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ABSTRACTS

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Session 1

Transport Systems

OPTIMAL RELIABILITY DESIGN OF TRANSPORTATION NETWORK

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Keywords: Network Monte Carlo, Birnbaum importance measure, gradient function, network design, link failure, earthquakes, s-t network reliability

In this paper we consider optimal reinforcement problem of a transportation network. We mean by that network reliability improvement achieved by reinforcement of a certain number of its most important links (road segments), which are subject to failure (destruction). This reinforcement is made given a budgetary constraint, and its goal is to maximize the global network performance index, which depends on the source-terminal reliability of a fixed set of origin-destination routes.

The central role in the proposed optimisation is played by a combinatorial Monte-Carlo algorithm for estimating the network s - t reliability gradient vector and the network links importance measures. The proposed optimisation method is illustrated by an example described in literature of a road network having 30 links, 20 nodes and five origin-destination pairs. The link failures are caused by natural disasters like earthquakes, and link e reinforcement means its replacement for a cost $c(e)$ by an absolutely reliable one.

PROVIDENCES AND PROJECTIONS ON THE PROGNOSTICATION OF RAILWAY TRANSPORT FLOWS FOR LONG-TERM PERSPECTIVE

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Keywords: railway freights volume, transport flows, DGP projections, providences of the economic development, influence of internal and external factors, forecast of macroeconomic indicators.

Seeking to carry out long-term forecasts of railway freight volumes, it is necessary to perform the analysis of the process of freight activity and to form projections on perspectives of the internal market and effects of external factors. Since the economic crisis still has main influence on the economical context of whole country, neither national long-term economics development strategy nor providences on the perspective development of social sphere are being prepared. The Gross Domestic Product (GDP) is one of the most important macroeconomic indicators used in assessing the level of national development. This indicator is also being used in forecasting flows of freight volumes of Lithuanian railway transport [7].

Assumption of the recovery of national economy in Lithuania and other Baltic states are related to global and international economical expressions. The recovery of national economy is possible only with the boom of global economy including the recovery of main export partners – European Union countries, Russia, Belarus, Ukraine, Kazakhstan and other remote countries, international trade partners. Other necessary assumption is the recovery of the competitiveness of national economy [1,2,6]. For this purpose the reduction of manufacture costs and production price is required. Unfortunately it is related to the decrease of wages and real income per household member. The latter may even lead to the deflation.

Accomplished analysis of projections and providences of main official macroeconomic indicators allows expecting possible recovery of national economy and the end of critical situation during 2010-2011. However positive changes of socio-economic indicators are forecasted to be slower and results will be expected later.

Lithuanian Railway Company has sufficient potential to transport growing flows of freights by main transport corridors of European significance on the territory of Lithuania. Main railway freight transportations are connected to cargoes load activities of Klaipeda State Seaport and Kaliningrad commercial seaport, which is often used to export and import the materials and persistent production of Lithuanian industrial enterprises. Therefore local contribution to internal carriages is becoming more important: local industrialists are exporting larger amounts of production to foreign countries [4,5].

Special attention is paid to the problem of passenger transportation. Linger socio-economic crisis is the main barrier to forecast macroeconomic indicators and to form projections even on short-term perspectives. Since the tendency of the decrease of passenger transportation asserted before the crisis it was necessary to accomplish researches of quality changes, to forecast the proportion of carried passengers by road public transport and cars [3,4].

Increased popularity of road public transport and cars offering better travelling comfort, travelling in higher speeds, greater mobility, transportation “from door to door” created serious competitiveness to the services of railway transport despite of lower travelling prices. Therefore the forecast of railway passenger transportation for 30 year perspective is a difficult task. Positive results can be achieved improving passenger route transportation, creating new services, installing new ticketing systems, coordinating railway transport and city bus traffic or services of other transport modes.

