

- It can be difficult, or even impossible, to wirelessly cover high-speed communications of the entire railway infrastructure. Geographic factors, right-of-way issues, and interference often interfere with serial cellular communications and Wi-Fi coverage.

- The cars are moving. Sometimes they move for maintenance or insertion into another train. Some railway operators prefer wireless solutions for each wagon; others only outside wagons from front to rear wagons. However, the European (British) version of architectural IT integration of the main working elements of the digital railway has already been formed, and it corresponds to the emerging ecosystem of railway Internet standards.

For digital railway projects in Ukraine and countries that want to participate in the Silk Railway, it is extremely important to consider both the economic aspects of its creation and the technical aspects in the most detailed way possible. In all countries, universities and academic science are connecting to this.

For example, in the UK this is called the Digital Railroad Academic Initiative, which is strongly supported by both railway companies and government agencies. Following the accepted standard, research is planned in various directions, including the possible use of cheaper sensors of the Internet of things.

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ROAD TRAFFIC SAFETY MANAGEMENT

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Road transport safety management provides identification and evaluation of negative factors affecting the level of safety, preparation, adoption and implementation of management decisions aimed at ensuring the safety, preservation of life and health of people, the environment.

Traffic safety management is a comprehensive process for managing safety risks. It provides a managed and focused approach to security with a clear process of goal setting, planning and performance measurement. The security management system is based on the assumption that pre-emptive controls are required to identify and resolve security problems before they lead to accidents. It is important to use management systems that will make trucking operations as safe as possible.

The main objective of this system is achieved by:

1) determining participants' responsibilities;

2) establishing general rules for the management, regulation and supervision of road transport;

3) guarantees of safe transportation of passengers and cargo;

4) reducing the number of accidents and their consequences;

5) reduction or elimination of the relevant factors causing accidents and injuries;

6) reducing the negative impact of road transport on the environment.

Risk is a combination of danger that can cause some severity of its consequences. The risk management process includes risk assessment and mitigation strategies.

The purpose of risk management is to improve the internal control system and to make better informed decisions through a proper understanding of individual risks and overall risk aversion. Some of the following aspects need to be combined before assessing traffic risks:

- traffic intensity and composition;
- possible accident scenarios;
- frequency of accident scenarios;
- frequency of dangerous vehicles involvement;
- the risk factors associated with the volume of cargo;
- possible consequences for humans, transport infrastructure and the environment.

Areas of risk management include:

1) Enterprise sustainability management is a management process that protects the interests of stakeholders in the operation of the enterprise, its reputation, brand and profit-making activities.

2) Incident and Crisis Management - Events that can lead to job losses or disruptions, service delivery.

3) Health and Safety Management - Preventing harm to human health in the workplace by taking precautionary measures and ensuring proper working conditions.

4) Security risk management is a process designed to maximize the benefits of security in support of business goals.

5) Financial risk management is a practice whereby an organization takes on financial risk.

6) Environmental risk management - a process that identifies problems caused by the release of pollutants into the environment.

7) Reputation risk management - reputation is one of the most important assets for most organizations.

8) Contract risk management is the process of effectively managing contracting and performance and analysis to improve operational and financial performance and reduce risk.

According to the standards of the management system, it is necessary to consider the importance of 10 intermediate security factors:

1) pavement construction and safe speed, in particular demarcation, roadsides and intersections;

2) use of the necessary roads depending on the type of vehicle, user, type of cargo and equipment;

3) the use of safe driving speed, taking into account the type of vehicle, the situation on the road and the weather conditions;

4) use of personal safety equipment, such as: restraints, helmets, lanterns;

5) the physical fitness of the driver - fatigue, distraction, alcohol and drugs;

6) safe trip planning - needs, number, mode of travel, route selection;

7) safe vehicles - vulnerable or with protection of passengers, reliable fastening of cargoes;

8) proper rights for the class of vehicle;

9) elimination of unsuitable vehicles and drivers;

10) post-emergency readiness, repair and rehabilitation.

For transport, it is important to assess the risk with respect to three elements: the road user, the trip itself and the vehicle.

Once the risk has been identified and assessed, a reduction plan can be developed to mitigate the impact of the unexpected event. Risks can be reduced by avoiding, distributing, reducing, and transferring. The risk mitigation plan covers the risk mitigation approach for each identified strategy with a higher probability of success. The risk avoidance method is to use proven technologies instead of adopting new ones. Risk sharing involves working with other companies to share responsibility for risky activities. Risk mitigation is a contribution to mitigate project risk. Risk transfer is a risk mitigation method that transfers risk from a company to another party, such as buying an insurance policy, transferring the risk to the insurance company.

By reducing the risk, the goal of the Road Safety Management System can be achieved, namely to ensure the safe transportation of passengers and goods and to reduce the environmental impact of road transport.

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ADAPTIVE MANAGEMENT OF ROAD TRANSPORT SYSTEMS BASED ON INCREASED SAFETY

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A modern car is a source of increased danger. The constant increase in the power and speed of the car, the high density of traffic of car flows significantly increases the likelihood of an accident. Vehicle safety includes a set of structural and operational properties that reduce the likelihood of an accident, the severity of their consequences and the negative impact on the environment.

Active safety systems are a driver-to-car system that has the features that reduce the likelihood of dangerous traffic situations and accidents, allow the driver to steer the vehicle confidently, accelerate and brake with the required intensity and perform maneuvers without significant physical effort. The essence of active safety features is in accordance with the traction and braking dynamics of road conditions, as well as in the reliable functioning of the car and the driver.

By far, the two most important things to keep your car safe are not based on high-tech components: it's good rubber and a thoughtful and considerate driver. But no one is safe from mistakes, so car companies offer a variety of solutions that help you cope with the difficult situation on the road and thus prevent the traffic accident.

The most common of the automatic safety system include the following:

- electronic braking systems;
- adaptive cruise control systems with Stop & Go;
- collision prevention and parking systems;
- lane monitoring systems;
- tire pressure monitoring systems;
- headlamp control systems;
- wheel survey systems;
- night vision systems;
- driver status monitoring systems.

The anti-lock braking system (ABS) is designed to increase the lateral stability of the vehicle, its steering and to prevent the wheels from locking when braking. In case of emergency braking of the car it is possible to lock one or more wheels. The locked wheel ceases to perceive the lateral forces that hold the car on a given trajectory, slips and the vehicle loses control, and when any lateral inertial force occurs, its skidding begins.

In many situations, the driver is not able to timely evaluate all the components of the braking and steering process and making the optimal decision in the absence of time.

Along with the use of ABS on vehicles began to use anti-skid systems (ASS), which when traction mode prevents the drive wheels of the car. There are two functions in the system - electronic differential lock and engine torque control.

Dynamic Stabilization System (UDF) is designed to maintain the stability and controllability of the vehicle by early identification and elimination of a critical situation. The task of the UDF is to control the transverse dynamics of the car, helping the driver to hold the car within the given trajectory under different modes - acceleration, braking, cornering, etc.

The safety of the vehicle is in accordance with the traction and braking dynamics of the road, as well as in the reliable functioning of the car and the driver. Therefore, automotive designers are constantly introducing more and more new tools to improve traffic safety. In the long run, the transition to automatic vehicle control is more reliable than human capabilities.

The above stated once again convinces us of the importance of road safety and road safety as an integral component of Ukraine's national security. It is possible to prevent road accidents in the country, but the components of the solution to this problem are: creation of a system of state standards in the field of road safety, taking into account international requirements and agreements; improving the coordination of the activities of executive authorities in this area; taking administrative and criminal responsibility for traffic offenses in accordance with the public danger of such violations; improving road safety monitoring and control activities; improvement of technical regulation on road and urban public transport to ensure the structural and operational safety of vehicles; development and improvement of the state of the road-road network, improvement of means of traffic organization; imparting to children of preschool and school age stable skills of proper behavior as road users; increasing the level of requirements for organizations that train future drivers to drive; development of systems for timely detection of accidents and providing first aid to victims; technical improvement of railway crossings; development and improvement of insurance mechanisms for guaranteed damages from road accidents; implementation of a set of scientific measures aimed at optimizing the research of the most urgent problems of road safety in Ukraine, etc., but this is a promising direction for further scientific research.

In countries involved in the development, implementation and the improvement of intelligent transport systems or, at least, of their individual elements, such indicators are much lower, and therefore, the elements of in-

telligent transportation systems presented in the diagram can be an effective way to improve the situation on the roads and should be studied more deeply, in particular, at the global level and receive more widespread at national levels.

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TRENDS AND PATTERNS OF ROAD TRANSPORT DEVELOPMENT

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In the single transport system of the country a significant place belongs to road transport, which by volume of transported freight several times exceeds the work of all other modes of transport combined. At the same time, the share of road transport in the total turnover of the transport system is much smaller and accounts for about 50% of all transport work. This is due to the fact that the average range of road transport by several times less than other modes of transport (rail, sea, air, etc.).

For the successful operation of the highway system, that is, road transport and highways, it is necessary that the parameters and characteristics of highways meet the requirements of car traffic, and the basic parameters and characteristics of the cars corresponded to those for which the roads are designed.

Transport development itself affects the surrounding area, giving it particular impetus to accelerated development. Territories provided with transport infrastructure are becoming more attractive to many human activities. Thus, the largest transport hubs of international importance (seaports and river ports, air-

ports) attract the industry focused on imported raw materials for export of finished goods, concentrate manufacturing enterprises, banks' capital, commodity exchanges.

The areas adjacent to the thoroughfares in the areas of new development receive additional incentives for development. Advances in means and routes (increasing the tonnage of ocean vessels, their speed, container shipping, mechanization of loading and unloading) have contributed to the growth of world trade and the attraction of new kinds of resources into the economic turnover. If a few centuries ago the most important international cargoes were expensive goods of small weight and volume (jewels, spices, fabrics, salt), then with the development of international division of labor, means and routes of communication, world trade became more global and trade began to attract mass cargoes and raw materials.

Transport is one of the most important consumers of petroleum products and environmental pollutants.

The highest levels of development are in North America's regional transportation systems (about 30% of the total length of world routes, first in freight) and in Western Europe (first in transport network density). In these regions, there is a reduction in the rail network and an increase in road transport. In developed countries, road transport is leading (40% of transportation), with 25% of railways. In countries with economies in transition freight is dominated by rail (60%), with motor vehicles accounting for 9%.

The development of the container transportation system, the mechanization of the loading and unloading operations have helped to reduce the cost of transportation by sea. The efficiency of transport depends largely on the organization of the work of the port infrastructure - overloading and warehousing of goods, repair of ships and their supply with fuel, water.

The share of transport costs in the cost of goods varies between regions and countries of the world, and depends, first of all, on their geographical location. The cost of transport services for landlocked countries is almost ½ higher. In addition, it is obvious that transport costs per unit of goods are much higher for production of extractive industries, agricultural products that require special conditions of transportation than for expensive industrial goods.

In the future, road transport will continue to belong to one of the leading places in the Unified Transport System of the country. At the same time, further improvement of its efficiency and improvement of technical and economic indicators are connected with the necessity of increasing the technical level of operation, development of the road network and solving a number of scientific and technical problems.

The main directions of increasing the level of technical operation of road transport are to ensure the predominant development of public transport and

consolidation of motor vehicles, improving the structure of the fleet, further expansion and development of a centralized mode of transportation.

Concentration of public transport is an effective way of improving the planning, organization and management of the transportation process, the widespread introduction of centralized terminal transportation, increasing the use of rolling stock, which in the aggregate will significantly reduce the cost of transportation and transportation costs in general.

The most important issue for improving the efficiency of motor transport is to improve the structure of the vehicle fleet. This requires minimization of the number of types of vehicles, maximum unification and installation, in accordance with the conditions and volume of transportation, the optimum ratio of the number of cars, road trains of different load capacity in order to carry out each trucking with the least cost of resources and cost. At the same time, it is necessary that all cars meet the road transport and natural and climatic conditions of operation as much as possible.

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RISK MANAGEMENT SYSTEM IN THE AREA OF MOTOR SAFETY

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Traffic Safety Management (TSM) is a systematic, explicit and comprehensive process for managing safety risks. Like all management systems, SMS provides a managed and focused security approach with a clear goal setting, performance planning and measurement organizational structures

and measures that ensure the effectiveness of the security management system are applied at all levels.

Safety rules mean all rules that contain road safety requirements established by applicable legal acts, as well as regulatory technical documentation, the implementation of which ensures road safety. This term may cover national, international or European laws, as well as national standards (for example, ISO39001: 2012 – State Standard of Ukraine (SSU) "Road Safety Management System (SMS) Requirements and Instruction for Application").

Risk valuation is a specially organized regulatory activity for the development and approval of technogenic and natural safety rules, rules and regulations of economic activity, in particular in the transport industry, which are determined on the basis of risk values within acceptable values. Rationing is the means which sets in the state the limits of the admissibility of man-made activities and the limits of protection against dangerous natural phenomena.

The regulatory risk base is based on two main regulatory levels of risk: the minimum and maximum permissible. An acceptable level of risk is a risk lower than or equal to the maximum permissible, minimum is a level of risk below which further risk reduction is not economically feasible. The question of the level of acceptable or acceptable risk is the most important in decision making. The choice of an acceptable level of individual risk depends largely on the economic situation of the country. Risk of less than or equal to the minimum is considered acceptable. That is, any activity with such a low risk value is acceptable and does not require any further effort to reduce it, and therefore may not be monitored by the appropriate supervisory authorities. A risk that is greater than the limit is considered absolutely unacceptable. For each industry, they set their own minimum and maximum risk levels, which should be within the same national values. There are a number of international standards designed to assist businesses in developing risk management approaches. The priority of these standards is the application of risk management in the entire structure of the organization at all stages of its development.

The application of risk management is a relevant and promising direction in the development of enterprises, which will allow to stabilize activities within the enterprise. In our country, this approach requires reviewing many security regulations and formulating a nationwide strategy in this area. The starting point for effective risk management in transport management at an enterprise is to build an effective risk management system that must include and logically link and manage all its steps. The risk assessment segment involves the identification, analysis and assessment of risk,

where the risk identification step should provide comprehensive information on the range of internal and external environmental factors related to transport processes. Only a risk can be identified and evaluated on the basis of this. Risk identification begins with the monitoring and synthesis of the enterprise's transport processes, which allows a closer look at the set of operations that are mediated by the enterprise's capabilities in conducting its business activities. Separation of sources and risk factors inherent in transport processes is a central component of risk determination, since finding out the origin of the factors that determine the performance of an enterprise not only allows the accumulation and use of data on the current state of affairs, but also to some extent predict what processes at the enterprise and how they can determine (passenger and freight, logistics, etc.). Management as a deliberate influence of the governing system manifests itself in the form of many interrelated processes (stages) of preparation, adoption, organization, implementation of management decisions, adherence to the technological process and consists of the following stages:

1. Determination of parameters of the existing or predicted situation occurring in transport processes. This process is based on the collection and processing of data on the impact of existing risk factors. Information plays a key role in the risk management process. The timely provision of all the necessary information helps to reduce uncertainty in decision making and, therefore, to prevent erroneous decisions.

2. Transport risk analysis. The information base of the risk management process is its analysis. The main purpose of the analysis is to formulate a holistic picture of the risks and scope of potential liability. In the transport industry, such a study of data will allow us to continue to properly organize the risk management system. The risk analysis provides a picture of the possible risk events, the likelihood of their occurrence and the consequences.

3. Comparison of analysis data with maximum permissible hazard levels. After comparing the values of the risk indicators with the maximum acceptable (acceptable risk levels), they develop a risk management strategy and measures to reduce it.

4. Rationale for the transport process risk management program. This process includes the following steps: search for risk reduction options through appropriate preventive measures, compensation for losses if they occur; assessing the cost-effectiveness of risk management costs for each option; comparing options and choosing the best one. When looking for risk reduction options, you need to anticipate changes in the existing situation and model the behavior of the object under consideration. Risk mitigation options are initially selected using the justification principle.

5. Deciding whether the planned measures are sufficient. After choosing a certain set of measures, they decide on the degree of their sufficiency. 6. Monitoring of results. This process provides feedback in the risk management system and allows us to take steps to improve it. Monitoring is carried out on the basis of an assessment of the effectiveness of the measures implemented.

The experience of risk analysis and management shows that the development and improvement of procedures and methods in this area is carried out by approximation to the principles of a systems approach. Indeed, risk management is a process that requires consideration of a wide range of issues, namely: technical, information, socio-economic, environmental, political.

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INNOVATIVE DEVELOPMENT OF PASSENGER TRANSPORT ON MOTOR VEHICLES

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Road transport is the most manoeuvrable and efficient mode of transport for the carriage of bulk goods by small lots at a short distance.

Road transport occupies a leading position in Ukraine not only in the economy but also in the social sphere. Given its purpose, it is the main mode of transport that delivers door-to-door passengers and goods and can operate independently of other modes of transport. Motor transport ensures the functioning and territorial organization of all sectors of the national economy, and above all, the branches of agriculture, which occupy an important place in the

economy of Ukraine. As interstate highways are created, the value of motor transport is steadily increasing in interstate relations.

The development of road transport and its territorial organization depend on the sectoral structure of the national economy, its territorial organization, natural conditions, in particular relief. These factors determine the direction and density of roads.

The problem of the development of road transport is its growing technical and technological backwardness, which will not contribute to the further economic development of the country, its European integration and can lead to unsatisfactory level of transport services, slowing down the speed of traffic, increasing the level of accident and environmental burden. The solution to these problems is especially important in the context of the transition of the national economy into the phase of intensive economic growth and the course for European integration.

Thus, defining the main directions of road transport development is a topical topic of both the transport system of Ukraine and its economy as a whole.

The main task of the development of the road complex is to identify ways of solving the problems of further development of the transport industry, increasing the demand for transport services, intensifying the processes of integration of the road complex of Ukraine to European and world transport systems. The present economic situation of Ukraine is characterized by an increase in the role of transport, which ensures the vital activity of the population, the functioning and development of the state's economy, the preservation of its defense capability, the ability to achieve the country's foreign economic goals.

