

## ABSTRACT AND REFERENCES

## CONTROL PROCESSES

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**IMPROVING COORDINATED MANAGEMENT OF ELECTRIC CONSUMPTION BY A CRUSHING-ENRICHMENT COMPLEX OF AN ENTERPRISE (p. 4-12)****Valentin Khorolskyi**

Donetsk National University of Economics and Trade named after Michael Tugan-Baranowski, Kryvyi Rih, Ukraine

**Dmitry Klyuev**

Donetsk National University of Economics and Trade named after Michael Tugan-Baranowski, Kryvyi Rih, Ukraine

**Valentina Khotskina**

Kryvyi Rih Economic Institute of the Kyiv National Economic University named after Vadym Hetman, Kryvyi Rih, Ukraine

**Dmitry Khorolskyi**

JSC «South Mining and Processing Plant», Kryvyi Rih, Ukraine

We developed a strategy for coordinated management of power consumption by an enterprise with energy-intensive technological processes in the crushing and enrichment complex. An approach is presented to model power consumption by a complex based on the constructed causal model. We defined energy consumers at a crushing and enrichment complex, energy consumers – regulators and presented a characteristic of electric drives at an enrichment plant. A structure of integrated intelligent system is attached. It provides for the optimization of iron ore production in the periods of limited power supply from the energy system.

The system is integrated with the expert and operational subsystems and the management systems at the top level execution of business processes. The main task of expert and operating systems is the diagnosis of problematic situations, estimation of parameters of active, reactive powers and the prediction of output indicators of product quality. These innovations will enable the operating staff and the decision maker to receive in real time: predictive values of reactive, active values of capacity required to ensure planned indicators in production, predictive values of the trajectory in production. In the process of synthesis of control over power consumption by a crushing-enrichment complex, we defined a structure of artificial neural networks. During experimental research, we devised a procedure for training a neural network and the methods for learning. The scope of their application is separated in the system of coordinated situation management. A classification of production situations is established. We studied the modes of ball mills operation in the periods of limited power supply. A model for optimum loading of mills is presented. As a result of research, we developed: optimal setpoints for the exciters of ball mills' synchronous motors; production rules for the expert system to work out the fulfillment of planned production indicators over periods "peak", "half-peak", "night". The devised algorithms, intelligent systems of coordinated control over trajectories in power consumption and production have economic importance for enterprises in the mining-metallurgical sector of Ukraine. This is achieved by reducing specific electricity consumption by 5–7% from the indicators in 2013, decreasing the losses in production during periods of limited power supply by 3% from the indicators in 2013.

**Keywords:** electricity consumption, enrichment plants, ball mills, synchronous motors, exciters, adaptation, intelligentization.

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### EXAMINING THE ATTRIBUTES OF TRANSITIONS BETWEEN TEAM ROLES IN THE SOFTWARE DEVELOPMENT PROJECTS (p. 12-17)

**Vira Liubchenko**

Odessa National Polytechnic University, Odessa, Ukraine  
ORCID: <http://orcid.org/0000-0002-4611-7832>

**Iuliia Sulimova**

Odessa National Polytechnic University, Odessa, Ukraine  
ORCID: <http://orcid.org/0000-0001-5697-4988>

In project management, efficiency of team performance is often associated with the balance in terms of its team roles. All explanations, however, as well as conclusions that relate to balancing a project team, were obtained verbally and are not confirmed either theoretically or empirically. Therefore, it is appropriate to examine the transitions between team roles based on mathematical modeling.

To understand regularities in the transitions of team members between team roles, we constructed a transition model based on the discrete Markov chain and defined parameters of the model. Using the simulation, we performed the study and demonstrated that it is natural for a software development project team to balance the team roles. This attribute does not depend on the initial composition of the team in terms of team roles. A difference in initial conditions only affects the rate of change in the probabilities of individual team roles, but the attribute of reducing the difference between the values of probabilities of individual team roles persists.

The results obtained confirm that by helping some team members to take on secondary roles to prevent the duplication of roles or to resolve certain problems, a project manager may influence the balancing of team in terms of team roles.