References

1. Ministry of Transport and Communications of the Republic of Lithuania, VGTU TMI 2004. *Long-Term (until 2025) Development Strategy of the Lithuanian Transport System. Approved by Resolution No 692 of the Government of the Republic of Lithuania of 23 June 2005.*
2. European Commission. 2007. COM (2007) 608. *Towards a rail network giving priority to freight.*
3. Transport science institute under VGTU. 2008. *Recommendations for the guidelines of Long-term (until 2030) Development Strategy of Lithuanian Transport Systems. Working – paper.*
4. SC “Lithuanian railways”. 2008. *The Lithuanian Railways long-range Strategy for 2008-2030.* 114 p.
5. SC “Lithuanian railways”. 2005. *Corporate Action Plan 2006-2008.* p.4.
6. Transport Investment Directorate under the Ministry of Transport and Communications of the Republic of Lithuania. 2004. *Lithuanian Strategic National Rail Transport Development Plan for 2005–2015. Final draft.* p.121.
7. VGTU. 2010. *The forecast of volumes of goods and passengers transportation by Lithuanian railways to 2040.*

THE THEORY AND PRACTICE OF INCREASING THE ROAD TRAFFIC SAFETY IN ACCIDENT SITES BY METHODS AND MEANS OF THE ROAD TRAFFIC ORGANIZATION

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Keywords: losses in road traffic, methodology of accident forecasting, accident losses, forecasting methods

One of the main reasons of high accident rate in cities is the absence of an appropriate methodology of increasing the traffic safety in urban accident sites. About 50 % of all accidents in the country occur there. It is necessary and possible to create such a methodology where all basic threats in road traffic would be considered equally. For its realization it is necessary to create scientifically-methodical system of increasing the safety in urban accident sites. In the context of this methodology it is necessary to develop a high-precision method of accident forecasting on the conflict objects that allows receiving the forecast at the decision-making section in the road traffic organization. It is also necessary to work out an accident analysis technique in urban accident sites, a technique of definition of the calculated social and economic accident cost, calculation techniques of accident rate forecasting and accident losses on typical objects; calculation techniques of economic and ecological losses at speed control bumps. It is also important to develop the complex of accident forecasting computer programs, the complex of losses calculation in road traffic and optimisation (by criterion of total losses minimization) of accepted decisions on the road traffic organization on typical urban objects.

It is proved that the existing methods are unsuitable for accident forecasting at urban conflict objects at the decision-making section (it is necessary for optimisation of the last). The method of "Conflict Areas" is exception. It is characterized however by the low accuracy of the forecast that is insufficient for practical works on road traffic organization.

There is a problem of choice of estimating criteria for road traffic quality. The private criteria estimating the different aspects of the basic road traffic properties (crash, economic, ecological, social) are not interconnected themselves and cannot estimate road traffic quality as a whole. Today thereto only two complex estimated criteria really can be applied – "the grade of service" giving quality estimation (reference to this or that level), and "losses in road traffic" giving quantitative (monetary) estimation. Both criteria have the advantages and disadvantages and require further perfection and possible unification.

The activity on the increase of traffic safety relatively can be divided into 4 sections: reception of the initial data; determination of reasons for accident, search making of decisions on their elimination; estimation of efficiency and optimisation of the accepted decisions; development and introduction of measures.

In the system under research the following expenses are considered: crash costs – all accidents with and without victims; economic costs – delays, stops, transport overrun and fuel over-expenditure, delays and pedestrian overrun; ecological costs – the ones exceeding the minimum possible level of harmful substances emissions in atmosphere and noise of transport. For the calculation of losses according to the choice and optimisation of the accepted decisions is made. It is necessary to be able to calculate (predict) all considered costs and to have sufficient and qualitative initial data. However, getting the initial data is rather time-consuming, expensive and not highly precise because of almost total automation absence and corresponding equipment. The definition of accident reasons and decision-making on their elimination is made by the technique of focal analysis, developed within the

framework of the researches. After the decision is accepted, the estimation of its efficiency is made including the calculation of economic, ecological and crash losses by means of the methods worked out. At that, for the creation of crash losses calculating procedure it was required to develop a new more exact accident forecasting method of "Conflict Zones", individual accident forecasting techniques on the method of "Conflict Zones" at signalised intersections and at speed control bumps and technique of calculating the cost of accidents in the Republic of Belarus. After the estimation of the decision efficiency its optimisation is made by the criterion of total losses minimization using the developed computer programs of losses calculation and of made decisions optimisation for signalised intersections and speed control bumps.