Automobile transport plays an important role in socio-economic development.

In general, road transport meets the needs of the national economy and the population in transportation, but the structure of the fleet of buses and trucks is imperfect; requirements.

One of the major problems of road passenger transport should be recognized by the severe wear and tear and the slow pace of renewal of the bus fleet. Increasing population mobility in cities and suburbs while reducing the production capacity of trucking companies leads to the overcrowding of buses, reaching almost their physical limit in the so-called "rush hour". This impedes not only the comfort of the passengers but also the observance of the conditions of safety of transportation.

Fleet renewal is slow - almost 70% of rolling stock is technically obsolete and 50% of buses have been in operation for more than 10 years.

There is still a problem of compensation for the loss of income of carriers in connection with the carriage of privileged categories of citizens and transportations at regulated tariffs, since it is impossible to determine the real amount of income.

Stages of development of the motor transport industry are qualitatively related to events, have dramatically changed the material and technical base, forms of ownership and, accordingly, forms of economic relations from socialist to market. In accordance with these conditions, change the methods of production organization and management, organizational structure of the transport industry, management relations, regulation, etc.

State regulation of the market for transport services is also important for the study of the experience of individual ATPs and its dissemination, which in the market is limited by competition. ATP's priority in using the experience gives it a competitive edge as a source of additional revenue. The struggle of enterprises for competitive advantage, its creation and maintenance, on the one hand, initiates the progress of the industry, on the other hand, slows it down.

Accurate assessment of possible changes in technology and economy is associated with the need to build forecasts and plans for the development of the transport industry, to identify the main factors for its development. Reality involves a large number of options for the future (each of which requires a proper assessment of the quality, nature and nature of the processes and phenomena under study) to build a development strategy and the transport industry as a whole, and its individual elements - modes of transport, transport complex, infrastructure, enterprises.

The function of the state in the transport sector in the market form of management is to achieve the main social goal - a cost-effective combination of diversified commercial interests of manufacturers of transport services, transport and other enterprises with public interests and needs for the movement of goods and passengers. Only the state is able in the market conditions to balance the development of modes of transport in the transport system, setting priorities, fully acceptable to the economy of the country as a whole, and to the participants of the market of transport services.

In a market environment, automotive professionals have great opportunities to rapidly improve technology, technology, information and communication networks; to apply the latest statistical and mathematical methods, which allow deep and comprehensive assessment of objective patterns of transport development; make fuller use of the results of studies of economic processes and relationships, enhancing the efficiency of industry and the economy.

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RAILWAY RISK MANAGEMENT SYSTEM IN RAILWAY TRANSPORT

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Railway safety is a set of organizational and technical measures aimed at reducing the likelihood of the occurrence of threats to the life and health of passengers, the preservation of transported goods, the preservation of infrastructure and rolling stock of rail transport, environmental safety of the environment. The problem of ensuring the safety of traffic on the railways appeared simultaneously with the transport itself.

On September 15, 1830, at the opening of the Liverpool - Manchester railway, a Member of the English Parliament, William Haskinson, was hit by a train and died on the spot; after that, he became famous as the world's first person to die under the wheels of a train.

With the increase in the capacity and speed of steam locomotives, the intensity of train traffic increased accidents in rail transport continued.

Traffic safety is ensured by reliable operation, good condition and reservation of the main technical means of railway transport: structures and devices of railways, rolling stock, as well as proper organization of train movement (Fig. 1).

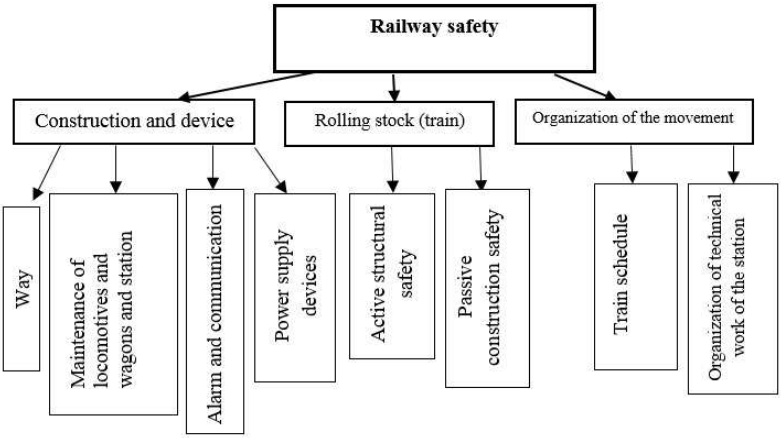

Fig.1. Train safety components

The economy of any country depends to a large extent on a reliable transport system, the purpose of which is to ensure constant links between different regions of the country. Historically, there are two ways of dividing routes: public highways and in-house routes (the difference between which is manifested only in different conditions of operation and operation, but does not change the essence of transport). In addition, the division of trunk transport into types by type of traffic environment (rail, sea, river, road, air, pipeline) creates costly competition for the development of all modes of transport and the economic situation in the country.

This brief coverage of the benefits of railroads makes rail transport a versatile mode of transport and it is not surprising that rail transport accounts for over 90% of freight and about 2/3 of passenger traffic.

Without a detailed analysis of the indicators, we can conclude that safety performance - the number of accidents - is declining, reflecting the efforts of railways to improve safety. The number of injured passengers does not have a growing trend, which is due to the small number of traffic accidents and the victims (which occurred during 1997 and 1998). But one can still argue for a trend towards increasing the level of traffic safety on the world's railways.

The state of traffic safety on the railways of Ukraine does not differ from the trend on the European railways. Compared to 1992, when the number of transport events was 3945 with the volume of transportation 4086.52 * 100 million tons-km., 2001 had the following picture: transport

events - 2042, and the volume of transportation - 2271.26 * 100 million. t-km. The number of people injured as a result of traffic accidents has no explicit distribution law and varies constantly depending on the consequences of the events.

The problem of analyzing the level of security is the lack of a well-formed, unified system of indicators of safety, which does not allow to adequately compare the state of safety on the different railways of the world. concept of the country, but in all circumstances the process of transportation should be safe for both passengers and railway workers

As a result of technological progress, qualitative changes in the structure of the transport system are also possible, which can lead to structural changes in the transport complex itself, shifting demand to certain types of transport.

Therefore, rail is a source of increased risks and dangers. This implies negative consequences that arise or may arise as a result of an activity in the area in question. These include: consequences that occur inevitably or with a certain probability; what stakeholders are trying to avoid conscious actions aimed at causing harm; observed immediately and probably possible in the distant future; which can be avoided by technological measures and which are the reverse of the use of vehicles; which are conditioned by the existence and use of transport and which may be due to the lack or inadequate development of transport infrastructure.

The many risks involved in rail transport are often recognized intuitively. However, it is very difficult to distinguish the same types of risks from different groups, because all the risks are interrelated. Some risks come from others, others overlap them and we cannot say with certainty that we have certain risks in their pure form. The operation of the transport system is often accompanied by typical risks in the ongoing activity of the enterprise, which are inherent to all economic entities and the railway complex as a whole.

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INTEGRATION OF MOTOR VEHICLES OF UKRAINE INTO THE EUROPEAN TRANSPORT SYSTEM

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To its full potential, Ukraine should become a powerful transit country between the EU and Asia. However, despite the fact that transport now accounts for 6.7% of GDP and 6% of the total employed population (based on 2016 results), this goal is still far from being realized. And to this are added new requirements for transport - now the industry is an integral part of the country's defense capability. To understand how the industry is developing in the next decade, the Ministry of Infrastructure has prepared a draft National Transport Strategy - 2030.

The legislative act sets a number of complex tasks: implementation of EU directives within the Association Agreement, implementation of corporate governance principles and transparency of decision-making, development of competition and liberalization of markets, ensuring proper financing of transport infrastructure modernization, minimization of environmental impact, safety, implementation increasing the level of transport service.

The National Transport Strategy sets the following objectives:

1. Implementation of effective public administration in the transport sector;
2. Provision of quality transport services and integration of the transport complex of Ukraine into the international transport network;
3. Ensuring sustainable financing of the transport complex;
4. Increasing the level of transport safety;
5. Achieving urban mobility and regional integration in Ukraine.

Road transportation development:

• gradual liberalization of international road haulage and provision of access to the road haulage market;

• Increasing the responsibility of road users for violating the overall dimensions of vehicles;

• introduction of a system of certification of professional competence of drivers and road transport personnel.

The degree of integration of the road transport industry into the European market is already high. This is reflected not only in the fact that Ukraine is a party to virtually all major international conventions governing international road haulage within the territory of the European Union (say, the EUTR conventions on the operation of vehicle crews or one of the ma-

jor TIR customs conventions). But also in the fact that our carriers are in serious competition with their counterparts from Europe. According to the Ministry of Infrastructure, this year Ukraine ranks 2nd among 54 countries in the number of allocated permits for international road haulage within the ECMT base quotas - 337 units, and in 2014 it is expected 354 units - 5% more. But AsMAP assures that our share is not more than 3% (about 30 thousand cars against the background of 1 million involved in the European market).

Road haulage today is the one area where liberalization and market opening would be more profitable for Ukrainian campaigns than for European ones. Our motorists charge a price (the service is cheaper in cost mainly at the expense of low salaries to drivers and cheaper, often second-hand transport). AsMAP traveled with Ukrainian participants in the negotiations to Europe for several years to achieve the inclusion in the CA of obligations to lift restrictions on road transportation. ECMT is a system that artificially restricts transportation opportunities, allocating each trip within the quotas between countries. Ukrainian carriers do not always have these quotas, partly to resolve this issue by purchasing TIR Carnets for travel (another permitting system that is less profitable for motorists, but is a way out when ECMT quotas are exhausted).

Road transport occupies a significant place in passenger and freight traffic. Thus, in terms of freight traffic, it consistently exceeds rail transport by 4.5-5 times, and by passenger traffic - by 5-6 times. Bus transport carries almost as many passengers as all other modes of transport (trolleybus, tram, rail, metro, taxi, passenger, sea, river, aviation) combined. The total length of paved roads and streets, including the length of waterfront streets in cities and towns, exceeds one fourth

Due to the construction of motorways outside the settlements, regulation of construction in their area, adherence to the relevant rules and parameters in the construction of residential and industrial buildings can significantly reduce the harmful effects of traffic noise. The motorways located near the settlements will definitely be equipped with noise constructions.

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INFORMATION SYSTEMS APPLICATION FOR MANAGING RELIABILITY, SECURITY, RISKS AND RESOURCES IN ROAD TRANSPORT

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Today, Ukraine occupies one of the places in accidents and mortality on the roads of the world.In 2019, 3,454 people died in road accidents in Ukraine, another 32,736 were injured. In total, 160 675 accidents occurred on Ukrainian roads.

The main causes of accidents and non-safety on the roads of UKRAINE are the poor condition of roads, violation of the rules of movement by motorists and pedestrians, exhaustion of the resource of cars.

So really, we can not reduce the accident on the road. We can create a security management information system for this. So let us look at what it is.

Information system - an organized set of elements that collects, processes, transmits stores and provides data. The information system consists of people, equipment, processes, procedures, data and operations. Each information system includes the following components:

- system structure;
- the functions of each element of the system;
- input and output of each element and system as a whole;
- the purpose and limitations of the system and its individual elements

Risk indicators are becoming increasingly used in road safety. This is especially relevant in the process of auditing the safety of existing highways, when it is necessary to conduct a rapid analysis of the danger of road sections or to assess the safety of traffic on specific highways.

An accident is a hazardous event of a man-made nature that creates a threat to the life, health and health of people on the site, territory or water area, causing the destruction of buildings, structures, equipment and vehicles, disruption of the production process, or environmental damage.

According to the size and the damage caused, light, medium, heavy and especially severe accidents are distinguished. Particularly serious accidents lead to major destruction and are accompanied by major casualties.

Today there is no clear understanding of the nature of risk. First of all, this is due to the multidimensionality of this phenomenon. In addition, risk is a complex phenomenon that has many inevitable and sometimes op-

posite real bases. This makes it possible to have many definitions of the concept of "risk" from different perspectives.

The information system not only reflects the functioning of the control object, but also influences it through the controls. It is a set of information processes to meet the need for information at different levels of decision making. Its purpose is to produce information for use (consumption) by the management apparatus. Accordingly, it provides for the accumulation, transmission, storage, processing and synthesis of bottom-up information, as well as the concretization of top-down information.

Now all problems are solved with the help of computer technology, but do not forget about the person who solves this as well.

There are many different factors and definitions of risk today. Most often, risk is defined as the aggregate of the possibility of loss and its severity. However, there is still no consensus on the interpretation of the concept of "risk" because of the variety of its aspects. Below are some definitions of the concept of risk. Yes, the Oxford English Dictionary defines risk as the likelihood of danger, bad consequences, loss, etc.»

In data processing systems, its main components are data and computation. Most information management systems in an organization have many other components, such as requirements, queries, triggers, and reports. And all of them, in particular, contain extensive descriptions of their own content, in one form or another. These descriptions are necessary for the interpretation and correct use of the information provided (when the system does not have a complete description, it is assumed that users receive it from another source).

Road transport standardization provides:

- implementation of a common scientific and technical policy on the creation, operation, repair, maintenance and disposal of vehicles;
- increase of reliability, comfort and safety of vehicles, quality of works and services in accordance with the development of science and technology, needs of the population and the national economy;
- protection of interests of consumers and the state in matters of safety of transportation for life, health of people and property of persons, environment;
- economy of all kinds of resources, improvement of technical and economic indicators of activity;
- security of facilities taking into account the risk of natural and man-made disasters and other emergencies.

Certification of vehicles, works, services in road transport is carried out in order to:

- prevention of the use of vehicles, the provision of work, services, life-threatening, human health and the environment;
- assistance to consumers in the conscious choice of vehicles, works, services;
- creation of conditions for participation of economic entities in international economic, scientific and technical cooperation.

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AUTOMATED MEASURING AND MODELING BENCH INSTALLATION «FRICTION MACHINE» FOR THE STUDY OF FRICTIONAL PROPERTIES OF THE CONTACT «WHEEL-RAIL»

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The problem of adhesion in the wheel-rail system is one of the most relevant for railway transport. Along with theoretical studies, experimental studies are also conducted to verify the adequacy of mathematical models, to confirm the feasibility of choosing or selecting the necessary parameters and factors during modeling.

There are three possible directions for experimental studies of the adhesion force in the contact of wheels with rails [1, 2]:

– on physical models in the laboratory;

– on skating rinks with full-scale units of rolling stock;

– on sections of railroads in conditions of actual operation of rolling stock.

In the study of the interlinked properties of locomotives on a real rail track, inadequate experimental and operational conditions are excluded. However, such experiments require significant costs, time and do not allow one to single out the effects of any one factor.

Bench tests on skating rinks are close to real, since they use full-scale units of rolling stock. They are more reliable for practical use, since full-scale units make it possible to take into account various design and technological factors, and the conditions and test modes are as close as possible to operational ones. But the imitation of the rail track with the help of rollers does not allow to recreate quite fully the process of coupling the wheel with the rail, which is associated with a decrease in the nominal contact area «wheel-roller» compared with a pair of «wheel-rail».

In laboratory conditions, the frictional state of the surfaces of wheels and rails is evaluated by special devices - friction machines or tribometers. Existing friction machines and tribometers do not allow to fully reliably measure the frictional characteristics of the wheel-rail contact pair, since they measure the friction coefficient in the pure sliding friction (skid) mode of the contacting surfaces. But the locomotive's wheel moves in sliding mode with sliding, with frequent changes in the surface temperature and friction value of the contacting surfaces.

In this regard, the urgent issue is the creation of modern, automated bench equipment for the study of the coefficient of adhesion of the wheel to the rail, reflecting the actual conditions of contact.

To do this, at the Department of Railway, Road Transport and Hoisting Machines of the Volodymyr Dahl East Ukrainian National University, an automated measuring and modeling bench installation «Friction Machine» was created to study the frictional properties of the «wheel-rail» contact (Fig. 1) [3, 4, 5].

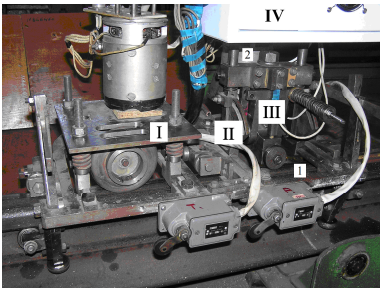

Fig. 1. General view of the automated measuring and modeling bench setup «Friction Machine» for the study of frictional properties of the contact «wheel-rail»

Functionally, the «Friction Machine» consists of a trolley (Fig. 1) with an accelerating device (I) placed on it, an orienting device (II) and a measuring unit (III), as well as a microprocessor measuring unit (IV) and allows to solve the following problems:

– determine the coefficient of friction of the wheel with the rail in case of real pollution (water, oil, diesel fuel);

– evaluate the effect of surface activation on the friction coefficient being realized;

– automatically simulate with the help of microcontrollers, the processes of a set of torque for disruption in boxing;

– determine the coefficient of friction in the regime of pure friction sliding (skid) of the contacting surfaces, while the rolling mode with sliding is implemented.

The measured parameters during the experiments are:

– vertical load on the working roller;

– linear speed of the friction machine;

– friction force of the roller on the rail;

– angular speed of rotation of the working roller.

The information received is transmitted to a computer, where it is further processed. A sample record of the measured parameters is shown in Fig. 2.