**Keywords:** project management, project team formation, Belbin team roles, Markov chains.

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### A STUDY OF THE TECHNOLOGICAL RELIABILITY OF RAILWAY STATIONS BY AN EXAMPLE OF TRANSIT TRAINS PROCESSING (p. 18-24)

**Viacheslav Matsiuk**

State Economy and Technology  
University of Transport, Kyiv, Ukraine  
ORCID: <http://orcid.org/0000-0003-2355-2564>

The study reveals an influence of the main technological parameters on the probability of failing and uptime work to receive and dispatch transit cargo trains in time. The determined regularities concern failures resulting from changes in the daily load, the technological equipment of transit depots, and uneven sizes of arriving and departing flows of trains. The importance of the research is grounded on a lack of objective assessment of the reliability of a standard operational model of processes that take place at maintenance depots for railway transport, which means that it is essential to determine the probability of failure of timely receipt and dispatch of cargo trains.

The level of failure and the trouble-free uptime are mainly affected by the size of the operational fleet of train locomotives, the uneven number of daily trains, and the minimal pre-set intervals of associated arrivals and departures of trains.

The research has established that the existing standards ensure the required level of reliability (the probability of a timely acceptance of trains at 95 %). However, the time of trains' staying on receiving and departure tracks exceeds the norm almost 4 times, which minimizes the likelihood of timely departures of trains. The probability of failure in timely departures is not taken into account by the current regulations; therefore, it is suggested that such a standard should be introduced.

The undertaken tests facilitate objective evaluation of the reliability of the typical technological processes that take place at technical railway stations and entail the need to review the methods of its rationing.

**Keywords:** technological reliability, failure probability, reliability, timely arrival, timely departure, technological conflict, inter-operational downtime, simulation modelling.

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## DEVELOPING A SYSTEM FOR THE INITIATION OF PROJECTS USING A MARKOV CHAIN (p. 25-32)

**Viktor Gogunskii**

Odesa National Polytechnic University, Odesa, Ukraine  
ORCID: <http://orcid.org/0000-0002-9115-2346>

**Andrew Bochkovskii**

Odesa National Polytechnic University, Odesa, Ukraine  
ORCID: <http://orcid.org/0000-0002-4166-3148>

**Andrii Moskaliuk**

Odesa National Polytechnic University, Odesa, Ukraine  
ORCID: <http://orcid.org/0000-0003-0970-6280>

**Olexii Kolesnikov**

Odesa National Polytechnic University, Odesa, Ukraine  
ORCID: <http://orcid.org/0000-0003-2366-1920>

**Serhii Babiuk**

Odesa National Polytechnic University, Odesa, Ukraine  
ORCID: <http://orcid.org/0000-0003-4681-9532>

We performed an analysis of the peculiarities and the generalization of assessing the degree of perfection in the production systems for the development of information-management system of the evaluation and initiation of projects using a Markov chain. A hypothesis was put forward and confirmed on that the degree of perfection of a production system can be represented by using a generalized indicator of system quality, which corresponds to the level of existing risk.

A model is proposed to assess the level of perfection of organizational-technical system, which includes four discrete states that correspond to the risk level ratings in the system: R1 – low risk, R2 – medium risk, R3 – high risk, R4 – extreme risk. A phenomenological reflection of the risk is a Markov chain. To construct a Markov model, we identified possible transitions in the risk degree assessments as the states of the production system. We devised a method for the identification of a Markov model by determining experimentally a matrix of transition probabilities based on data on questionnaire survey of the employees. It is proved that the size of minimal sample for a survey does not exceed 90 questionnaires for the assigned level of reliability  $pd=0.95$  – in this case, error in the values of transition probabilities will not exceed 0.75 %.

A structure of the information-management system is proposed to control the process of project initiation, in which Markov model is an element of the control loop. The key process that creates preconditions for the practical implementation of information-management system is to determine transition probabilities in the Markov chain through the technique of questionnaire survey.

We examined practical aspects of the initiation and implementation of projects under conditions of acting enterprise. Results in the coordinates of estimates of the degree of risk during the year of the study demonstrated significant improvement in the evaluation by personnel of the activities that addressed labor safety. This improvement occurred due to a decreased share of workers who assessed risk as high (from 28.6 % to 22.2 %) and those who evaluated risk as extreme (from 22.4 % to 10.1 %). Judging by these data, the implemented projects can be considered successful.