The initial data for analysis and accident forecasting, calculation of losses and for optimisation of decisions can be divided into 5 groups: accident statistics; geometrical characteristics; regulation and provision of the necessary facilities; road conditions; transport and pedestrian load. The list of the necessary initial data, requirements and ways of obtaining at least some of them, and also separate reference data are given.

A special technique of accident focal analysis in urban areas is developed. It includes the detection of sites (the places of concentration not less than 3 accidents per year), the estimation of the total seriousness of consequences by a modified technique, the preliminary determination of reasons using the worked out list of the typical reasons, obligatory natural investigation of accident site by a special technique, final determination of reasons after natural investigation and search (choice) of decisions to eliminate the accident reasons using the developed list of typical suggestions where the preliminary crash, economic and ecological efficiency is shown. For these purposes researches on adaptation to urban conditions of the Republic of Belarus of the statistical method of accident forecasting have been carried out in the part concerning speed control bumps, as the statistical information available is very inconsistent and coefficients of decreasing the accidents differ up to 3 times.

Results of practical application of the developed methodology on an example of a concrete site to the main street in Minsk are showed in the article. Thus, it is possible to state that the developed methodology of increasing the traffic safety in the accident sites allows carrying out the total complex of the problems on the choice of the optimal decision directed to the improvement of road traffic quality, as a cumulative attribute (taking into account equation of crash, ecological and economic losses).

THE URBAN PUBLIC TRANSPORT SYSTEM QUALITY INDICATOR FOR EUROPEAN CITIES

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Keywords: public transport, quality, composite indicator, weights, missing data, imputation

The research deals with the possibility of developing the composite indicator characterising the urban system of public transport (urban public transport quality indicator – UPTQI). The algorithm described in [1] has been used for developing of the composite indicator. The composite indicator is a linear function from sub-indicators and weights associated with sub-indicators [2].

In research the special accent is made on a choice of a missing data imputation method in an initial data set. It is not possible to make the unequivocal recommendation for use concrete method in the presence of a large number of offered methods. In many respects it depends on the initial data.

The initial data concerning the cities of Europe were taken from Eurostat database [3]. The following sub-indicators for 2006 have been used for constructing the UPTQI:

- Proportion of journeys to work by public transport (rail, metro, bus, tram);
- Length of public transport network/land area;
- Number of stops of public transport per km²;
- Cost of a monthly ticket for public transport (for 5-10 km);
- Number of stops of public transport per 1000 population;
- Number of stops per 1 km of public transport network;
- Proportion of public transport network on fixed infrastructure/Proportion of public transport network on flexible routes;
- Proportion of the area used for transport (road, rail, air, ports).

The research was divided into three stages. *First*, some variants of the algorithm OECD realisation of the composite indicator developing [1] have been applied to the data of 37 German cities (without missing data). *Second*, artificial missing data was introduced, and investigated the influence of the 3 selected methods of missed data substitution (unconditional mean imputation, imputation by median and clustering-based imputation) upon the results of composite indicator calculation. *Third*, the cities with the missing data have been added (in total 62 European cities). The method, which is chosen as the best for this problem, during the second stage has been used to the missing data imputation. To calculate the weights and to aggregate the same variants of algorithm, as at the first stage were used. The results of UPTQI constructing were analysed for uniformity (on the basis of consideration of ranks of cities with the full information).

References

1. Nardo, M. Handbook on Constructing Composite Indicators: Methodology and User Guide, *OECD Statistics Working Papers*, No 3, 2005, OECD Publishing.
2. Pticina, I., Yatskiv, I. Constructing the urban public transport system quality indicator. In: *Proceedings of the 1st International Conference on Road and Rail Infrastructure (CETRA 2010), May 17-18, 2010, Opatija, Croatia*. Opatija, 2010, pp. 223-229.
3. Statistical Office of the European Communities – EUROSTAT, <http://epp.eurostat.ec.europa.eu>

ANALYSIS OF POSSIBILITIES FOR IMPLEMENTATION OF INTEGRATED TRANSPORT SYSTEMS IN THE CONDITIONS OF SLOVAK REPUBLIC

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Keywords: integrated transport system, public passenger transport, tariff system

The integrated transport systems are the solution of decreasing utilization of public passenger transport in many cities and areas around the cities not only in the countries of European Union. The statistics numbers about using the public passenger transport in Slovakia have the decreasing tendency in last the 10-15 years.