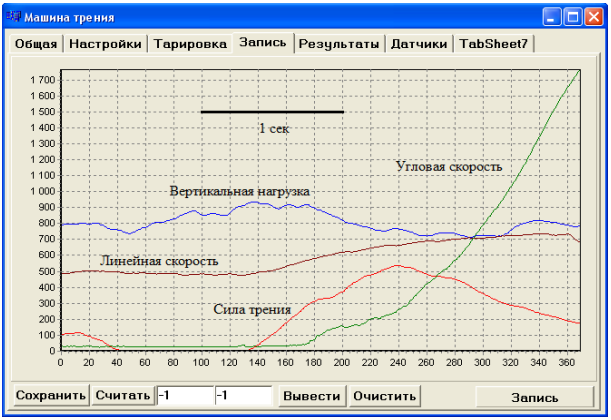

Fig. 2. Sample recording of measured parameters

Separately adjusting the translational and angular speeds of the working roller, we separately study the effect of the sliding velocity and

temperature in the contact zone on the coefficient of sliding friction during rolling with sliding.

Thus, the created design of the bench installation and the method of investigating the coefficient of sliding friction allow one to obtain the dependences necessary for the theory of adhesion.

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THE USAGE OF LMS MOODLE FOR TRAINING SPECIALISTS OF THE TRANSPORT COMPLEX IN THE CONTEXT OF DISTANCE LEARNING

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Currently, distance learning is an integral part of the education system. This form of education allows to solve many goals in the training of transport specialists: obtaining a higher education, advanced training, exchanging experience, getting expert advice, and actively participating in professional communication. Many countries pay great attention to the development of distance learning [1 - 4].

Distance learning is one of the most convenient forms of education for students who have priorities different from learning, such as work or family [5]. Sometimes, for various reasons, distance learning is the only way to get an education.

However, this form of education has its own problems connected with the peculiarities of distance education as well as with with the organization of the learning process.

The usage of information technologies allows to solve many problems of distance learning.

Learning Management System (LMS) is used to manage distance learning. Moodle (Modular Object-Oriented Dynamic Learning Environment) is one of the most popular open-source learning platforms with a huge number of implementations [6, 7]. LMS Moodle is popular among teachers all over the world, as it is free, and its technical capabilities and characteristics are superior to commercial LMS. A majority of universities, universities of applied sciences, educational institutions, and vocational schools in the world has implemented LMS Moodle.

LMS Moodle software has the following properties:

– compatibility, i.e. provides the possibility of interaction between different systems;

– adaptability, i.e. includes developing information technologies without redesigning the system and has built-in methods for providing individual learning;

– accessibility, i.e. allows you to work with the system from different places (locally or remotely, from the classroom, from the workplace or from home);

– user-friendly and convenient interface that allows people to work at different levels of education and different physical abilities;

– economically accessible, because LMS Moodle is distributed free of charge.

The usage of electronic educational resources developed in LMS Moodle, provides:

– effective organization of the educational process in general and independent work in particular;

– opportunity to develop professional competencies of students;

– study of academic subjects on an individual plan;

– taking into account the individual abilities of students, their needs and interests;

– rational allocation of time spent by a student on studying academic subjects according to the curriculum;

– free and fast access of students to electronic databases of educational institutions containing educational and methodological literature on academic disciplines;

– conducting remote electronic testing and determining the level of student development of the content of the discipline;

– the opportunity to study the academic discipline in depth;

– increasing the social and professional mobility of students, their entrepreneurial and social activity, their outlook and level of self-awareness.

Thus, the introduction of distance learning in the practice of higher education will ensure the development of cognitive activity, independence, initiative, responsibility, freedom of choice, self-control skills and motivation to master new knowledge. The successful implementation of information and communication technology, such as LMS Moodle system, makes education accessible to a larger audience without time and space barriers.

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OPTIMIZATION OF THE SYSTEM OF MANAGEMENT OF RELATIONS WITH CUSTOMERS OF MOTOR TRANSPORT ENTERPRISE

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The development of international freight transport and the provision of transport services intensify competition among international carriers. Such conditions force transport companies to look for new opportunities to reduce transport costs.

The study retags to the development of a communication system of with customers of services provided by a motor transport enterprise (MTE). This system is based on the principles of CRM-concept used by the company for work organization with consumers of goods and services. Such technology includes the collection, storage, analysis of information about customers, suppliers and other participants in the transport process and information about the relationship between them. It is known that modern CRM-systems (Customer Relationship Management) are aimed at studying the specific needs of the client. Based on the analysis of the literature, three CRM approaches were identified: operational, collaborative, analytical [1].

A block diagram of a CRM-system oriented to MTE needs is proposed. The main components of the system are: a lead base (customer base and leads), consisting of two parts: customer information and customer rela-

tionship information; service base (this is information about the services that an enterprise can provide and information about customers who have used these services).

The provision of quality transport services is a dynamic process that occurs under uncertainty [2]. In particular, the use of the mathematical apparatus of the fuzzy sets theory allowed to develop an algorithm for the optimal route choosing under the condition incomplete and inaccurate information received from experts - participants of the transport process (shippers, carriers, consignees, etc.) [3]. The production rules of fuzzy logic are based on linguistic variables, which reflect the main characteristics of the transportation process (speed, security, service, etc.) and are aimed at achieving high quality of transport service [4]. The task of reconciling the interests of all participants of the transport process on the quality of services rendered, which is solved by the algorithm, allows to consider it as an effective component of the CRM-system, which places the interests of the client on the foremost activity of the enterprise. Such an algorithm can be an element of the task base, which, along with the customer base and the service base, is the core of the customer relationship management system. The structural scheme of CRM-system for the enterprise providing transport services is offered (Fig. 1).

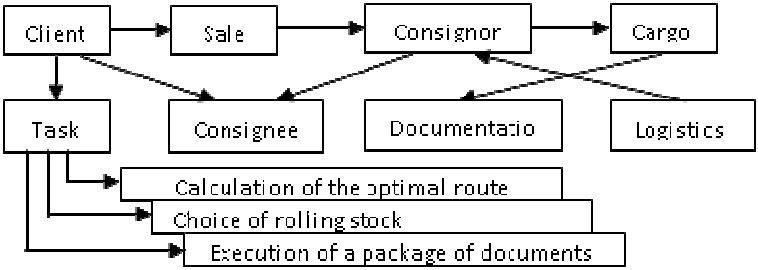

Fig.1. Structure of elements interaction CRM-system

To enhance capabilities and enhance flexibility, the system can be supplemented by a variety of tasks that reflect customer contact control operations and the typical or individual requirements of transport participants, such as selecting the optimal rolling stock, selecting a consignee, forming a package for transportation, and so on. With the right software, such a system can be deployed on MTE to streamline business processes.

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APPLICATION OF LUBRICANS IN A PAIR OF FRICTION WHEEL-RAIL

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The long-term operation of the rolling stock shows that the life of the wheel pairs is determined by the constractuction of the rolling stock and, to a greater extent, the wear of the wheel reboards. This is evidenced by numerous publications devoted to the excess, over-standard wear of the flanges of wheel pairs and the side surface of the rail head.

The problem of the interaction of rolling stock and railway is among the most important in transport science. The relevance of numerous studies on this problem is due to the fact that the safety and technical and economic indicators of traction rolling stock of railways (speed of movement, losses associated with overcoming resistance to movement, wear of rails, wheels, etc.), depend on the processes occurring in the point of wheel and rail interaction.

The analysis of numerous publications dedicated to the over-standard wear of the wheel couples and the side surface of the rail head shows that the produced turns of the wheel tires of the wheel couples by the permissible value of rolling are 4%, while the wear of the flange their value reaches 65%.

In order to reduce the intensity of wear of wheel couples and rails to acceptable values, a number of technical and organizational-technological measures have been carried out in recent years. For example, lubrication, improvement of the structure of the track and rolling stock, improvement of the profile geometry of the surface of rolling wheels and rails, monitoring in the wheel-rail system, etc. Of all these areas of work, the most quickly implemented is the introduction into the contact zone of the third body with the specified characteristics. The choice of materials used for cooling and lubrication of the contact surfaces of the flanges of wheel pairs and rails should be made taking into account the temperature conditions of inter-?ction of the friction couple under consideration. Just as friction temperat - re causes the thin surface layers of conjugated bodies to be heated and the lubricant layer separated, it is one of the most important factors influencing the entire complex of service properties of lubricants that determine their antifriction properties.

In this paper, modeling of thermal processes in a pair of wheel-rail flanges determine the force and geometric conditions of contact. With this calculation, it is possible to estimate the possible contact temperature of the pairing under the most difficult conditions of its operation and to select a lubricant with the required performance properties.

In the interaction of the flange wheel with the side surface of the rail head in the presence of lubricant between them, the coefficient of ultimate friction can be calculated by the formula given in [4]:

$$f_{mг} = f_{mp} - k \frac{\eta_{см} \cdot v_{ск}}{P_{пог}}$$

f_{mp} - coefficient of friction of non- lubricated surfaces;

$\eta_{см}$ - dynamic oil viscosity;

$v_{ск}$ - sliding speed;

$P_{пог}$ - running load;

k - proportionality factor.

The three factors that affect the lubrication mode are speed, load and viscosity of the oil. The coefficient of friction depends on the actual (working) viscosity of the lubricant at a temperature T on the surface of the contact, and not on the nominal value, which is determined in the viscometer at conditional temperature and atmospheric pressure.

The viscosity of all droplets and their mixtures decreases with increasing temperature. To calculate the viscosity from one temperature to another we use the formula [6]:

$$\eta_T = \eta_u \cdot \left(\frac{t_u}{t_T} \right)^n$$

η_T - the viscosity of the determined oil at temperature t_T [n·s/m^2];

η_u - the viscosity tables (in ns/m2) are given in the oil test temperature;

t_u - the test temperature of the oil to determine its viscosity;

t_T - temperature at which the viscosity is calculated;

n - coefficient - an indicator of the degree for each grade of oil. The coefficient values can be taken as tables [6].

Based on the calculation of the temperature at the contact spot in the presence of the lubricating layer, the processes occurring on the friction surface can be represented in the following form. Thus, with a constant sliding speed and an ever-increasing tugging, there is a gradual increase in the intensity of heat release of friction and, consequently, an increase in the temperature of the layer of oil separating the friction surfaces. In the zone of interaction of co-interacting bodies in the ranges from 3 to 25 kN is the inflection. The presence of inflection can be explained by the change in the physico-chemical condition of the lubricant due to the heat release in contact.

Further increase of the temperature causes the oil layer to lose its protective properties and the coefficient of friction becomes the same as for non-oiled surfaces. A similar result was obtained in [7].

The analysis of the obtained results shows that the effect of lubrication on friction surfaces is observed at relatively small values of the guiding force up to 10 kN. Under these conditions, there is relatively little wear and tear. A decrease in the intensity of wear and temperature with increasing directional force can be achieved with an oil viscosity corre-?ponding to temperatures much lower than the design temperature in the friction zone.

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INTEROPERABILITY OF RAILWAYS AND TECHNICAL PREPARATION OF THE NEW GENERATION PLATFORM OF THE STANDARD OF 1520 MM FOR OPERATION ON THE 1435 MM TRACKWAY

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Successful implementation of transport infrastructure projects depends on the economic development of the country, so Ukraine has an important task - the introduction of new transport technologies and the creation of a free zone of transportation with EU countries. One of the main obstacles in this way is the presence of system joints of railways with

different width of the track at the borders of the states, as a result, there are considerable material costs, especially - when carrying out freight traffic.

Topical issues are the safe use of rolling stock in different countries (different undercarriage designs, braking systems, maintenance features, etc.) for continuous traffic and railway infrastructure (alarm systems, electrical traction systems, etc.). Therefore, the issue of increasing the interoperability of domestic railways, facilitating the intensification and reduction of international traffic, should be given priority today.

At present, the direction of 1520 mm rail cars on the railways of Western Europe is allowed only in the established directions and routes. At the same time, their speed is limited to 80 km / h, while Western European cars go there with speeds of 100-120 km / h [1].

The most important problem remains the fast transition of carriages from one track to another. There are three ways to do it:

- change of carts;
- change of wheel pairs in carts;
- sliding wheel pairs usege.

For the co-operation of 1520 mm and 1435 mm track carriages, it is also necessary to solve the problem of differences in the structure and parameters of the brake systems.

Carriages admitted to circulation on the railways of both «C» standards (oriental with 1520 mm track width) and C (western with 1435 mm track width) must meet the requirements of the NHS O + P 516 (or MSZ O + P 430-4). For these messages, 4-axle C-C carriages are adapted for movement on railways on the main routes of the Euro-Asian continent, primarily from international transport corridors.

To send the composition of the platforms abroad, it is necessary to perform a number of operations that allow the carriages of joints of track of different width to cross. There are three ways to change the distance between the wheels:

- sliding wheel pairs,
- change of wheel pairs,
- rearrangement of carts.

Sliding wheel pairs ensure that track gauge is changed in the mode of moving carriages on shifting track devices with minimal labor and time. However, the process of developing a sliding wheel pair that would meet the requirements of reliability and reasonable cost for freight wagons is not yet complete.

The main part of the carriages change points is a track with a track width of 1508 mm, on which 1520 mm and 1435 mm track carriages can pass freely (Fig. 1). The permutation track is limited on both sides by the ar-

rows [2, 3]., Facing one another. On one side it is approached by two paths of the 1520 mm track, and on the other by two track paths of 1435 mm. The length of the path section with a track width of 1508 mm is determined by the number of permutations at this point.

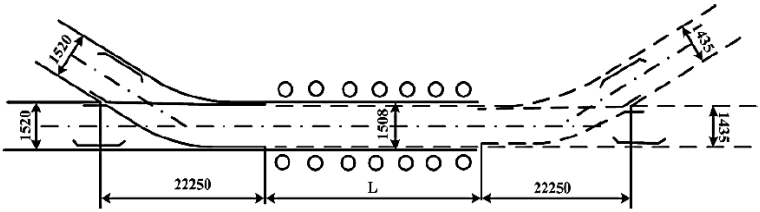

Fig. 1 Track scheme for carriage permutations

When rearranging the passenger carriages, it should be taken into consideration that the 1520 mm track carts are rigidly fastened to the carriages and can only roll under these carriages [2, 3]. The rearrangement of passenger cars is accompanied by additional operations (fixing of carriageways, disconnection and connection of lighting wires, radio cables, etc.). The carts of the 1520 mm track wagons are depersonalized and can be placed under almost any wagon adapted for international traffic.

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INTEROPERABILITY. GUARANTEE OF THE HARMONIOUS DEVELOPMENT OF UKRAINIAN RAILWAYS

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The need to make rail more compatible in order to be more competitive and increase its market share is constantly growing: the concept of interaction is at the heart of any plan or project for the development of the rail system. An important aspect of railway interoperability is the harmonization of technical requirements and regulatory framework with the aim of creating organizational, legal, technical and technological prerequisites for the implementation of the principles of European transport policy, defined by the Concept of the State Railway Transport Reform Program approved by the Ministry of Ukraine. dated December 27, 2006, No. 651-r [1].

Issues related to dimensional differences is not a significant technical problem. It is clear that carriges designated for transportation on routes of international transport corridors must correspond the overall dimensions of the 1435 mm route. Another thing is the harmonization of requirements for undercarriages, couplings and braking equipment. These tasks require efficient solutions. Some rolling stock issues are outlined in the "Rolling Stock" TSI, infrastructure, logistics, interoperability issues are in the GCC monuments, but many issues are still pending.

Therefore, in order to ensure the harmonious development of Ukrainian railways and their harmonization with European transport systems, it is necessary to ensure the effective interoperability of railway transport at all levels.

Within the framework of the International Union of Railways, strategic principles for the development of the world railway system are outlined by 2050 [2]. Strategic principles include:

1. Interoperability (railway technologies adapt to different volumes of demand, market requirements, areas of operation).
2. Connectivity (railways are the basis of an interconnected transport system).
3. Productivity (railways combines high capacity with the ability to provide service for a small customers).
4. Stability (railways provide an effective solution to mobilize sustainable mobility and make a significant contribution to reducing emissions).
5. Security (rail - the safest of all kind of transport).

6. Attractiveness (passengers and carriers receive high-level services).

7. Competitiveness (rail transport is a competitive and viable option for the cost and quality of transport).

One of the most important of the above principles is interoperability, that is, an unobstructed border crossing, which requires the harmonization of the rail systems of different countries, through the harmonization of standards. Effective rail interoperability is achieved by meeting the following requirements:

- interaction for optimization and development of the railway system;
- pan-European registration framework for vehicle with clear and understandable requirements;
- harmonized operating processes;
- harmonization of worn-out parts;
- pan-European system design and standardization increase flexibility.

Ukraine's goal is to continue the process of adapting Ukrainian legislation to the requirements of EU law. It is necessary to adopt a bunch of new laws of Ukraine and government decisions on issues that are subject to legal regulation in this area and which belong to priority areas, the legal relations in which are governed by European Union law. They also need to align the amendments for the current laws and regulations of Ukraine

It is necessary to develop and approve 12 technical regulations based on European New Approach directives and a considerable ammount of directives in the field of technical regulation and consumer protection, harmonize the regulatory framework, particulary: replace old standards with current international and European standards.

In accordance with Ukraine's course on European integration, the transition from product certification to confirmation of its compliance with technical regulations has been made. On February 10, 2016, the Law "On Technical Regulation and Conformity Assessment" came into force in Ukraine.

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THE ROLE OF EDUCATIONAL PROJECTS IN TRANSPORT TECHNOLOGY PROFESSIONALS` TRAINING

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Nowadays, traditional education is going through a crisis. There are significant gaps between knowledge that students gain when studying at higher education institutions and the actual set of knowledge, skills, and competences that graduates need in the workplace. Accordingly, the relevance of innovative approaches and the search for «fresh» formats are increasing. One of the ways how the educational process and its outcomes can be modernized is the implementation of educational projects. Let's clarify this concept.