**Keywords:** project initiation, labor safety, degree of perfection, risk, assessment, Markov chains.

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**THE EFFECT OF METHODS OF ELIMINATING SPIKES IN THE TIME SERIES OF FREIGHT FLOWS ON THEIR STATISTICAL CHARACTERISTICS (p. 33-39)**

**Sergey Gritsay**

Zaporozhye National Technical University, Zaporizhzhia, Ukraine  
ORCID: <http://orcid.org/0000-0001-7055-6977>

**Alexandr Lashchenykh**

Zaporozhye National Technical University, Zaporizhzhia, Ukraine  
ORCID: <http://orcid.org/0000-0003-3568-4353>

**Serhii Turpak**

Zaporozhye National Technical University, Zaporizhzhia, Ukraine  
ORCID: <http://orcid.org/0000-0003-3200-8448>

**Elena Ostrogyad**

Zaporozhye National Technical University, Zaporizhzhia, Ukraine  
ORCID: <http://orcid.org/0000-0002-8496-3271>

**Tamara Kharchenko**

Zaporozhye National Technical University, Zaporizhzhia, Ukraine  
ORCID: <http://orcid.org/0000-0002-9774-393X>

Types of the data aggregate spikes of the time series were analyzed taking as an example the incoming freight flows at the industrial enterprise. Effect of the method of correction of abnormal series levels on its quantitative characteristics and the trend component was established. The ranges of deviation from the mean value of actual data were determined. Decrease in dispersion for one-step correction up to 20 % and up to 99 % for iterative correction was determined. It was established that the degree of correlation of the time series levels weakly reacts to the method of correction of abnormal values. Methods of elimination of the trend and cyclic components by iterative correction of abnormal observations by means of different estimators were considered. As a result of partial robust processing of abnormal values, an updated time series was obtained/ This time series can be used further for modeling and predicting indicators studied for different systems. It was established that the remaining parts of the deterministic actual series accumulate in themselves about 75 % of dispersion of the actual series for one-step correction and 54 % for iterative correction. On average, 6 % of the actual series dispersion is the share of the trend for all methods of correction (except VOS and MO).

**Keywords:** freight flow, time series, statistical characteristics, abnormal spikes, trend, supply volume.

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#### CREATING A QUALIMETRIC CRITERION FOR THE GENERALIZED LEVEL OF VEHICLE (p. 39-45)

**Sergii Panchenko**

Ukrainian State University of Railway Transport, Kharkiv, Ukraine  
ORCID: <http://orcid.org/0000-0002-7626-9933>

**Oleksander Lavrukhin**

Ukrainian State University of Railway Transport, Kharkiv, Ukraine  
ORCID: <http://orcid.org/0000-0003-1302-4960>

**Olga Shapatina**

Ukrainian State University of Railway Transport, Kharkiv, Ukraine  
ORCID: <http://orcid.org/0000-0002-9185-6212>

A comprehensive qualimetric criterion for determining the generalized level of a vehicle, which was obtained by the method of dimensionality analysis, was proposed. It was determined that the components of this criterion are controversial, so when choosing a technology for cargo transportation, it is necessary to consider the importance of one or another component of the criterion at a specific moment of time when making a decision.

Optimal quantity, coverage range and load-carrying capacity are assessed based on the characteristics of vehicles. The integrated qualimetric level of a vehicle is determined, taking into account the level of reduction in unproductive time cost and costs of maintaining a vehicle over its lifecycle and its level of competitiveness.

The proposed qualimetric criterion has a major advantage over the existing ones; it has a systemic character, takes into account a complexity of indicators of the level of vehicle, which have an impact on the transportation effectiveness. The proposed qualimetric criteria may be used both to increase efficiency of interaction between automobile and railway transport and for other types of transport because of its integrated nature and due to the fact that graphic dependences provide significant possibilities for visualization.

The procedure of integrated assessment of vehicle was implemented in the form of nomographs, which comprehensively evaluate characteristics of vehicles for various transportation options. For the railway transportation, we obtained  $Z=1215 \cdot 10^{12}$  tran; for the bimodal transportation,  $Z=6075 \cdot 10^{12}$  tran; and for the road trans-

portation,  $Z=506.25 \cdot 10^{12}$  tran, which demonstrates the prospects for cargo transportation by bimodal transport.