There were performed some experiments to create the integrated transport systems in Slovakia but they had not been developed anymore. The presented article will analyse the conditions for implementing the integrated transport systems in Slovakia. It will point out the key elements in creation of integrated transport system to be attractive for passengers and to be advantageous to the transporters and give the suggestions for solutions.

DYNAMIC VEHICLE FLEET MANAGEMENT IN DISCRETE TRANSPORT SYSTEMS

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Keywords: discrete transport system, reliability, Monte-Carlo simulation, fleet management algorithms, dispatching system

The paper describes a novel approach to analysis of management algorithms in discrete transport systems (DTS). The DTS is a simplified case of the Polish Post. The proposed method is based on modelling and simulating of the system behaviour. The income of mails into the system, or rather containers of mails is modelled by a stochastic process. Each container has a source and destination address. The central node is the destination address for all containers generated in the ordinary nodes. Where containers addressed to any ordinary nodes are generated in the central node. The generation of containers is described by some random process. In case of central node, there are separate processes for each ordinary node. Whereas, for ordinary nodes there is one process, since commodities are transported from ordinary nodes to the central node or in the opposite direction.

The containers are transported by vehicles. Each vehicle has a given capacity – maximum number of containers it can haul. Central node is a base place for all vehicles. They start from the central node and the central node is the destination of their travel. The vehicle hauling a commodity is always fully loaded or taking the last part of the commodity if it is less than its capacity. Vehicles operate according to the time-table. The time-table consists of a set of routes (sequence of nodes starting and ending in the central node, times of leaving each node in the route and the recommended size of a vehicle). The number of used vehicle and the capacity of vehicles do not depend on temporary situation described by number of transportation tasks or by the task amount, for example. It means that it is possible to realize the route by completely empty vehicle or the vehicle cannot load the available amount of commodity (the vehicle is too small). Time-table is a fixed element of the system in observable time horizon, but it is possible to use different time-tables for different seasons or months of the year.

We propose to change time-table based management system by dynamic algorithms. In all cases the decisions (send a truck to a given destination node) are taken in moments when a container arrives to the central node. First algorithm, a heuristic decision one, sends a truck to a trip if:

- the number of containers waiting in for delivery in the central node of the same destination address as that just arrived is larger than a given number,
- there is at least one available vehicle.

The truck is sent to a node defined by destination address of just arrived container. If there is more than one vehicle available in the central node, the vehicle with size that fits the best to the number of available containers is selected, i.e. the largest vehicle that could be fully loaded. If there are several trucks with the same capacity available the selection is done randomly. The Second management algorithm is based on artificial neural networks. The neural management system consists of a multi-layer perception to decide if and where to send trucks. The input to the neural network consists of numbers of containers waiting for delivery in central node to each ordinary node and the number of free vehicles in the central node.

The paper gives numerical results of simulation experiments. The results allow comparing mentioned above fleet management algorithms in different case studies.

ADAPTIVE TRAFFIC CONTROL

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Keywords: traffic light, controlled intersection, arterial movement, adaptive algorithm, traffic control, decision tree, prediction, platoon

Off-line systems are not flexible enough and the current state of urban streets, which are saturated with traffic, requires more effective solutions. Therefore, further discussion focuses on adaptive systems.

If the intersecting platoons fit exactly within the red-times, then it is not necessary to resolve green-time demand of conflicting movements. On the other hand, if flows at an intersection produced a concurrent green-time demand for conflicting movements, then the conflict must be resolved by determining to which movement the green-time must be allocated.