So, an educational project is a system of goals and programs for their achievement which include research, technological, organizational, financial and other measures providing an effective solution to a specific problem (task) in the field of education leading to innovation (new developments). Changes and innovations concerning the learning process are usually reflected in new educational concepts; educational and training programs; techniques; teaching and learning aids; educational technologies; organizational-economic and managerial models in education [4, p.2].Thus, educational projects are an effective tool of transformational changes in specialists` professional training systems. It is also worth noting that in the field of higher education such innovative proposals are not developed at the level of the Ministry of Education, but rather by providers of educational services (higher education institutions, scientific and teaching staff), often with the involvement of direct ultimate consumers (relevant enterprises and organizations). Such an approach results in the fact that the product of such projects reflects the actual market needs and solves real higher education problems.

In our opinion, the participation of national higher education institutions in the EU ERASMUS + program is particularly promising, since it provides grants, international cooperation opportunities, the opportunity to tap into successful EU experience, and significant financial support (the program budget for 2014-2020 is 14.7 billion Euros) [1]. It is particularly relevant for Ukrainian higher education institutions with their lack of funds and materiel and technical support that can significantly hinder educational process innovations and modernization.

Several Ukrainian universities providing training to professionals in specialty 275 «Transport technologies» are already actively participating in

the program. Consider, for example, the implementation of the Erasmus + Smart Transport and Logistics for Cities (SmartLog) project submitted for consideration in 2017. It involves collaboration among 4 Ukrainian universities (Lviv Polytechnic National University, O.M. Beketov Kharkiv National University of Municipal Economy, Zhytomyr Polytechnic State University, National Transport University (NTU) and the Institute of Market Problems and Economic-Ecological Research of the NAS of Ukraine), two universities in Georgia and 4 European countries (Italy, Germany, Poland) for the period from 2017 to 2020 [2, p. 5]. The EU grant was € 1,479,002.00 [5]. Let`s analyze what has been done through the example of NTU.

The most significant project result is the design and accreditation of the master's degree program in «Smart transport and logistics for cities» by the Department of Transportation Systems and Road Safety in 2018. The program of 120 ECTS credits has both a compulsory core (88 credits) and electives (31 credits). Compulsory courses are subdivided into the cycles of general («Occupational safety in the field and civil protection», «Foreign language for scientific communication», «Computer technology in transport»), professional and practical training as well as on-job training. Professionally-oriented courses include «Smart Transport and Logistics for Cities», «Traffic Flows Simulating and Management», «Traffic Control», «Smart Transport», «City Passenger Transport», «Freight Transportation Simulation», «Integrated Transport Systems in City Logistics», «Traffic Flows Management in the City Center», «Efficiency of City Transport Systems», «City Passenger Transport», «Supply Chain Management» [3, p.10-11]. Among elective courses, there are the following: «Methods of scientific research", «Transport planning of large and the largest cities», «Economy of traffic organization», «Outsourcing of logistic services in transport», «Telematics traffic control», etc. [2, p. 15-16]. As we can see, the educational program is aimed at generating specialists who can apply transport and information technology in urban transport system management. Besides, for the university community to become a full member of the international research network the Master's degree curriculum is based on the latest courses and the most topical research projects in the field implemented in the world in recent years.

The compulsory part also includes research and on-the-job training (12 credits) as well as a master's thesis (18 credits) [2, p.15]. Students` scientific research is done using the Smart Transportation and Logistics for Cities Research Laboratory facilities created at the Department of Transportation Systems and Road Safety in terms of participation in the Erasmus + project. The laboratory is intended, on the one hand, to equip students with practical skills and, on the other, to be used in students and instructors` re-

search activities. On-the-job training is carried out in cooperation with the specialists of the «A + S Ukraine» company, a subsidiary of «A + S Consult GmbH Forschung und Entwicklung» (Germany) [3, p.12-14].

An important program outcome is good international student mobility opportunities. The best and brightest first-year students for the period from September 2019 to February 2020 undertook an internship at European Smartlog project partner universities (Sapienza University of Rome and University of Rome Tor Vergata). The possibility of obtaining an EU-Ukraine dual degree and the recognition of such a diploma in European countries is a valuable outcome resulting from the project realization.

It should be noted that as a part of the project a number of coordination meetings, webinars, and workshops, conferences, visiting professorship for native and Georgian academic staff were held at universities in Italy and Germany. During the above-mentioned events, project participants from Ukraine and Georgia received consultations and suggestions and were provided with necessary resources.

Thus, the design of educational projects is a valuable source of transformation in Transport Technology professionals` training not only at the level of individual institutions, but also by modernizing its system and raising educational training standards in general by attracting investment, advanced knowledge and experience in education, expanding international scientific and academic cooperation, and opening up wider employment opportunities for graduates not only in Ukraine but also in the EU countries.

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UNCERTAINTY IN THE LOGISTIC CHAIN OF THE CROP DELIVERY

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The sources of uncertainty in the logistic chain of the crop delivery from producer to consumer has been analysed. The main sources are: production and consumption irregularity (supply and demand for products); unstable operation of the system elements (non-rigidity of the technological process, statistical uncertainty of the certain transport and technological operations duration); the structural insecurity of the system, manifested in the failure of its certain elements and technical means. It has been established that during the collection and harvesting of grain crops, weather conditions are added to the indicated sources of uncertainty in the management of the transport process, and during international transportation additional problems arise with the uncertainty of the duration of cargo delivery operations due to customs clearance [1]. It has been established that during the grain harvest and storage, the weather conditions are added to the indicated sources of uncertainty in the transport process management, and during the international transportation, the additional problems arise with the uncertainty of the duration of cargo delivery operations due to the customs clearance. It is noted that in the considered logistics chain, the criteria for the efficiency of the transport process in terms of cargo safety and transportation cost are in conflict. In this regard the performance evaluation of the whole process is under consideration. The performed analysis of the problem solving approaches and available grain harvesting models, which reflects the connection of weather and climatic conditions, technical and technological parameters of the field, culture, means of transport and other transport participants has confirmed the lack of tools with which it would be possible to develop measures to improve the efficiency of the transport process planning and managing in the context of the complex impact of uncertainties. Comparing the models of the goods delivery logistic chains based on the theory of reliability of the transport process and fuzzy logic, it is concluded that the development of a model using fuzzy sets is promising. Taking into account the fact that the technical and technological parameters are partly controlled parameters, the developed model should provide means of influence on the technological process.

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PROSPECTS USE AN EXOSKELETONS IN LOGISTICS

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One of the promising areas for improving the efficiency of logistics operations at present is the use of exoskeletons. Modern exoskeletons are special devices that a person puts on. Their main purpose is to unload the musculoskeletal system of the operator and transfer the weight of the load on themselves. Any exoskeleton consists of several components: the mechanical skeleton itself and the mechanisms that set it in motion. A number of designs require an energy source and software to control the entire device. The frame consists of high-strength elements that are connected by hinges. The structure is driven by electric or hydraulic motors. Together with the battery and on-board computer, this design can weigh several tens of kilograms. However, the operator dressed in an exoskeleton does not feel his weight and does not make special efforts to move. Its functions include the commission of ordinary movements of the limbs to direct the machine. There is practically no delay between the movements of the operator and the exoskeleton reaction: the device retains the full potential of human reflexes and flexibility. Supporting body weight, helping to lift and hold the load, correcting the position and stabilizing the body are those auxiliary opportunities that can ease the heavy work of loaders (Fig. 1).

There are exoskeleton models with active and passive operation. Active exoskeletons need an external source of energy, but they provide a qualitative increase in the employee's capabilities. The principle of operation of passive exoskeletons is based on the use of kinetic energy and operator strength. Thanks to them, you can avoid excessive loads, but you can not exceed the limit of "carrying capacity" of a person.

Leaders in the use of exoskeletons are large American automobile corporations. They have already introduced passive exoskeletons of three types of muscle support: supporting arms at chest level and above; assisting torso when leaning forward; "Chairs without a chair", which are fixed in a sitting position.

It should be noted that, in contrast to the military and medical fields, where the active development of exoskeletons has been going on for quite some time, the results of using these technologies in industry and logistics are still quite modest. Although, according to forecasts of Global Markets Inside [1], by 2024 industrial exoskeletons will outstrip military and medical development by 120%. This is quite natural, since physically difficult professions for a person are concentrated mainly in the fields of industrial

production, agriculture, and logistics. Exoskeletons there can play a very important role, preventing overload of workers, reducing pain and eliminating health problems of staff.

Fig. 1. Using exoskeletons

Robotization of manual labor, automation of technological processes is not always a rational way to increase the efficiency of production and logistics. Robots can be replaced with standard, algorithmic operations. Everything that does not fit into strict algorithms, while people continue to execute. An exoskeleton helps optimize these operations. Standard, algorithmic operations can be replaced by robots. Operations that do not fit into strict algorithms, while people continue to perform. An exoskeleton helps optimize these operations.

Automation of production and logistics processes in which people are now involved can cost business owners hundreds of times more and will require scheduled repairs and maintenance of equipment. So, for example, an industrial robot costs about $ 100,000, and the cost of an exoskeleton for an employee does not exceed several thousand dollars. With serial production, a reduction in this price is possible.

Thus, exoskeletons are the least expensive way to protect staff from occupational diseases and injuries and increase productivity. Experts believe that in logistics there will be a stratification of technological operations and their redistribution. There will be no competition between exoskeletons and robots.

The use of exoskeletons is effective for production and logistics. In

industrial production, productivity increases due to this by 250–2000 percent (according to Ekso Bionics research [2]), the return on investment does not exceed 8 months. In logistics technology, an even greater effect can be expected. The use of exoskeletons in the processes of loading and unloading will lead to a reduction in the personnel involved and will increase the speed of work with goods.

For logistics, the use of active exoskeletons will lead to a complete transformation of the technology of freight processes, where human power is still used.

The development of exoskeletons in Ukraine is still in its infancy, and much work remains to be done to improve them. For instance. DTEK introduces exoskeletons for workers in the coal and energy industries [3]. The unique invention of Ukrainian developers won the competition in the United States [4].

Built-in computers and software are being improved that analyze the nature of human activities in order to provide maximum support and help in the performance of work. Ideally, the functionality of the exoskeleton of the freight forwarder should be determined by the features of the manipulations performed during loading, unloading and lifting of cargo in various planes.

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FEATURES OF THE TECHNOLOGY OF FASTENING OF THE CARGOES BY MEANS OF PNEUMATIC SHELLS

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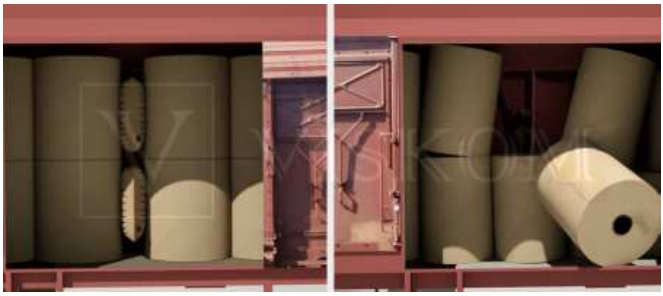
The most common way of securing tare goods inside the cargo area of a vehicle or container is traditional fastening using wooden stops and struts. This method is quite simple and widely used, but it has several disadvantages. First of all, laboriousness: during fastening for some types of cargo it is required to create quite complex wooden structures. The spacer material must be of high quality. Obviously, the technology of securing cargo during transportation requires improvement.

One of the effective, but so far little used methods of securing cargo in cargo rooms during transportation are the use of pneumatic shells - multilayer air bags of increased strength with a valve.

Pneumatic shells are used for unfastening piece, packaged goods, barrels, rolls of different overall dimensions in sea, railway and automobile vehicles. Cargo securing is carried out by placing pneumatic shells in technological voids between cargoes and pumping air into packages (Fig. 1).



а в

Fig. 1. The result of transportation:
а - using pneumatic shells, в - without using them

Pneumatic shells are moisture-proof and absolutely tight, they allow to fix and isolate loads of any size and configuration reliably due to the full filling of the cavities between the loads. Such bags are quickly inflated using an automobile pump or compressor, filling any form of void.

Pneumatic shells are made of various sizes and designs, withstand a

load of up to 30 tons. Bags can be used repeatedly for securing cargo during transportation. The amount of reuse is dependent on proper operation.

When using a pneumatic shell, it is extremely important to calculate the required size for fixing a specific product. If the calculations are not made, then the pneumatic shells will not be able to perform their function properly [1].

The pneumatic shell must meet the requirements of the Technical Conditions for the placement and securing of goods in covered wagons of the Agreement on international railway freight traffic [2].

The bag during filling with air copies the geometry of the void, no matter how complex it is, the same, providing load distribution on the entire surface of the adjacent cargo or car body structure that protects. The displacement of individual cargoes is excluded and, therefore, the displacement of the common center of gravity of the wagon with the cargo. All operations for securing cargo by air bags can be performed by one person. Air bags are easy to use and reduce load securing times. They are lightweight, do not require large storage areas due to compact placement in an unfilled condition. Ease of removal of packages during unloading and the absence of jamming of structures that fasten significantly reduce the complexity of unloading operations.

The choice of the type of air shell depends on the load on it and the size of the filled void.

To remove the pneumatic shell, it is necessary to bleed the air by pressing the spring mechanism integrated in the valve, and then remove the pneumatic shell from the inter-cargo space.

The use of air casings is cheaper than other methods of securing cargo, for example using lumber, nails or plywood.

To protect the air shell, it is necessary to place cardboard, corrugated, cellular or similar materials on the side of the bag, which is in contact with a rough surface or sharp objects.

The use of pneumatic shells will allow the carrier to significantly save time on loading and unloading, use cargo space more efficiently, increase labor productivity, reduce labor costs, reduce packaging / fastening materials, and improve the quality of cargo transportation.

After analyzing the features of the considered technology, we can formulate the main advantages of using air fastening packages:

• Guaranteed security of the transported products;

• Reduced loading and downtime of the vehicle by reducing the duration of cargo fixation;

• Pneumatic packages can be mounted in any conditions in a few minutes using any type of compressor;

• Air bags easily withstand repeated operation without loss of functional properties;

• Pneumatic packages are absolutely tight and waterproof, suitable for use in conditions of high humidity (up to 100%) and temperatures up to +50 C;

• Bags are suitable for securing bulky goods and cargo of non-standard configurations, since they fill cavities with a width of 10 to 50 cm;

• Pneumatic packages are manufactured using technology that allows their recycling;

• Air bags - universal, they can be used on any type of transport (except air);

• Cargo fastening in the cargo room can be performed by one person (a significant reduction in labor costs for cargo securing);

• The mass of the pneumatic packages itself is negligible, when folded it takes up little space.

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ANALYSIS OF LOGISTIC TECHNOLOGY DELIVERY OF PASSENGER CARS

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The problem of the movement of goods from the wholesale seller to the buyer is always associated with a reduction in the transport component in its final price. And this means that the transport component is a decisive factor that determines the demand for goods and, in particular, for cars.

The main problem that has now developed in the logistics sphere of delivering cars is the desire of automakers to reduce the length of the logistics chain and switch to mass forms of car delivery to the regions [1].

Road and rail carriers are currently competing with each other. Now some advantage in this fight is on the side of trucking companies.

Several methods are known for delivering cars from a supplier to a recipient. To choose a rational logistics technology for transportation, it is necessary to analyze their advantages and disadvantages.

1. Delivery on a car transporter.

A car transporter is a special vehicle for transporting cars. This type of transportation has several advantages:

• Ability to deliver cars "door to door". The geography of transportation is limited only by the presence of hard ground cover.

• Fast loading and unloading. The design of the car transporter is specially designed for the arrival of cars.

• Relatively short delivery times.

• A reliable and convenient way to mount cars on platforms.

• Professional staff. Drivers of car transporters undergo special training.

2. Railway transportation.

Rail transportation of cars is carried out in special two-tier wagons.

The wagon capacity is on average 8-10 cars. In professional automotive logistics, wagons are effectively used to transport batches of cars at a distance of more than 1000 km. This is due to the costs of loading and unloading, which are carried out on sites equipped with special ramps. Therefore, car carriers are often used by large companies to transport regular shipments of cars.

It can take a long time to assemble a batch to load a full wagon with cars. Therefore, the disadvantage of this method is a rather long delivery time.

3. Transportation in a tented or insulated body.

Advantages: the organization of such transportation is quite simple.

Disadvantages:

• Mandatory availability of a ramp or crane for loading and unloading.

• The inability to use special vehicle mounts (wheel stops and belts) against displacement during transportation.

• Relatively small capacity - 2-3 cars are included in one van at the same costs as a car transporter per 1 km of run.

4. Dispatch in container.

Sending in a container is a fairly reliable way of transportation, which ensures maximum safety of the transported goods.

Disadvantages: long delivery time associated with terminal handling of the container at the stations and along the way; relatively high transportation cost; The laborious fastening of the car inside the container.

5. Driving on its own.

This is at first glance the most economical way. However, there are direct costs - these are tickets for travel, fuel, living expenses and meals on the road, the salary of a "professional driver". But there may be indirect costs: increased vehicle wear during distillation in domestic roads; significant risk of damage or loss of the vehicle; unforeseen expenses: tire puncture, damage to the body, windshield and other troubles.

In addition, if you drive a car yourself, the owner gets: lost time, monotonous work requires constant attention, a sense of danger throughout the trip, communication with police officers.

The analysis of modern requirements for passenger car transportation technologies indicates that there are increased requirements for the safety of the transported cargo and the personification of the final recipients. Therefore, a transition to an appropriate safe transportation technology is needed, which combines the signs of mass traffic and individualization. In all respects, such technology is container technology [2, 3]. It is able to fully not only satisfy the specified requirements, but also significantly increase the participation of rail transport in the delivery of passenger cars.

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USE OF OPEN CONTAINERS TO IMPROVE TECHNOLOGIES OF TRANSPORTATION OF HEAVY CARGO

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Heavy cargoes are quite common in the range of goods transported. These include: machines, equipment, spare parts, metals and metal products, reinforced concrete and other cargoes that have a mass of more than 0.5 tons in one package [1].

The common features of their transport and technological characteristics are the large mass and significant dimensions of one cargo place, the need for complex special fastening on vehicles in order to avoid displacement during transportation; overload only in a mechanized way; adaptability to storage in an open storage area.