**Keywords:** qualimetric criterion of the generalized level of vehicle, method of dimensionality analysis, bimodal transportation.

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**DEVELOPING GENDER MATURITY MODELS OF PROJECT AND PROGRAM MANAGEMENT SYSTEM (p. 46-55)**

**Tetiana Fesenko**

Luhansk National Agrarian University, Kharkiv, Ukraine  
ORCID: <http://orcid.org/0000-0001-9636-9598>

**G. Fesenko**

O. M. Beketov National University of Urban Economy in Kharkiv, Kharkiv, Ukraine  
ORCID: <http://orcid.org/0000-0001-7133-484X>

Conceptual approaches to the formation of gender sensitivity of the project and program management system are analyzed according to global gender equality principles in business (Gender Equality Principles, GEP). The organizational and structural specificity of integrating gender components was identified and their relational impact on the level of organizational maturity of project management of companies was highlighted.

The conceptual model of integrating gender components in the architecture of the organizational capacity of companies was offered in the context of the mission, strategic planning; structure and management style; adaptability; partnership and cooperation; role in the sector; provision of services; financial viability and resource mobilization.

Gender maturity assessment model was developed on the platform of the project management maturity model (PMMM). The need to use gender mainstreaming technology to improve organizational maturity, including at the level of “benchmarking” is emphasized. The gender maturity assessment model of organizational processes was developed as a result of integration of two dimensions: organizational capacity (seven system blocks) and gender sensitivity (five principles) of companies. It is noted that the responsibility for centralized coordination of integration of gender mainstreaming in the project and program management is assigned to Gender-responsible Project Management Office (G-PMO).

Cognitive causal model of gender maturity of the project and program management system was proposed based on the principles of gender equality and maturity model of project management. The stages of gender maturity of the project management system were outlined: (“knowledge of gender terminology”, “mastering specific techniques and tools by the project team”, “gender mainstreaming technologies integration into a single project and program management system”, “gender mainstreaming technologies benchmarking”, “achieving more gender-sensitive values of projects and programs”. The proposed assessment tool can be used to measure the gender maturity of both a separate unit, and the organization as a whole.

**Keywords:** gender mainstreaming, management maturity, gender maturity of the organization, organizational capacity, gender responsibility.

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**DEVISING A METHOD FOR THE AUTOMATED CALCULATION OF TRAIN FORMATION PLAN BY EMPLOYING GENETIC ALGORITHMS (p. 55-61)**

**Tetiana Butko**

Ukrainian State University of Railway Transport, Kharkiv, Ukraine  
ORCID: <http://orcid.org/0000-0002-6707-4552>

**Viktor Prokhorov**

Ukrainian State University of Railway Transport, Kharkiv, Ukraine  
ORCID: <http://orcid.org/0000-0001-8963-6467>

**Denys Chekhunov**

Ukrainian State University of Railway Transport, Kharkiv, Ukraine  
ORCID: <http://orcid.org/0000-0002-1570-6351>

We devised a method for calculating the plan of formation of single-group freight trains, which is based on the use of genetic algorithms as the optimization method. Development of the method is predetermined by the need to improve accuracy in calculations and quality of making management decisions in the area of organization of railcar traffic under modern conditions. A mathematical model is constructed that uses accumulation parameters as stochastic variables. This will make it possible to find the most rational variant of the plan for train formation. The simulation we performed demonstrated effectiveness of the method devised. The method developed demonstrated improved accuracy of about 3 per cent relative to the classical analytical methods. The method makes it possible to consider the limitations on the throughput and processing capacity of technical stations and throughput capacity of the sections. This method uses parameters of accumulation as stochastic variable that makes it possible to find a more efficient variant of the plan for train formation. These capabilities allow us to consider a possibility of applying this method as a basis for building an integrated automated system for managing railcar traffic, which will bring together the tasks of strategic and operational planning at the new qualitative level. Creating such a system, in turn, might provide opportunities for strengthening the systems effect, reducing downtime of railcars, increasing profitability and competitiveness of freight rail transport.

**Keywords:** plan of train formation, accumulation parameter, stochastic-combinatorial optimization, genetic algorithm.

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