Two platoons demanding conflicting movements may arrive at an intersection at the same time. In that case one will be given priority on the green-time, or one of the platoons will be split to maximize the given measure of performance. Optimally resolving such conflicts in real time is the main objective of the algorithm presented.

The method makes a forward pass in time. When a conflict arises a decision node in a tree is formed; the types of decisions at this node include: (a) give green time to Platoon A, (b) give green time to platoon B, or (c) split Platoon A (or Platoon B, because only one or the other platoon needs to be split). Each branch of the tree is propagated over time to keep track of the total performance up to the decision node plus the performance on the link associated with the potential decision. An implicit approximation is used on the additive nature of the performance measure to propagate from node to node in the decision tree.

When the time horizon is reached (200-300c), associated with each end node will be the total cost of the all the decisions leading up to the node on the path from the root of the decision tree to the end node (leaf) of the decision tree. Selecting the one with minimum cost provides the least cost trajectory of conflict resolution decisions. A final backward pass provides a phase plan within the time horizon considered for the identified platoons. This is passed to the local level of the hierarchical traffic control system (intersection control logic) as constraints (and, hence, an initial cut at a sequence of phases) that specify the "winning phase" from the outcome of each conflict resolution on the optimal root-to-leaf path in the decision tree. Further optimisation is performed at the intersection level, at which more detailed data on individual vehicle movement are gathered. The path with optimum performance is chosen (in this case minimum total delay). The resulting optimal decisions from the decision tree include the red and green times for the arterial.

The advantages of the algorithm approach include as follows:

1. Using real-time data, the algorithm explicitly identifies the platoons and predicts their movement in the network; the method also sets traffic signals to respond to the identified platoons.

2. The method does not necessarily require a predetermined sequence of phases. The output provides an initial cut at a sequence of phases for further optimisation at the lower intersection level.

A final issue that needs to be resolved in the method is the computation of performance measures, (e.g. the total number of stops, total delay, etc.). For real-time applications, these performance measures are needed quickly so that the performance criterion may be optimized in

real time. A detailed simulation becomes computationally unwieldy when the simulation model is used as a function evaluator (i.e., for evaluating the performance function for each candidate signal setting) in an optimisation routine. To be in the proper range for the optimisations being performed at the intersection level, only approximate values for optimal signal timings are necessary at this second level of hierarchy.

The method procedure for network flow control exploits the availability of real-time traffic data to control vehicular traffic through an arterial to optimise a given performance measure. It is envisioned that this procedure will be suitable for light-to-moderate traffic conditions, but not over saturated conditions. The method should perform as well as or better than off-line methods such as PASSER II, MAXBAND, and TRANSYT. Further laboratory evaluation and testing of the method also are planned.

SURFACE PAVEMENT CHARACTERISTICS AND ACCIDENT RATE

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Keywords: accident rate, operating ability of the pavement, technical condition of the pavement, mutative pavement characteristic

Accident rate has three main reasons. The main reason is of course the ability of the driver. The second reason is the technical condition of the vehicle. The third reason is the technical condition of the pavement. These are three main reasons with influence on accident rate and the given study is focused on the mentioned theme. The authors analyse the technical characteristics of the pavement especially mutative of them and analyse its influence on accident occurrence.

Non mutative pavement characteristics are on constant level during the lifetime of the pavement and traffic loading has minimal influence on its rate or quality. On the other side the mutative pavement characteristics are directly proportional on the influences like traffic loading, climate condition, pavement construction, etc.

To ensure the suitable rate of mutative pavement characteristic (road-traffic safety depend on its) we use the Pavement management system (PMS). PMS is the effective tool for maintenance and repair works cost optimising from the view of road network in Slovakia. This toll based on diagnostics and evaluation of the technical mutative pavement characteristics is useable all over the world. This system (PMS) allow the road administrator to evaluate the economic effectiveness of the designed maintenance and repair works for each road section selected to investment . The economic effectiveness evaluation of all selected road section allows the road administrator to make a road section rank from the view of economic results of the prepared investment to maintenance or repairing work of the road pavement. The next output is the optimal year of the maintenance or repair calculation. It is year when the benefits in compare to costs are on the best level.