Particularly stringent requirements are imposed on heavy cargoes: they must be prepared by the manufacturer for transportation, transshipment and short-term storage, that is, the necessary conditions for rational placement and reliable, fast and convenient fastening of goods on vehicles, high-performance and safe transshipment at points of departure and destination. The shipper is responsible for fulfilling these requirements, as well as for the correct packaging of the goods.

All these requirements are best fulfilled in the case of the use of container transportation technologies. They are ensured by the design of containers and compliance by shippers with the rules for the placement and securing of goods.

Containers, as a type of transport equipment, were created with the goal of standardizing transportation technologies. There is a single world standard used by all carriers, both railway, sea and automobile, which determined a number of advantages of this type of transportation [4]. First of all, these are:

- minimizing the cost of transportation;
- expansion of the geography of transportation around the world (most of the world's terminals, both sea and land, work with containers);
- optimal storage of cargo (lack of free access to cargo, the possibility of sealing);
- a single world system of document and cargo circulation;
- compulsory cargo insurance;
- acceleration of customs procedures;
- convenience of transshipment to other modes of transport during intermodal transportation.

Particularly relevant is the issue of container transportation when it comes to intermodal transportation: the delivery of goods by rail, road and sea [4].

When transporting heavy cargo, first of all, it is necessary to take into account the features of the vehicles with which the transportation takes place. If we talk about delivery by rail, then the main limiters are the carrying capacity and dimensions of railway platforms and the current loading dimensions.

Standard closed containers of the parallelepiped shape are used to transport a large assortment of goods suitable in size for packing into such a container. Very often, heavy machinery and equipment can be disassembled into components and placed in a universal closed large-capacity container.

If machinery or equipment cannot be placed in a standard closed container, open universal containers can be used:

• Open Top - containers that have an open top;
• Flat platform - open container platforms;
• Flat Rack - containers that consist of a base and end walls.

Open Top containers do not have a rigid top roof, which also allows you to conveniently load heavy loads into them with a crane. Open Top containers are indispensable for transportation of high non-heavy cargoes that do not fit in containers of other types, for example, when transporting special equipment.

The use of flat platform containers such as Flat platform is appropriate in the case of transportation of heavy cargo.

In many cases, the solution to the problem of transportation of heavy cargo is the use of containers such as Flat Rack. Their base is the bottom of a standard universal large-tonnage container of one or another standard size. But the side walls and top of such a container are missing. Common designations for a 20-foot platform container also include: 20 Flatrack Container, 20 FC, 20 PL, 20 FB and 20 FR, and a 40-foot container container - 40 Flatrack Container, 40 FB, 40 FR , 40 PL and 40 FC.

Another important advantage of using such containers is the convenience and cost-effectiveness of stacking, storing and transporting them unladen due to the ability to fold compactly.

The effectiveness of using open containers during the transportation of heavy cargo is manifested in the fact that the cargo is loaded and properly secured to such a container only once - when loading at the shipper. Further, when performing reloading operations, cargo operations are carried out not with cargo, but only with a container. Especially important is the advantage of container platforms when used in intermodal transport.

Modern universal open containers are equipped with special devices

for securing the cargo and its movement in space. An indisputable advantage of the container transportation of heavy cargo is also the ability to provide the maximum safety regime during loading and unloading, since it is not the cargo itself that is loaded, but the container on which it is located.

Thus, using open universal open containers, it is possible to organize a safe and efficient transportation of heavy cargo.

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INTEGRATION OF NON-MOTORIZED AND AUTOMOBILE TRANSPORT IN THE CITY

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In many cities around the world, public transport is effective in holding back the growth of the quantity of the road [1]. Each person is potentially a pedestrian, a cyclist, and a car or public transport user. The person first needs a trip, and in the second one chooses a way to travel. A specific type or combination of transport modes is used to make the trip. Accordingly, the process of deciding how to move is affected by the accessibility of the transport option, ie not only the presence of a bicycle or car but also the availability of a network, such as the passage of a public transport route in the departure and arrival areas.

The transport network is a set of nodes (for example, points of gravity) connected by links (arcs between points). In this case, sections of the infrastructure suitable for movement of the respective transport mode will be arcs for different transport modes. The arcs of the network can pass through

the streets, which combine elements of different or even all networks and be completely separate. For example, public transport can take the road network or on a completely separate route (high-speed tram, subway).

However, public transport does not provide door-to-door transportation services necessary to compete with private automobile transport and improve the living conditions of the poor [1]. The need for door-to-door transportation can mean extending bus routes to all parts of the city. The use of bicycles as auxiliary vehicles can be important, increasing the reach of city dwellers and inaccessible public buses. Providing cycling infrastructure is important as it can potentially induce a significant number of passengers who did not choose these cycling trips earlier [2]. Bus stops and roads require to prioritize bicycle and bike lanes [3].

The aim of this study is to prioritize bus stops using the maximum coverage algorithm, including reducing distances when determining potential demand. The heuristic model uses two criteria: the elimination of redundant bus stops and the priority of bus stops for the operation of transfer stations for the integration of bicycle buses. Potential demand and the distance to the furthest point of demand are served by bus stops.

The location of stops in the city determines the total cost of transport between them [3]. This affects the behavior of travelers when traveling, as people tend to choose less expensive transport modes [4-7] and try to use stops that are closer to their accommodation. Thus, it was found that the compactness of the city, as a rule, affects the travel scheme of people. Studies show that more compact cities lead to more trips but a shorter average distance [8]. The compactness of the city can leads to much slower modes of transport [8]. However, the implementation of such a policy becomes difficult or practically impossible in the case of an already developed city, because compactness is realized when planning a city.

Using the optimum number of bus stops, it is possible to identify ways in which priority should be given to securing bicycle lanes and tracks through network analysis. The route with the highest potential number of bicycle and bus passengers receives the highest priority. The results of the study will be useful for planners and decision-makers in integrated cycling and public transportation planning in Ukrainian cities.

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DEVELOPMENT OF REQUIREMENTS FOR THE AUTOMATED CAPACITY MANAGEMENT SYSTEM OF THE RAILWAY INFRASTRUCTURE OF UKRAINE

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At present, there is no experience in the public railway use of Ukraine in the allocation of capacity of the railway infrastructure. The stages of production processes of JSC “Ukrainian Railways” (JSC Ukrzaliznytsia) that are included in the capacity allocation procedure are automated in a fragmented way. Some stages of dispatching are automated, but there is no link to the process of developing a standard train schedule (FRG), and its manual-based assembly process is outdated. The Graphic Engineer ARM, which was developed in 1999, is currently in operation and does not have the functions required to allocate network bandwidth, including automatic plotting, delay modeling, etc.

In the context of the implementation of the model of reforming the railway industry by the vertical method of separation, there is a need to automate the process of planning the movement of train formations. In the first stage of the formation of the railways of Germany, Switzerland, Poland and others, this process was rather lengthy and performed manually, but with the introduction of automation the time to access the infrastructure was reduced from days to hours and minutes. Therefore, to develop the requirements of the automated system for JSC Ukrzaliznytsia it is important to analyze the existing systems on the railways of Europe. The analysis of the existing automated network bandwidth distribution systems proves the absence of many functions regarding the automation of the train formation planning process at Ukrzaliznytsia JSC, which requires the development of its own automated system.

Requirements for the creation of an automated system for managing the bandwidth allocation of railway infrastructure (ACS) on the basis of the distributed decision support system (DSS) have been developed for the implementation of a complex of scheduling problems of transportation from the application for route organization to the distribution of the thread of the train movement and analysis implementation of the transport process. The paper proposes to consider the AU of the Bandwidth Management in the form of a modular structure. This will allow to solve a complex of problems of transportation planning from the application for the organization of the route to the distribution of capacity, the development of the thread of the train movement and the analysis of the implementation of the transport process.

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PROSPECTS OF THE TRANSIT POTENTIAL OF UKRAINE

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Ukraine is a European country located at the intersection of the most important directions of world trade directly between Europe and Asia, as well as other continents with advanced transport infrastructure. According to the results of 2018, the volume of transportations is more than 571 million tons of cargo (without pipeline) and more than 2082 million passengers per year (excluding urban transport) [1]. The fact that Ukraine occupies one of the leading places in Europe by its transit position, testifies to the presence in its territory of international transport corridors, such as: "Cretan" №3, №5, №7, №9, TRACECA, Baltic - Black Sea , BSEC, Europe - Asia.

On the basis of information of the State Statistics Service of Ukraine (including containers on rail cars, trucks and ships), data on transit transportation of goods in thousand tons by different types of transport across the territory of Ukraine for 2014-2018. 1. a schedule is drawn up that reflects the drop in the total transit of goods carried by all modes of transport across the territory of Ukraine [2].

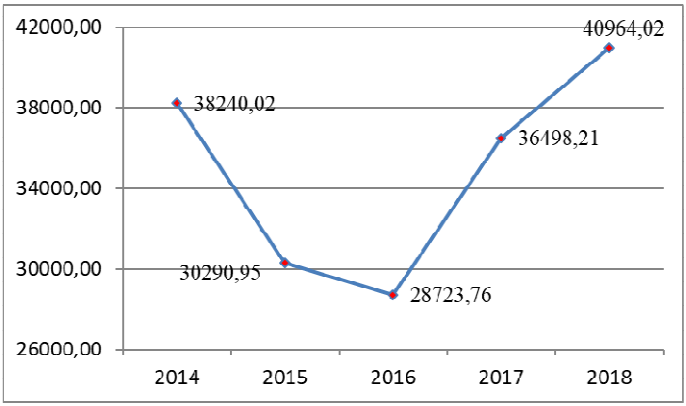

Fig. 1. Graph showing the total transit traffic of goods by all modes of transport across the territory of Ukraine for 2014-2018

To date, science has come a long way in the development of forecasting technologies. Specialists in the art are familiar with methods of

neural network prediction, fuzzy logic, and the like. Appropriate software packages have been developed, but in practice, unfortunately, they are not always accessible to the average user, and at the same time many of these problems can be successfully solved using methods of operations research, such as simulation modeling, game theory, regression analysis, and implementing these algorithms in the widely known and widespread suite of MS Excel applications [3].

In Fig. 2 presents the consolidated data of the results of the regression analysis of statistics on the volumes of transit cargo flows from 2014 to 2018 and the projected volumes of transit cargo flows in Ukraine for 2019-2021. This task was made in MS Excel using exponential, linear, logarithmic and power trends.

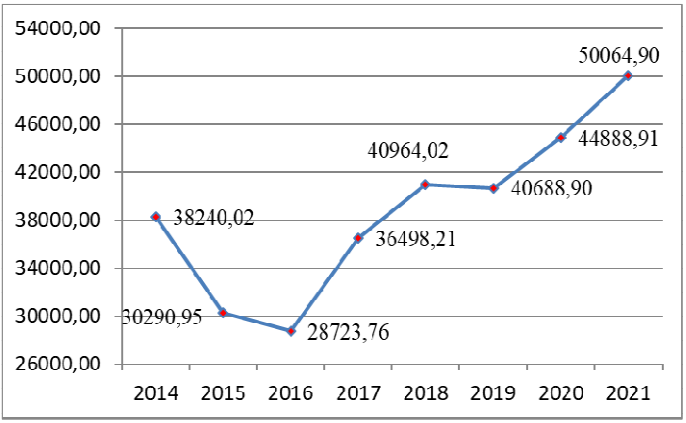

Fig. 2. Consolidated chart of transit freight flows in Ukraine for 2014-2021

The reliability of the approximation of R2 in the exponential trend (R2 = 0,1121), the linear trend (R2 = 0,1237), the logarithmic trend (R2 = 0,018) and the power trend (R2 = 0,014) were not sufficiently representative, and in the polynomial trend (R2 = 0.8828), although quite high, but the predicted values do not inspire much confidence. Therefore, the average values of the forecast data of all five equations of approximation, that is, we obtain thus consolidated information.

The analysis of the consolidated timetable of transit freight flows in Ukraine for 2019-2021 (Fig. 2) makes a positive conclusion. Studies have shown that the transit opportunities of Ukraine are in demand and are constantly growing. The task is to bring the transportation system of Ukraine in

compliance with international requirements and to constantly increase the throughput capacity of all types of highways.

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IMPLEMENTATION OF THE "ELECTRONIC OFFICE OF THE CARRIER" PORTAL

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According to subparagraph 24 of the first article of Article 7 of the Law of Ukraine "On licensing of types of economic activity" in the field of transportation by road the economic activity on transportation of passengers, dangerous cargoes and dangerous wastes by road transport is subject to international transportation of passengers and cargoes.

Licensing Authority - State Transport Security Service of Ukraine. In Decree No. 4 of Decree No. 5 of the Regulation on the State Service of Ukraine for Transport Safety, approved by the Cabinet of Ministers of Ukraine 103 of February 11, 2015, in accordance with its tasks, Ukrtransbezpeka licenses entrepreneurial activity in providing transportation services with belts, dangerous goods, by rail.

Since 2013, the State Transport Service of Ukraine has been operating the Unified Transport Information System of Ukraine (UIS) (at that time

- the State Inspectorate for Terrestrial Transport Safety). The automated accounting workplace for CII licenses has the following features:

- the major licensing accounting processes are implemented taking into account the hierarchical structure of the organization and aimed at interaction of the Central Office with the territorial departments;
- functionality takes into account the need for accounting forms and mass printing of licenses and license cards in compliance with the license form;
- there is no possibility to enter the content of the submitted documents in the Application;
- There is no way to access Carriers through the site to view and update data, which causes a problem of partial inconsistency of Carriers data (exceptions: carriers included in AsMAP - have access only to view international road transport permits).

As of 2017, according to the legislation of Ukraine, the issues of licenses are considered exclusively by the relevant subdivision of the Central Division of Ukrtrans without the participation of territorial bodies (territorial offices renamed to territorial bodies in accordance with the Decree of the Cabinet of Ministers of Ukraine No. 103 of 02.02.2015). Printing of licenses on the forms of strict reporting, storage of license cards have lost their relevance. There is an urgent need to publish information on the status of licenses and vehicles available to the carrier.

Therefore, there was a need to automate the process of issuing the Ukrtransbezpeka license for the right of business to provide transport services for the creation, collection, storage, accounting, retrieval and compilation of information for the purpose of issuing / expanding / narrowing / canceling / reissuing the licenses under consideration and the procedure for submission documents for issuance / renewal / narrowing / cancellation / renewal of licenses considered by Ukrtransbezpeka, through the creation of the ECP portal, which was launched in Ukraine on August 30, 201 8 years.

The carrier's electronic office is available on e-services.dsbt.gov.ua, as well as on the government portal kmu.gov.ua in the section "Electronic Services". An online service created in collaboration with the Ministry of Infrastructure, the State Agency for Electronic Government and the State Transport Service of Ukraine and supported by the USAID / UK AIDS project Transparency and Accountability of the Government and Services / TAPAS Foundation and Eastern Europe.

The main tasks of the portal "E-cabinet of the carrier":

- Accounting for the Carrier's data and the information provided in the documents to the Application for Issuance / Extension / Narrowing /

Revocation / Reissuance of the License (in particular, regarding the vehicles and personnel of the Carrier);

- Possibility of remote submission of documents by the Carrier by means of the Carrier's Electronic Cabinet;
- Implementation of the process of issuance / extension / narrowing / revocation / reissuance of the license and updating of the data of the Licensing case in accordance with the requirements of the legislation at the moment of development;
- Ability to export road transport licensees information for further ro-offs on sites for public access to data;
- Organization of interaction of the existing Civil Service Systems on transport safety;
- Providing the access of the Carriers' representatives to their own up-to-date information regarding the available fines, issued permits for international carriage, their own Perevoznik licenses, etc .;
- Availability of responsive design that allows you to work with a web portal using your smartphone, tablet, laptop or PC;
- Enabling unauthorized users to search and view publicly available Carrier information;
- Transmission of publicly available information about Carriers to the Unified State Portal of open data and access to it through the Ukrtransbezpeka web portal.

The purpose of the Portal is to provide the ability to collect and record data of licensees.

Advantages of the Portal implementation:

- Update information on existing carriers and their vehicles.
- Extension of the list of Carriers' data to be accounted for in the Unified Information System of Ukrtransbezpeka.
- Partial knowledge of the burden on licensing professionals due to the ability to submit already completed electronic documents to the Carriers.
- Improving the interaction between Ukrtransbezpeka and Carriers by providing access to information.
- Possibility of development towards remote use of data during inspection activities.
- Possibility of further development of the e-cabinet of the carrier in the direction of providing administrative services.

The basic requirements for the structure and functioning of the Portal are the development on the basis of a universal platform with the available tools for business process automation and the availability of interoperability. When filling in the forms, the System must automatically check the cor-

rectness of the format of the entered data. Carriers have access to their e-cabinet using an electronic digital signature (EDS). This is a reliable protection against unauthorized intervention by third parties.

The purpose of development of the Portal "E-cabinet of the carrier":

1. ensuring access of the Carrier to the data concerning its organization, the state of the license, from the EIS2, as well as data about the fines, permits, the list of vehicles from the EIS1.

2. providing the possibility for the carrier to submit electronic documents regarding the issuance / extension / narrowing / revocation of the license and updating of the License data by means of the EKP;

3. provision of the possibility of filing a message by the Carrier for:

4. confirmation by the Carrier of the data available in the State Service for Transport Safety of Ukraine;

5. informing the State Transport Service of Ukraine on the updating of data on vehicles, personnel, etc.

6. providing unauthorized access to users to search and view publicly available information about the Carriers, both from personal computers and from mobile devices to the KP;

7. Provision of possibility for editing of data by the Carrier, including in case of authorization in the EDC for the EDS, in the case of authorization by login / password, it should be possible to only view their own information and receive notifications from the EIS.

UIC1 - the existing Civil Service System for Transport Safety in Ukraine. The version of UnityBase platform on which the EIS was created: 1.5.30.6442. UIC1 includes the automated workplace "Licenses" and contains data on carriers registered with the UIC1 licenses, vehicles and the like.

In the context of the functioning of the UIC1, it must ensure:

1. keeping up-to-date with the Carriers and Vehicles Directory for further use in the processes:

- centralized accounting of permits for international transportation;
- distribution and reporting on the use of ECMT permits;
- accounting for fines.

2. transfer of license data to the EIS2 structure.

EIC2 - A system designed to take into account Commission Decision of 17 December 2009 on minimum requirements for data to be entered in the national electronic register of road transport undertakings (notified under document C (2009) 9959). Purpose of the development: To provide a tool to Ukrtransbezpeka staff to keep track of their licenses in accordance with applicable law.

The UIC2 should provide:

- accounting for Carriers;
- records of the Carriers' data on their own, leased, obtained on credit or leasing of the vehicle;
- records of qualification data of the Carrier's personnel;
- accounting of data on the existing material and technical base that ensures the execution of technological operations or contracts with economic entities providing services for performing such operations;
- updating of the Carriers 'data on the basis of electronic documents submitted by them in order to keep the Carriers' data up-to-date;
- adoption of electronic documents transmitted from the ECP for consideration;
- transfer of data on Carriers to the UIC1;
- creation and maintenance of an electronic Licensing case by Ukrtransbezpeka for each licensee;
- Formation of requests to the state electronic information resources of the registers of the Ministry of Internal Affairs, the State Fiscal Service and the Ministry of Health in order to obtain information about the Carrier (financial status, vehicles, business reputation of management / management of personnel) using the System of electronic interaction of state electronic information resources.

Interaction of the EIS2 with the ECP has the following advantages:

- Carriers have access to view their own data and, if necessary, will be able to initiate on-line the process of supplementing, updating this data;
- Carriers can monitor the status of licenses, initiate changes to licenses and take appropriate measures;
- the load and the number of errors when entering data by licensing specialists of Ukrtransbezpeka are reduced (part of the data is entered by Carriers through the ECP using directories);
- On the basis of interaction between participants of the process of licensing in road transport, the percentage of false information in electronic systems of state bodies decreases.
- establishes the technological basis for the Single State Electronic Registry of Road Carriers in accordance with the Implementation Plan of Regulation (EC) No 1071/2009 of the European Parliament and of the Council of 21.10.2009, which establishes common rules for the conditions of admission to the operation of road transport operators and the repeal of Council Directive 96 / 26 / EU.

The UIC2 should be able to upload data for further posting to public resources:

Website of the State Service of Ukraine for Transport Safety (http://dsbt.gov.ua/). Existing system. The official site of the State Transport Service of Ukraine.

Single State Open Data Portal (http://data.gov.ua/). Existing system. The only state-owned open source web portal.

Prospects for development of the Portal:

1. Possibility of development in the direction of remote use of the Carriers' data during the inspection activity (including registration of fines).

2. Possibility of further development of the Carrier's Electronic Cabinet portal to ensure the receipt of other administrative services provided by Ukrtransbezpeka.

3. Integration of the System with the EDR, National Police, etc.

4. Extension of data stored in the Ukrtransbezpeka System for automatic reporting according to the requirements of the European Union.

5. Development of information functions for Carriers. The multiselection is the licensing specialist and the components of the Ukrtransbezpeka, which were found by certain criteria and sent to the KP (or E-mail) the necessary message.

6. Access to other authorities: the Ministry of Internal Affairs, regional administrations, city competitions for transportation, etc.

The service aims to simplify the procedure for communicating business with government bodies in the licensing process, eliminating the human factor at the decision-making stage.

“The carrier's e-cabinet is a real business tool that not only simplifies the licensing process for market participants, but also allows them to better comply with the requirements of the law. That is the essence of any public electronic service: convenience, speed and transparency.

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THE INVESTIGATION OF THE VORTEX CHAMBER FORM INFLUENCE ON THE VORTEX CHAMBER SUPERCHARGERS OPERATION PARAMETERS

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Pumping solid abrasive particles in many industries is causing rapid wear on pumping equipment [1]. The abrasive wear of the seals and the working parts of the dynamic pumps leads to energy performance degradation and to the significant reduction in the lifetime [2]. Classic jet superchargers have fairly low workflow performance [3]. The efficiency of the direct-flow jet pump does not exceed 30% [4]. It contains the spread of jet technology for pumping bulk solids. Vortex chamber pumps are new pumps created on the basis of using the positive properties of jet and centrifugal pumps [5]. These pumps, in contrast to direct-flow jet, allow pumping hard abrasive mediums with greater efficiency.

It is known that the shape of the vortex chamber rather strongly affects the performance of vortex devices, such as vortex valves, cyclones, vortex tubes, etc. Studies of the vortex chamber form effect on the performance of vortex chamber superchargers have not been carried out yet.

The aim of the work is to assess the influence of the vortex chamber form of the vortex chamber supercharger on its energy characteristics and hydrodynamic parameters.

The vortex chamber forms investigated in this study are shown in Fig.1. The mathematical model has consisted of the Navier-Stokes equations averaged by Reynolds, a turbulence model adjusted for the curvature of streamlines, and continuity equation [6, 7].

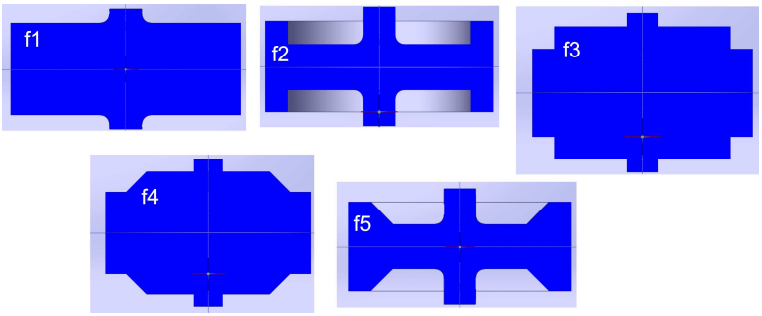

Fig.1. The forms of the vortex chamber

The grids are constructed in such a way as to ensure the value of the parameters of the prismatic boundary layer $y^+ < 2$ [8, 9]. The calculations were completed under two conditions: reducing the residuals of the solution of all equations to values and ensuring a constant flow rate through iterations in the outlet.

For calculations, the OpenFoam software package was used, which allows to obtain reliable results and is distributed under the terms of the GPL version 2 license of the Free Software Foundation (FSF) [10].

The shape of the vortex chamber affects the interaction of axial flows sucked by the supercharger, which, in turn, affects the energy performance [11].

Fig. 2 presents a comparison of the energy performance of the vortex chamber superchargers with various forms of the vortex chamber. All indicators are related to the best design indicators f1. That is, the efficiency values shown in Fig. 2 for forms f2-f5 are related to the efficiency of the form f1.

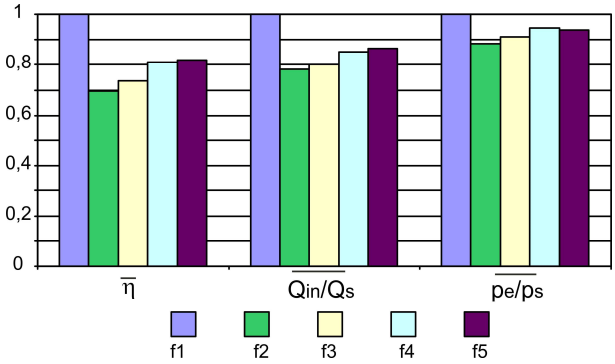

Fig.2. The forms of the vortex chamber

The influence of the vortex chamber form of the vortex chamber supercharger on its operation parameters and energy characteristics is discovered. It was found that the classical cylindrical vortex chamber is the rational form of the vortex chamber. The use of a vortex chamber form different from classical design leads to a decrease in efficiency by 20 to 30%. This is due to a significant decrease in the ejection coefficient of the supercharger (from 15 to 22%). A local decrease in the height of the vortex chamber leads to a collision of the pumped flows, which reduces the flow rate of the suction fluid and reduces the efficiency. On the other hand, a local increase

in the height of the vortex chamber leads to an increase in the friction of the flow and to energy loss in the vortex chamber.

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CREATION OF TRANSPORT-LOGISTIC CLUSTERS IN UKRAINE: THE INVESTMENT ASPECT

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The process of integration of Ukraine into the world economic space determines the priorities of the country's development in the direction of closer integration with the countries of the European Union and other international institutions and requires improvement of the existing system of management of the road and transport complex of our state. Development of Ukraine requires finding new ways to increase the competitiveness of the country's economy and its regions. The transport industry plays a significant role in Ukraine's overall economic system, being a global industry in the world economy. The leading countries of the world with high rates of development of the national economy have achieved their competitiveness through the implementation of innovative technologies.

The introduction of innovative technologies in Ukraine is related to foreign investment, which is one of the promising ways of development of the Ukrainian economy, since the level of physical and moral deterioration of the fixed assets of the Ukrainian economy sectors for 2014-2017 (Fig. 1) averaged 64, 2%, and the indicator for the transport industry - 61,9% [1].

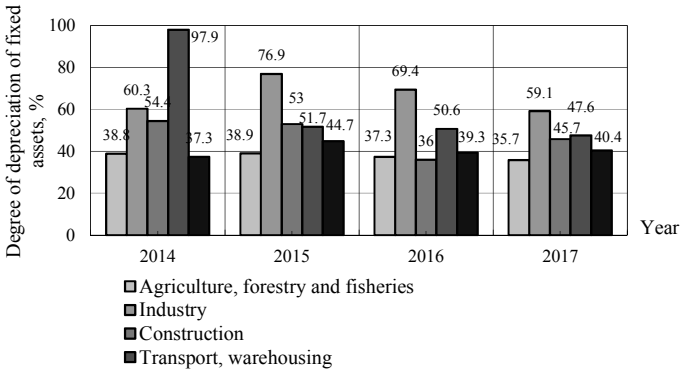

Fig.1. Degree of depreciation of fixed assets by type of the Ukrainian economic activity for the period 2014-2017

First and foremost, foreign investments should contribute to sustainable and balanced development, structural modernization of the national economy, and enhancement of its competitiveness. Investments from countries that are technology leaders are important for the Ukrainian economy. Priority should be given to investments in the development of high-tech and science-intensive industries, which contribute to expanding export potential and increase the competitiveness of Ukrainian goods in world markets [1,2] (Table 1).

Table 1

Distribution of foreign investments in the field of economic activity of Ukraine in 2018

Field of economic activity of Ukraine	Amount of investment, million USD
Industry	10688,8
Wholesale and retail trade	4970,4
Information and telecommunications	2190,9
Professional, scientific on technical activity	2147,4
Administrative and support services	1521,9
Transport and logistics	979,6
Construction	926,1
Agro-industrial complex	560,8

The most desirable form of investment for a developing country's economy is foreign direct investment, which allows to implementation of large projects, new corporate governance practices. Thus, in 2019, foreign direct investment in the first three quarters amounted to $ 1711.0 million [1] (Fig. 2).

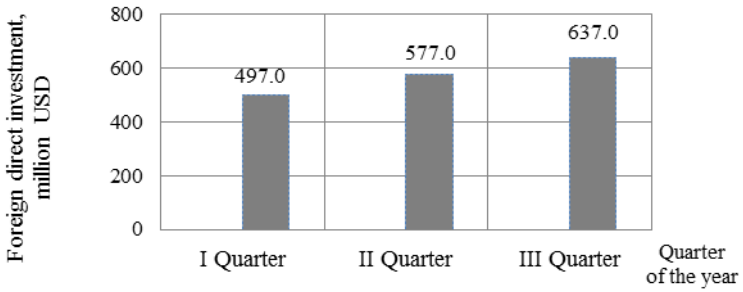

Fig.2. Foreign direct investment in Ukraine in 2019

In order to make efficient use of the existing transport infrastructure, the issues of creating transport-logistic clusters (TLC) in Ukraine, considering the economic level of development of the transport sector of a particular region, are noteworthy. The investment aspect of strategic management of financial potential for the implementation of the TLC creation project is realized through the strategy of forming an investment portfolio, which is a set of financial investment projects (investing in securities) and real direction projects (support the material and technical base at a level that ensures a constant growth of competitive status of enterprise) [3]. In order to integrate this project into international trade relations, it is necessary to ensure the inflow of foreign capital into the development and operation of the TLC. One of the main ways of foreign investment in the economy of Ukraine is loans, which have a huge impact on the economic development of the country by bringing into motion all its unused production capacity [4]. Researches of the investment aspect of the creation of TLC in Ukraine can be carried out using a comparative analysis of the payback of an investment project with the use of equity and borrowed capital.

Studying the prerequisites for the feasibility of implementing an investment project for the formation of TLCs in Ukraine revealed the need to use investment credit in its formation. An analysis of the distribution of foreign investment in 2018 (the share of foreign investment in the transport sector accounted for 3.11% of the total investment) showed that industries that do not require long-term investment and the development of new technologies are popular for foreign investment.

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DETERMINATION OF THE RESIDUAL OPERATION TIME OF THE LOAD-BEARING METAL STRUCTURES OF THE HOPPER DOSER AND DUMPING WAGONS (DUMPERS) ON THE BASIS OF THE TECHNICAL DIAGNOSTICS AND TYPE TESTING RESULTS

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In Ukraine railways most of hopper doser and dumping wagons (dumpers) are much higher service life that it is specified by the manufacturer. Due to the lack of ability of JSC Ukrzaliznytsia to update the wagon fleet timely, it is necessary to determine the residual life of the load-bearing metal structures (hereinafter referred to as LBMS) of the rolling stock.

Resource (equipment) is device operating life from the beginning of its operation or after repair and to reaching their limit state, which is determined by the standard process documentation. For different devices the resource can be expressed in different units of measurement, for example, operation hours, run, years, etc. Residual life is the total operating time, which is projected on the results of the equipment technical diagnostics, from starting the control of its technical condition for passing to the limit state.

In Ukraine the freight wagons residual life research is carried out by scientific organizations. But the techniques of these studies are based on bench-based operational life testing and the recommendations made for extending the freight wagons service life without sufficient scientific justification.

In determining the residual life of hopper dosers and dumping (dumpers) LBMS wagons, technical diagnostics and typical tests are carried out with recommendations for further scientific research of this issue. Technical diagnostics is the residual life study and justification of the possibility of the freight wagons operation continuation after the end of the service life specified by the manufacturer. Typical (control) test is experimental verification of strength indicators conformity of the wagon structure with the requirements of current regulatory documents, which include: static tests on the strength of the vertical load; dropping from wedges; impact tests for impact strength.

Hopper doser is a vehicle for transportation, mechanized unloading, track laying, dispensing and leveling of ballast in the construction, repair and maintenance of the railway track. Dumping wagon (dumper) is specialized rolling stock and other wagons of the truck park that are distinguished by the structure of the body and the presence of specialized equipment for its tilt during unloading.

The scheme of the strain gauges installation on the frames of the hopper doser and dumping wagons (dumpers) during the control tests.

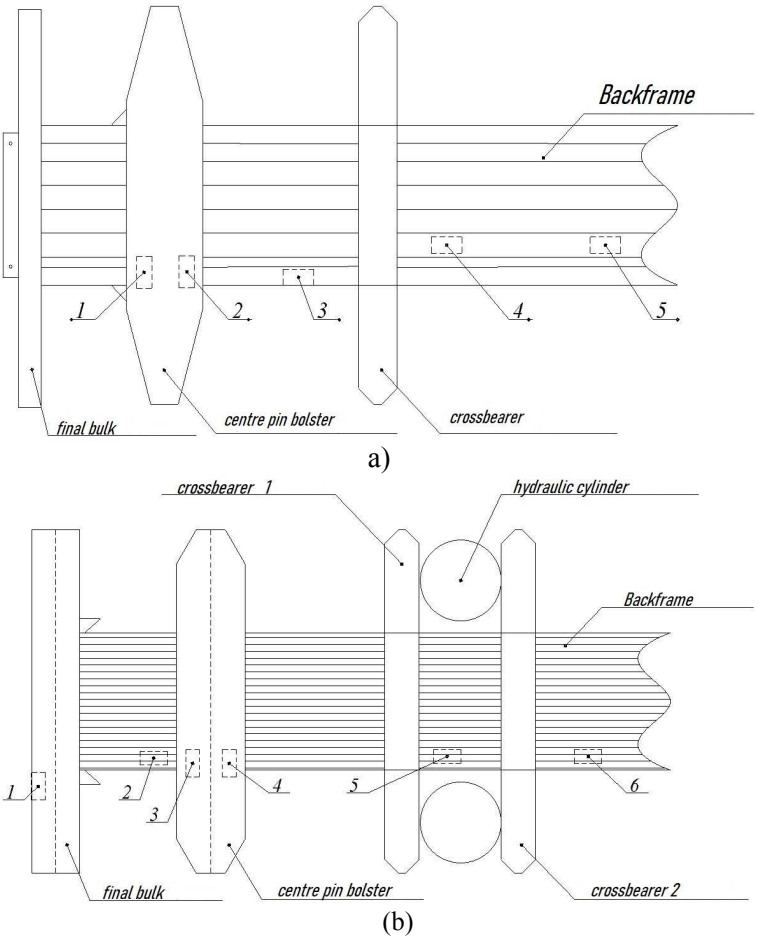

Fig.1. The scheme of the strain gauges installation on load-bearing metal structures of hopper doser (a) and dumping wagons (dumpers) (b).

The possibility to set the new service life of wagons is determined on the basis of technical diagnostics and typical tests.

The actual corrosion rate is calculated

$$V_c = \frac{S_n - S_f}{T} \ mm/year, \quad (1)$$

where S_n – is the nominal thickness of the element, mm;

S_f – is the actual thickness of the structural member according to the measurement results, mm;

T – is the life of the wagon up to the moment of measurements, years.