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QUALITY OF RAIL FREIGHT TRANSPORT

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Keywords: rail transport, quality services, standards

The rail transportation management control and key performance indicators are necessary for the effective and efficient management of customer's cargo throughout the transport process.

The purpose of the current article is to give a partial overview about the quality management of cargo transportation by rail. The customers of rail transport are not fully satisfied with quality of the service. Use of the Quality contracts along the transportation route should be further developed. Service providers must carry out regular self assessment of performance against defined criteria of service with the objective of continually improving the quality of services provided and is prepared in a manner which facilitates independent audit of the service provider's performance in order to give confidence to customers that the integrity of performance measurement is maintained. Most sensitive service quality parameters and indicators for freight quality are information, rolling stock, reliability and punctuality.

References

1. Communication from the Commission to the Council and the European Parliament “The quality of rail freight services”. 08 09 2008.
2. Directive 2007/58/EC of the European Parliament and of the Council amending Council Directive 91/440/EEC on the development of the Community's railways and Directive 2001/14/EC on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure. 23 10 2007.
3. Communication from the Commission to the Council and the European Parliament “Towards a rail network giving priority to freight”. 18 10 2007.
4. Situation and Perspectives of the Rail Market TREN/R1/350-2008 Lot 2. Final Report. Price Waterhouse Coopers, the University of Leeds, NEA, Significance. 2010.
5. EAST WEST Transport Corridor Strategy and Action Plan. Interreg IIIB 2005-2007.
6. Freight Quality Charter – 2003 CER-UIC – CIT.
7. Joint Declaration on “Quality in international conventional and combined railway freight traffic”. UIC/CER and FIATA/CLECAT. 15 04 2005.
8. Guidelines for the development and implementation of quality agreements for specific trainloads in international conventional rail freight traffic. FIATA, UIC and CIT. 2006.
9. WHITE PAPER European transport policy for 2010: time to decide. EC. 2001.

EVALUATING THE OPERATIONAL RELIABILITY OF ROAD VEHICLES

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Keywords: evaluation, operational reliability, road vehicles, software, Excel

Reliability is a term that has undergone a long development. It has various interpretations and it is used with many different connotations. In the last decades the research in the theory of reliability has been intensified and new methods of analysis of reliability, new computational models, methods of reliability test as well as other tools enabling to deliberately influence reliability have been developed. Many analytical methods are described in European norms and they are used in the phase of development of a product or system.

Evaluation of operational reliability is more complicated. The operational reliability takes into account operational conditions. It can be specified by evaluating the operational data gained during the operation of the object. In the area of operation of road vehicles, it is possible to evaluate records of failures, repairs, maintenance, operation costs, etc. These are stored in an information system or in another digital evidence system and are usable for operation reliability evaluation. The operational data can be also used to prognosticate the development of some reliability parameters.

Most of SMEs in the area of transport do not use special software for the monitoring and evaluating of the operational reliability of road vehicles. This article refers to the possibility to acquire some variables of operation reliability from a commonly used Information Systems and to the possibility to create simple programming tool for decision-making and management support in the area of maintenance and replacement of road vehicles by means of common used office software. This paper briefly presents a simple software tool created by application of the theory of reliability and replacement of road vehicles. The software is created to evaluate some reliability parameters in the operation of road vehicle in an enterprise providing cargo transportation services. It was based on a research performed in three enterprises operating in the region of Žilina.

The system is based on a register of spare parts used and work done in maintenance and repairs of a road vehicle kept continuously in a database. Consequently, it offers an overview of some reliability variables displayed as tables or charts and it enables to check the logistics development trend for any component group or for the vehicle as a whole.

The software consists of a package of templates and books in MS Excel, named Evidence, Time, Cost and Replacement and a special program in Visual Basic named Prognosis.

It was generated by using the tools of the spreadsheet calculator MS Excel, especially pivot tables, charts and macro programming in Visual Basic for Applications.

The software is simple and user-friendly, with low hardware requirements and it is easily compatible with other platforms of business information systems or maintenance management systems. Thanks to these qualities, as well as its low cost, it is especially suitable for SMEs in the transport business that could find the purchase of a complex information system with an integrated support for the operation, maintenance and repairs of road vehicles beyond their needs and means.