The residual life is determined by the formula

$$T_r = \frac{S_f - S_{\min}}{V_c} \ \text{years}, \quad (2)$$

where S_{min} – is the minimum admissible thickness of the element in terms of strength and durability, mm.

Determining the residual life during typical tests, an assessment of fatigue resistance indicators is carried out, taking into account the stress of the load-bearing structures of the wagon during the test.

The assessment of fatigue resistance is as follows

$$n = \frac{\sigma_{a,N}}{\sigma_{a,e}} \geq [n], \quad (3)$$

where $\sigma_{a,N}$ – is the endurance limit (in amplitude) of the full-length part in the case of a symmetrical cycle and a steady load test-based N0 = 107 cycles, MPa;

$\sigma_{a,e}$ – is the calculated value of the dynamic voltage amplitude of the conditional symmetric cycle, reduced to base N0, equivalent to the damaged action of the real mode of operational random voltages during the service life, MPa;

[n] – is the allowable fatigue resistance factor.

According to the obtained results, the reduction of the fatigue resistance ratio to the minimum recommended service life is equivalent to at least 65 years for hopper dosers and 55 years for dumping wagons (dumpers).

As a result of technical diagnostics of hopper doser and dumping wagons (dumpers), the done works in-depth analysis was carried out and defects were systematized, which made it possible to identify the weakening in the wagons LBMS, according to the currently valid the JSC Ukrzalizny-

tsia regulatory documents, such wagons must be excluded from inventory rolling stock.

The obtained practical and theoretical results make it possible to develop a science-based methodology for estimating the residual life of freight wagons load-bearing metal structures used on the Ukraine railways.

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THE OVERVIEW OF INNOVATIVE ACTIVITIES ON RAILWAY TRANSPORT

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Current trends in the development of transport, taking into account the importance its role in the economies of countries, require new approaches to the search for promising technologies. Therefore, a review of research aimed at developing innovation is one of the most important and useful problems for industry in the world, associated with significant depreciation of production assets.

Today, innovations in science are considered as the most important factor in development and are its integral component. There is a desire to intensify the competition of innovative systems with the "traditional" production systems of the necessary resources. Economic development has some dialectic: the one side, this development is generated by intensification of scientific and technological progress; on the other side, and its result leads to an increase in the level of technological development. That is why a review of innovation is crucial in the present, especially for an industry such as rail.

In most developed countries of the developing world, the state is actively involved in the development of innovative systems. Moreover, huge financial resources are allocated for the creation, implementation and market promotion of the most promising from economic point of view technical means and technologies, with the attraction of private investment, which can positively affect the state economy in the future.

One of the countries that actively uses and develops innovative technologies is the United Kingdom, which has become an exporter of innovation and development [1]. The Netwok Rail program is an innovative system in the country's railway transport, which allows us to improve the technical specifications for the interoperability subsystems of various levels. For example, with the help of this program, workers on railway tracks have the opportunity to independently control light at night through mobile devices using SMS messages. According to [1], the indicated implementation is successful and intensively used.

A feature of innovation in railway transport is the tendency to obtain a synergistic effect. So, when designing the rolling stock of “future”, a hybridization modes of transport and vehicles is observed with the prospect of a combination of “strengths” and the opening of their application.

An interesting development is the vacuum train project, proposed in 2013 by the American entrepreneur I. Mask. He took as basis model of a vacuum train, the advantage of which is the lack of need to overcome friction of support and counter air resistance.

It is worth noting that the plans for implementing Hyperloop have now been modified, and are somewhat different from the original idea. The main difference is the engineers abandoned the full vacuum in tunnels. It is too complicated, expensive and dangerous. Therefore, air is pumped out until pressure reaches one tenth of atmospheric pressure. This means that the capsules cannot move at the highest possible speed, air, although very rarefied, will prevent this. The design of the tunnels was also changed, the pipes are made aerodynamic so that air flows around the capsules and does not interfere with their movement.

Important innovations in railway transport are ready-made technical solutions aimed at resource conservation. Vivid examples are the commissioning of a solar-powered train by Bayron Bay (Australia), which is a modernized version of the old passenger train. In the “past life” he had two diesel engines, one of which was replaced by an electric motor and batteries, and the second was left to maintain balance and as a backup source of energy. The battery capacity of 77 kW • h is designed for a whole day of trips back and forth [2]. Its charging is carried out using solar panels both on the train roof and at stations equipped with 30 kW solar panels. The train was reported to be able to operate even with high cloud cover.

Renewable energy trains already exist, but for the most part they do not generate it directly, but receive electricity from the network. For example, in the Netherlands, electric trains are now 100% powered by wind energy [3]. In other cases, clean energy provides only part the needs of vehicle, for example, in India, the "solar-powered train" is driven by a diesel locomotive, and the sun only provides air conditioning and lighting.

According to experts, of all transport, it is the railway that is most promising from the point view direct generation of solar energy, in particular because of stops at stations where it is possible to charge the battery. Of course, the train in Byron Bay will be a faster tourist attraction than a truly commercial route, but it is proof of the concept’s performance.

Thus, in current conditions the development of society, the introduction innovations and stimulation of innovative activity seems to be the most reliable way to increase the competitiveness of goods and services, as well as industries and the economy as a whole. At the same time, innovation in rail transport should be carried out so that hybrid modes of transport and vehicles expand the capabilities of industry. This allows railways to improve their efficiency and competitiveness in changing conditions. To un-

derstand this thesis came as individual companies and the leadership of leading countries in world. It takes steps to create favorable conditions for the development of innovation. Therefore, the importance of innovative development of railways goes beyond the industry and has important macroeconomic significance.

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ANALYSIS OF RISKS ON A RAILWAY TRANSPORT

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The technical maintenance the railway network of Ukraine requires large economic costs. They are associated with maintaining reliability the corresponding state of infrastructure facilities and ensuring the safety of transportation process. In recent years, the state of country's transport complex has deteriorated significantly. The decline in traffic led to an unprofitable industry, which is already underfunded. Also, there is a depreciation of fixed assets, which approached critical values. This leads to an increase in the need for reconstruction, repair and maintenance. The issues of technical innovation and modernization are practically not resolved. Minimum social conditions for workers in the industry are not ensured. Not fully utilized the potential of the transport complex to develop the export of transport services [1, 2].

These factors require the development of such a mechanism for obtaining reasonable assessments and safety criteria, which will take into account the totality of socio-economic factors.

In such conditions of limited resource, choosing the wrong solution can lead to irrational planning of repair work on infrastructure sites. Formally, they require repair, but have an acceptable level of reliability. Also, reliability sections of the infrastructure continue to be operated not only without modernization or major repairs, but also ongoing restoration work. This in turn leads to risks of traffic accidents.

The rational management of limited resources requires the fulfillment a number of conditions, among which obtaining real-time objective information about the state of reliability and functional safety of all railway infrastructure facilities, development a methodology and the creation on its basis of innovative information technology to support decision-making on technical content and ensuring the functional safety of railway transport infrastructure at the linear, regional and network levels.

A separate area of reliability, which has a certain impact on the safety of transportation process, is the functional safety of railway facilities. Confidence in achieving the complete safety of functions within the system can be achieved through the effective use a combination of certain tools, methods and technologies. Safety integrity refers to reliability of the failure, which is necessary in order to achieve the necessary functional safety. Functions with the highest safety integrity requirements will be more expensive to use.

An analysis of statistical data over recent years has shown that the reasons for insufficient reduction in the number of safety violations are systemic and are related to the current state technical and technological base of railway transport. Under these conditions, a large role in reducing the number of safety violations is played by the formation of requirements for railway equipment products, developed technological processes, taking into account reliability indicators, operational safety and general quality indicators.

The conditions for development of high-speed traffic and the introduction of innovative technologies require the strengthening of these requirements, as well as the development of special procedures for monitoring their implementation. In this case, special attention in the development of modern technical systems related to traffic safety should be paid to software. According to the function maintaining high levels of safety and reliability the transportation process, risk management is important. As a matter of priority, risks that affect achievement the strategic goals of UZ should be evaluated and processed.

The analysis [1-3] showed that as the most significant risk factors associated with the safety and reliability of transportation process and strategic goals that affect the achievement of UZ, one should consider such as a lack of public investment (investment risk), cost growth repair and maintenance of infrastructure facilities and rolling stock due to their increased wear violation of uniform requirements for facilities and processes of maintenance and repair of rolling stock, with weapons (risk of structural transformations) reduction in traffic safety due to a decrease in the reliability of railway transport means (technological risk).

Based on the analysis and modern requirements, it was revealed that risk management should comply with such principles as: the decision related to risk should be economically sound and should not negatively affect the results of financial and economic activities the railway company; risk management should be carried out as part the corporate strategy of enterprise; in risk management, decisions should be based on the necessary amount of reliable information; when managing risk, decisions should take into account the objective characteristics of environment in which the railway operates; risk management should be systemic; risk management should include a current analysis the effectiveness of decisions made and prompt adjustment the set principles and methods of risk management used.

Risk management in rail transport should be carried out in accordance with the requirements of international standards (ISO 31000: 2009, IEC / ISO 31010: 2009, EN 50126, etc.), taking into account the specifics [3].

The essence each stage of risk management in rail transport involves the use of well-known risk assessment methods [1, 3], as well as their combinations. These methods are systematized in a phased process for implementing risk management. For effective analysis the whole range of risks in the railway transport, it is necessary to apply a set of appropriate analysis methods. These methods can be applied autonomously or in addition to each other, and analysis methods may also include quantitative risk criteria.

Unfortunately, there is no integrated risk management system in rail transport, the purpose of which is to achieve and maintain an acceptable level of traffic safety and operation. The introduction of such a system will allow the transition to a new model for managing the life cycle of infrastructure and rolling stock, taking into account risk assessments.

The analysis showed that reasons for insufficient reduction in number of security breaches are systemic and are related to the current state the technical and technological base of ultrasound. Under these conditions, a large role in reducing the number safety violations is played by formation of requirements for railway equipment products, developed and technological

processes, including indicators of reliability, operational safety and general quality indicators.

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STANDARDS AND PROBLEMS OF FIXING ROLLING STOCK ON STATION RAILS

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Consolidation of rolling stock remains a problem in Ukrzaliznytsia's transportation economy. In recent years, serious work has been done to establish a stricter procedure and norms for securing rolling stock to prevent its unauthorized exit.

The number of traffic accidents and material damage has been declining in recent years.

However, it was not possible to completely eliminate the risks in ensuring the safety of trains associated with the unauthorized departure of rolling stock.

It is obvious that the effectiveness of technological measures to increase and clarify the norms of laying brake shoes under cars and regulating the implementation of operations to secure. It is necessary to introduce new technologies that solve the pressing problems of securing cars.

Due to insufficient fastening of cars with brake shoes in 2019, 3 traffic accidents were allowed during the shunting work, all related to the human factor, primarily assembly teams.

Thus, on the Odessa railway the rolling stock was allowed during maneuvers due to violation by the train organizer of the requirements for the

allowable number of cars in the supply of freight operations and non-compliance with the rules of securing, there was an unauthorized departure of cars with subsequent descent.

An incident occurred on the Lviv Railway during shunting work to rearrange a group of cars from the access track, a collision of a locomotive with a car, with the subsequent descent of the car, who arbitrarily went out of the border column out of the way due to violation by the train organizer of the order of securing cars, instead of two brake shoes was put only one.

The brake shoes used to secure the rolling stock must be in good working order and, when fastened, fit under the wheels of the carriages so that the toe of the shoe slide touches the rim of the wheel.

If two or more brake shoes are secured, they must not be fitted under the same wheel axle. In places of cargo operations, brake shoes must be laid with the wheels rolling on the slide of the brake shoe.

In the development of these requirements on the station tracks of the directorate and access tracks, serviced by road means in order to ensure the safety of brake shoes and increase the reliability of fastening, as a rule, brake shoes are placed in all cases with rolling wheels on the brake shoe slides.

Brake shoes, as a rule, are placed under the cars, starting from the extreme, under the different axes of the cars from the possible exit of the group (composition), which is fixed.

Exceptions are some precinct and freight stations. On the station tracks of a number of precinct stations it is allowed to place the brake shoes not under the extreme car from the side of the possible exit during the shunting work in order to reduce the time for performing technological operations, the train compiler additionally checks the reliability of coupling with this car of all other cars of the group.

The main initial data for calculations of norms of fixing of a rolling stock are technology of work of station and longitudinal profiles of station tracks.

The calculations used the method of sequential calculation by straightening the different values of the slopes of the longitudinal profile elements, starting from one end of the path or the starting point of the rolling stock for all types of longitudinal profile monotonous, sawtooth "broken", convex "mountain", concave "pit".

For a number of stations, based on technological necessity, when to accommodate a group of cars of different lengths use any section of track that contains several elements of the longitudinal profile, the calculation of fastening rates is performed by the method of sequential calculation with the difference, that the element which has the maximum inclination in the

direction of possible departure of the car is taken as an exit. Next, this element is straightened with one of the two adjacent, which has the largest slope.

When fixing trains on Ukrzaliznytsia station tracks, handbrake shoes are mainly used. Thousands of brake shoes are placed and removed under the wheels of cars every day.

In Ukraine, fundamental research is being conducted aimed at the development of high technologies, solving the pressing problems of securing cars in order to ensure safety in railway transport.

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INNOVATIVE TECHNOLOGIES IN WAREHOUSE LOGISTICS

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Modern companies constantly have to think about how to improve, how to attract and retain customers. In such conditions business begins to think about new technologies, the implementation of the information system, in other words - on innovation.

Today, the actual problems of cargo transportation. As statistics show, 43% of the functioning of vehicles in a warehouse is occupied by loading and unloading and waiting time service [1].

The importance of this problem is due to the fact that the warehouse is one of the key components of the enterprise's logistics system. Important signs of industrial, financial and economic stability of an enterprise can be confidently characterized: effectiveness, accuracy, speed of processing a customer's order. Therefore, the introduction of innovations for warehouse logistics is considered the most important issue for any enterprise today.

Warehouses and their infrastructure is an essential element of warehouse logistics. A modern warehouse is a complex technical design, which is equipped with modern warehouse equipment and consists of many interdependent elements. It has a certain structure and performs a number of functions, such as storage and accumulation of goods, transformation of material flows and cargo distribution between consumers. Therefore, the warehouse should be considered as an integrated component of the logistics chain, which allows to fulfill the basic functions of the warehouse and achieve a high level of profitability. To eliminate this problem, it is necessary to modernize the operation of warehouses and their infrastructure [2].

Warehouse logistics costs can reach 40% from cost of the goods. The key to the success of the company is to a greater extent in optimizing warehouse logistics by reducing the cost of handling and storage of a freight unit, flexibility and customer focus of services.

Conventionally, innovations in warehouse logistics can be divided into two directions:

- Innovations in the system of picking orders "Goods to man" (the introduction of drones, robocars etc.).
- Innovations in the system of picking orders "Man to goods" (implementation of technologies such as: Pick-by-Voice - voice selection, RFID - radio frequency identification, smart glasses - “increased reality” etc.).

The following are some examples of innovations that enable warehouse employees to spend less time on the move around the warehouse for accounting, distribution and order picking.

1. Drones. Warehouse drones are compact drones for indoor use. They can read QR codes or other markings from goods on storage racks. The WALMART company, which has been using drones in warehouses in the USA for several years, states: for an hour, a drone that reads bar codes from a pallet does the amount of work 50 employees. Data accuracy is close to 100%.

2. Smart glasses are successfully used for making orders and to ensure intellectual work. The first targeted use of "smart" glasses by innovative companies shows an increase in well-known warehouse operations by tens of percent. And now it’s clear that this technical accessory will soon become standard in warehouse logistics.

For smart glasses, their great appeal lies not only in providing visual cues, but also in using the voice or barcode scanning capabilities that most glasses have. Some smart glasses can also use Bluetooth to pair with a reliable ring scanner for more intensive scanning.

3. VoicePicking technology - a way to automatically identify, using voice selection, in stock. With voice control, the employee hears a command in the headphones and immediately goes to the destination. At the destination, the place is confirmed by sounding the cell number system, and the employee begins the selection; feedback is also given in voice format. Thus, the operator is fully concentrated on the job; the second ear of the operator remains free to ensure the safety of the worker. As a result, the accuracy and speed of warehouse operations increases up to 30% [3].

4. Automated loading / unloading system of motor vehicles (ALS) is an innovative technology that significantly changes the organization of the warehouse. The main advantage of the system is the reduction in the loading and unloading time of vehicles, which allows you to speed up the process several times. If 60 minutes is a typical time in order to load a truck, then the use of ALS allows you to load a truck in just 8 minutes. The high speed of cargo turnover allows at times to increase the company's profit and customer loyalty (by reducing delivery time) [4].

5. Also increase the productivity of the warehouse, helps the implementation of WMS. WMS - warehouse management system. This is a computer program used by warehouse workers.

WMS allows to:

- identify the goods that arrive at the warehouse and leave it;
- optimally distribute the load according to the composition, taking into account its weight and size;
- create tasks and automatically distribute them between workers and equipment.

To carry out product identification, it is necessary to have tags on the cargo and cells in the warehouse: barcodes (EAN-13 and EAN-128) or radio tags (RFID). This reduces the time of identification of goods upon arrival at the warehouse, since information about it (weight, size, type of cargo, manufacturer, position in the warehouse enc.) is automatically entered into the program database when reading the tags. Using these data, especially data on weight and size, WMS distributes the goods in the warehouse.

So, a modern warehouse complex, incorporating infrastructure facilities, possessing modern technologies, allows to solve indicated problems of goods flow management. The concentration of capital in the logistics system is accompanied by an increase in the volume of goods flow and the costs of its retention. Customers of warehouses are interested in timely and high-quality service, in the delivery of goods in the required assortment and high quality. The accuracy of the warehouse was the determining factor of its competitiveness. Therefore, we can conclude that innovation in ware-

housing and transport logistics helps the company to make their activities more effective and to get more profit.

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THE CONCEPT OF SUSTAINABLE DEVELOPMENT OF RAILWAY TRANSPORT

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Transport infrastructure is one of the priority sectors of the any countries economy and Ukraine in particular. The main objective of transport is to meet the needs of the population and industrial enterprises in high-quality transportation. A special place in the transport industry of Ukraine is occupied by rail. This situation is due to the fact that this type of transport has such features that allow it to be the main trunk transport not only in the present, but also in the future. Railways of Ukraine have one of the most extensive networks in Europe. The railway transport features include the universality of services for consumers, regularity, low cost, reliability, safety, environmental friendliness and, as a result, competitiveness. In addition, transport experts from around the world see rail as the transport of the future. Therefore, the state faces an important task to increase operational capabilities and competitiveness, as well as the implementation of the basic principles of sustainable development of the railway industry.

The recent post-crisis years can be considered with confidence the starting point in the use of fundamentally new approaches to the problems

of socio-economic development. They can be seen both in the actions of individual countries and their regional associations, whose efforts are focused on finding their own areas and development strategies. This challenges many of the negative processes and phenomena that have received the status of world crises in various fields of human activity. The most noticeable crisis affects transport systems and networks, which are the "circulatory" system of both individual regions and individual states. In the Ukrainian economy, this situation is due to such factors [1]: the specifics of the transport industry as a link in the economic production process; profound changes associated with the implementation of innovative communication and transport and logistics technologies. This contributes to the rational organization of cargo flows and ensures the sustainable development of the transport market, where the demand for high-quality and comprehensive transport services is guaranteed to be satisfied.

However, noting the problems of the development of the transport industry and the possibility of improving the work of transport enterprises, it is worth noting the importance of increasing the indicators that traditionally characterize the volume and quality of transport services, but also the need to reduce society losses caused by transport activities. Indeed, serious socio-economic problems are associated with transport, which are intensified by the measure of economic development and growth in traffic volumes, in particular, the growth of motorization of society. Such problems include: the growth of road traffic accidents; the growth of the negative impact of transport on the environment and public health; increased losses associated with traffic congestion; an increase in greenhouse gas emissions and fuel consumption and the like. Estimates show that the level of such losses is very significant and in total can reach 8-10% of the country's GDP per year. It is also worth considering that the systematic implementation of measures to improve the safety and environmental friendliness of transport usually leads to an increase in the efficiency of the transport system as a whole.

Given the above, as well as the fact that the transport system of Ukraine does not yet comply with EU standards and requirements and is marked by a significant lag in terms of infrastructure, equipment and operating standards [2]. It is necessary to recognize as objective that in the country now there is a need to solve the totality of issues of building up and rational use of transport potential on the principles of sustainable development. Their awareness at the state and industry levels is a priority for ensuring the balanced development of the transport system of Ukraine.

The problem of sustainable development of complex systems is considered in two aspects: static and dynamic. The system is in a state of static

constancy when the state of its elements and the connections between them do not change significantly for a long time. That is, the structure and state of the system does not change under the influence of small perturbations. But, at the same time, it should be noted that it is precisely the achievement by a complex system of a state of static stability that creates the conditions for the stable development of its subjects within a certain period of time. On the other hand, the permanent storage of this state, that is, the hyperstability of the system, makes the development of the system as a whole impossible. However, an empirical analysis of the functioning of complex systems showed that their evolution at some points in time is characterized by abrupt changes in the jump-like nature, which is a typical example of the dominance of positive feedback in the system [3, 4].

The system is in a state of dynamic constancy in the case when, after it is removed from the state of static stability, it will switch to another state of static stability over a period of time. So, the state of dynamic stability of the system does not inhibit its development, but makes the loss of integrity impossible. It leads to the self-preservation of the system.

Stability is one of the most important properties of complex systems, since it ensures their viability, adaptation to changing environmental conditions. For complex systems, which include railway transport, which determine stability, active forms of stability are characteristic.

The management of the development of the environmental management system at the railway enterprises in the conditions of the need to ensure economic and environmental safety should be aimed, first of all, at the development and implementation of new approaches to increase the socio-ecological and economic efficiency of natural resources use. This will allow for the expanded reproduction of transport services, the sustainable development of the nature management system in rail transport and the efficient use of natural resources with the preservation and improvement of the environment to ensure economic and environmental management of railway transport enterprises.

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METHODS FOR ASSESSING THE SERVICE LEVEL AT THE RAILWAY STATION

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The development of services in passenger transportation, including train stations, today and in the long term, is the basis for attracting passengers on the railway transport and increasing the viability of transportation regardless of the ownership form and the nature of the passenger companies functioning.

The dynamics of passenger traffic shows that in recent years the number of passengers carried has significantly decreased (Fig. 1) [1]. This is due to the situation in the east of the country and in Crimea. But one cannot ignore the fact that the level of service on the railways of Ukraine does not correspond to the cost of the trip.

The railway station is a combination of station buildings, structures and devices needed to serve passengers and provide related services. It has a special staff and a single economic and economic mechanism for organizing production activities. Its purpose is to provide safe, quick and convenient mass service for passengers when receiving and sending them from the station; the provision of additional services; providing short-term rest, leisure and meals during train waiting periods; ensuring comfortable conditions for meeting and sending passengers. Given the active role of the station in the service system for railway transport, increasing the level of service for passengers at railway stations is one of the most effective directions for the development of passenger traffic.

The level of service can be determined by assessing key indicators of service quality. The problems of forming indicators of the quality of services, determining the level of service and methods for increasing it are of particular methodological complexity. Moreover, the scale for assessing the requirements of each of the parties may vary significantly.

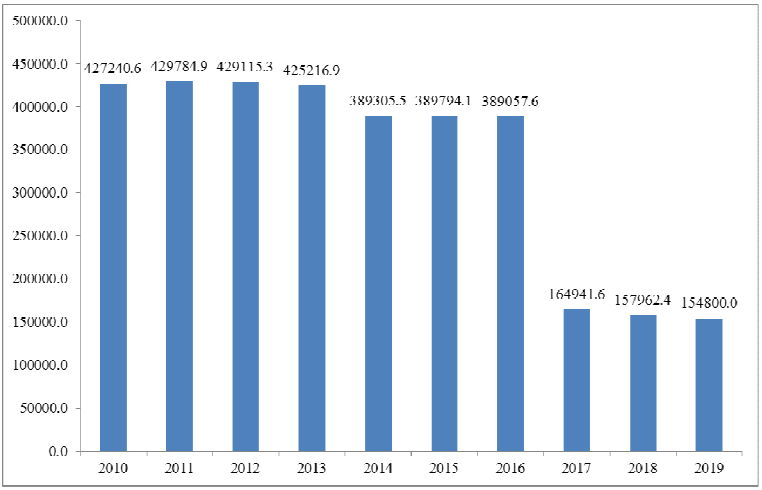

Fig. 1. The number of passengers transported by rail from 2010 to 2019, thousand

The company's ability to make money depends on the impression that all its employees make on customers. This impression is created by the quality and efficiency of the goods or services that the company sells, the accuracy and speed of service, as well as the attitude towards the client. Therefore, in the service system an important role is played by the level of qualification of staff.

In marketing research, it is important not only to study the essence and forms of service, but also to apply methods of substantiating the technical and technological possibilities of economic feasibility of implementing the elements of a transport service. [2]

There are four options for organizing a service:

• service is provided exclusively by carrier personnel;

• a consortium is created for the transport service, which operates on the basis of an agreement between carriers of certain types of transport;

• service is entrusted to an independent and specialized company;

• to carry out service work, intermediaries are involved who bear full responsibility for the quality and satisfaction of claims for the service. An important role in the selection of companies for the provision of transport services is played by the quality and competitiveness of these enterprises (companies).

Evaluation of service quality is one of the most important elements of corporate policy and service quality management policy in any company.

Attracting and retaining each of the clients is the main task of the company manager. Assessment of the quality of services includes a number of diverse indicators. For example, the deadline for the execution of the order, the timely receipt of permits and the implementation of international transport, settlements on the fact of the work performed. [3, 4].

In order to maintain a consistently high level of service, which keeps existing and attracts new customers, control and measurement are needed. To form the optimal model of service at the station, it is necessary to form an assessment of the quality of the services provided.

In order to streamline the service management process, the station services are proposed to be considered in the context of the following groups of indicators: nomenclature and quantity; quality; time; price; reliability of the service (in terms of quality, time and quantity).

Thus, the proposed structure of estimated indicators can serve as the basis for a system for assessing the level of passenger service at railway stations.

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THE ROLE OF A FOREIGN LANGUAGE IN THE TRAINING FUTURE LOGISTICIANS

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Currently, logistics is an important subsystem of almost all sectors of the real economy. The use of advanced methods, high technology and effective solutions by logistics company employees becomes an imperative for ensuring the sustainable development of a high-tech domestic economy and improving the quality of life in the country. Against the backdrop of rapidly developing industrial and scientific relations with foreign countries, one of the requirements for graduates is practical knowledge of foreign languages. A huge amount of educational literature on logistics is written in English. And the need to study it requires knowledge of a foreign language.

All these factors emphasize the relevance of the article, the purpose of which is to indicate what important role a foreign language plays in modern logistics.

The formation of the professional competence of a logistician at the present stage of development of higher education is unthinkable without integration into the general system of language training. It is important to prepare students to overcome the language barrier in countries where the language is official. Future professionals need to be introduced to the features of the chosen profession and the role of a foreign language in modern science. When teaching foreign languages at a technical university, it is necessary to pay attention to the volume of language and speech material, to determine priorities in choosing future activities and the corresponding speech skills. It is important to be able to analyze the training of undergraduates and graduate students, highlight the main difficulties in translating authentic texts and identify the factors that influenced the choice of this problem.

Many processes related to goods distribution are impossible without knowledge of a foreign language. Such processes include: negotiations related to the supply and movement of goods flow; conclusion of contracts; communication during the delivery of goods from the customer to the buyer, invoicing related to the provision of services or operations for the purchase / sale of goods; after-sales or after-sales service.

Today, knowledge of a foreign language is one of the conditions for the professional competence of future logisticians. Knowledge of English increases the competitiveness of a specialist in the field of logistics in the labor market. With all equal indicators, employers prefer to choose specialists with greater skills than are required for this vacancy. Most often, the psychological

factor is triggered and the image of a highly professional specialist is formed. Knowledge of English is a competitive advantage for the logistician in the labor market.

Logistics specialists often need to confidently communicate in English by telephone, conduct business and correspondence with foreign partners, read information materials, understand the intricacies of contracts in English, and have a special vocabulary used in the field of logistics operations and cargo transportation.

Any work is often associated with finding and obtaining information, and the work of a logistics specialist is directly related to this, where knowledge of English is necessary. The ability to get interesting, reliable, specific and required information increases by tens and hundreds of times - if you work in the English-language information space, just like millions of English-language web pages!

Competent written and spoken English is a serious sign of a business culture, educational level and general specialist status. Fluency in special and business terminology in English when negotiating, signing contracts, and business communication is the main fundamental work of logisticians.

Nowadays, when a business has become international, good written skills in English with business partners become relevant. Business written communication requires the respondent to know the rules for writing a letter - a request, a request letter, a letter of complaint, and so on, not to mention that in business correspondence it is necessary to take into account the national and cultural traditions of your partner.

If a specialist speaks a foreign language himself, he manages to establish truly partnerships with contractors, effectively develop and expand his own business. If a specialist plans to develop his own career in logistics, English is his priority, since all the major players in this market - foreign firms - owners and top management are fluent in English, as English is international.

From the foregoing, it is clear that fluency in English in negotiating, signing contracts, and business communication is a great advantage and the main duty of a qualified specialist in the field of logistics. Knowledge of English in the field of logistics makes a specialist competitive in the labor market. The work of such specialists is rated very highly by many companies.

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IMPROVING ROAD SAFETY THROUGH ALTERNATIVE WAYS OF ARRANGING U-TURN FOR CITY TRANSPORT VEHICLES AT TERMINAL STOPS

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The organization of urban passenger transport routes is a responsible issue, both from point of view of road transport and from point of view of road safety. Ensuring the necessary level of road safety when transporting passengers requires detailed study of all elements of the route along the route of urban passenger transport. One of problems that directly affect road safety is the presence of left turns and u-turns performed by route vehicles (buses, trolleybuses, electric buses) with a length of 12 m to 18 m, which are characterized by relatively large dimensions and weight (in relation to other types of vehicles). The most dangerous maneuvers for such vehicles are left turns and u-turns when they are performed at unregulated intersections from side of a secondary road, when right of priority passage of the intersection has a vehicle moving on the main road.

In cases where the terrain conditions associated with difficult terrain and dense buildings do not allow you to allocate sufficient territory for the construction of a special site for u-turns, and the layout of the road network does not allow you to provide for the turnover of vehicles by bypassing the block, etc., we suggest using a vehicles turntable for this purpose. Thanks to its design and device, the vehicles turntable allows you to turn a stationary vehicle located on it 180° around the axis. In this case, the vehicle does not exceed the overall dimensions of vehicles turntable.

We offer a vechicle turntable that consists of a base 5 with a bearing, which is installed in the turntable 7, which has a heel (Fig. 1).

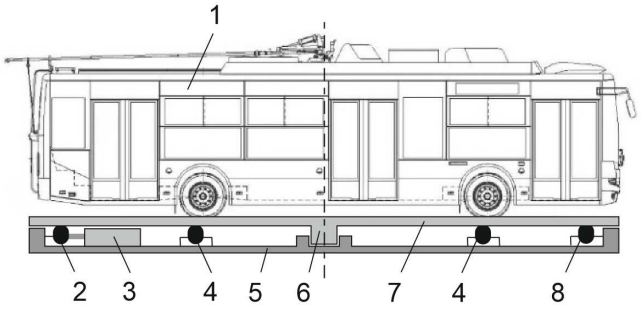

Fig.1. Proposed construction of the turntable

The heel of vehicle turntable, mounted in the bearings, forms the turning unit 6. The turntable 7 rests on the base 5 through the wheels 2, 4, 8 (wheels that are not in the front section are not shown in the drawing). In this case, the wheels 4 are bearing, and the wheels 8, located on the outer edge of the turntable, are supporting. All wheels are mounted to the base 5 of the turntable, have the ability to adjust the height, are mounted in bearings, on the mutual arrangement, diametrically in pairs, and thus are balanced. Wheel 2 is a drive and is connected to a gear-motor 3, which uses an AC asynchronous motor with an electromagnetic brake (operating voltage 220/380 V AC, power not more than 3 kW). For smooth starting and stopping of the turntable, it is proposed to use a special frequency-controlled electric drive. Due to the low power of the motor, it is easy to provide backup power to the electric drive. A special technological hatch is provided for access to the electric drive in the turntable.

Structurally, turntable 7 is a prefabricated metal structure that can be covered with asphalt concrete or other coating made of materials of the required strength. The reinforced supporting frame of this structure can be made as a prefabricated structure, It's consisting of segments connected to each other in a single turntable using bolted joints. The base 5 of turntable can be made of solid concrete, and also be a prefabricated structure, both metal with running tracks, and made of precast concrete slabs. For the removal of precipitation, rain and waste water, drainageis provided.

To perform a u-turn, vehicle 1 enters the turntable 7 “on its own”. The driver, driving a route vehicle, when it fed on turntable, focuses on the geometric center 6 of turntable 7 indicated by light signals, in order to correctly set the vehicle on the turntable.

Fig. 2 shows a schematic diagram of turntable application.

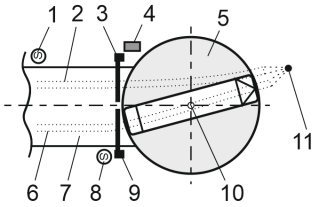

Fig.2. Schematic diagram of the application and variants of the turntable

The turntable 5 is installed on a prepared bridgehead at the end of the carriageway 7 of the street or local driveway, which are thus adjacent to it. Before entering the turntable vehicle stopped on point 8, where all passengers are disembarked for safety reasons. Barriers 3 and 9 are provided to prevent unauthorized vehicles from entering the turntable 5. When using trolleybuses, must be overhead wires 2 and 6 is mounted, which is fixed on the support 11.

After disembarking passengers at the stop point 6, the driver enters the turntable in such a way that the longitudinal axis of the vehicle crosses the geometric center of turn 10 (indicated by light signals for ease of orientation). Then driver brakes the vehicle with the parking brake and turns it off. The driver gets out of the vehicle and walks around it clockwise. If the driver is driving a trolleybus, the driver must lower the trolley poles. Then, with a special key (mechanical or electronic), the driver activates the u-turn mode on the control panel 4. After receiving the activation signal, the electric drive of the turntable rotates the drive wheel under the turntable, so that the turntable rotates and turns the vehicle on it. To restrict the access of unauthorized persons to the territory of the turntable, an appropriate fence is provided. Also, to notify that the turntable is in motion, it is proposed to install a flashing signal beacon on the control panel 4. After making u-turn, the driver switches off the vehicle u-turn mode on the control panel. After driver returns to the cab and drive vehicle to stop 1 for boarding (if there is trolleybus, driver must set up the trolley poles).

It should be noted that the overall installation dimensions of the turntable are actually determined by its diameter, which is limited by the length of the route vehicles used.

The construction of the turntable can also be performed prefabricated and thus actually represent the turntable in a mobile version, in which it will be relevant and practical for organizing the movement of temporary routes for the period of repair and reconstruction of the road network. At the same time, since the adjustment of the support wheels is provided for height, the

turntable can be installed even on an uneven base, and the accuracy of installation is leveled by adjusting the height of the wheels, relative to base.

Thus, when using a turntable, reverse driving maneuvers (that are dangerous for vehicles of this category, performed in conditions of limited space), turn maneuvers (associated with the u-turn of route vehicles on the roadway) are completely excluded. This solution can also be used for organizing transport routes and in limited conditions of the historical part of city.

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