THE SOLUTIONS OF VEHICLE TRAFFIC ORGANIZING PROBLEMS IN VILNIUS

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Keywords: traffic jams, traffic volume, communication system, automobilization level, control systems

The rise of economy and standard of living are crucial factors influencing the growth of transport mobility in different countries. The people transport mobility is persistent high still now.

As Vilnius is one of the main economic centres in Lithuania, balanced and well-developed communication system is necessary.

The number of transport means and the automobilization level guarantee transport mobility of citizens but, at the same time, increasing traffic volume creates traffic congestions, time-waste at the cross-roads, because the level of transport infrastructure does not grow such intensity as automobilization level. Therefore, it is very important to estimate general problems and to solve them after the analysis of communication system in Vilnius city.

References

1. Jarasuniene, A. The Importance of Development of new technological systems in Transport means. In: *Proceedings of International Conference "Transport Means". 28-29 October, 2004*. Kaunas: Technologija, 2004, pp. 233-236.
2. Jarašūnienė, A. Research into intelligent transport system (ITS) technologies and efficiency, *Transport*, Vol. XXII, No 2, 2007. pp. 61-69. ISSN 1648-4142. (Journal of Vilnius Gediminas Technical University, Lithuanian Academy of Science)
3. Button, J.K., Hensher, D.A. *Handbook of transport systems and traffic control*. Amsterdam: Pergamon, 2001. 602 p. ISBN 0080435955.
4. Slinn, M., Guest, P., Matthews, P. *Traffic engineering design: principles and practice*. London: Elsevier, 2005, p.208. ISBN 0750658657.

THE DYNAMIC MODEL IN TERMS OF THE EFFICIENCY MEASURES OF THE CARGO TRANSPORTATION PROCESS

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Keywords: transportation, dynamic model, efficiency measure

The study deals with the description of the dynamic model for the cargo transportation process. The model is represented by the set of mathematically related functionals that describe physical operations and actions with the cargo during the transportation process from the sender to the destination. For assessing the efficiency measures by specified conditions it is needed to describe every functional in terms of the taken measure, for instance, with respect to the reliability of delivery, speed of delivery, delivery time, etc. The described measures are not directly related to the cost parameters of the transport services.

Unfortunately, the description of every functional in the dynamic cargo transportation model in accordance with the specified direct measure is not always possible. But still the problem of objective and reliable assessment of the effectiveness of the transportation process is one of the most pressing and difficult. The solution of the problem makes possible to evaluate the efficiency of the cargo transportation process, as well as to optimise the entire process according to the selected measure.

In the work the description of dynamic model of the cargo transportation process in terms of the indirect measure of reliability of transportation, namely – “safe” travel time, as well as options for its use is offered.

QUANTIFICATION AND TREND OF TRANSPORT REQUIREMENTS BY TRANSPORT INDICATORS

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Keywords: transport, customer, mass public transport (MPT), methods

The main task to the managers in transport is preservation and expansion field of transport enterprise activity to transport market on the basic priority orientation to quality and customer, complexity of transport and application of the latest knowledge from research, and also contribute to achieve favourable economic indicators of enterprise activity by consideration of influence of changed environment.

The paper deals with customer requirements, possibilities of quantification of customer requirements and introduce of future trend on the base of assess of the reached results in last periods of time, the quantification and also by application of managers' knowledge and techniques.

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Session 2

Statistical Methods and Their Applications

THEORY OF MARKOV CHAINS AND SEMI-MARKOV PROCESS USING FOR RELIABILITY OF AIRCRAFT AND AIRLINE ESTIMATION

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Keywords: inspection program, Markov chains, reliability

Reliability of aircraft (AC) and airline (AL) operation is provided by implementation of specific inspection program, planning of which can be made using full-scale fatigue test data and Theory of Markov Chains (MC) and Semi-Markov process (SMP). The process of operation of aircraft is considered as absorbing MC with $(n+4)$ states. The states E_1, E_2, \dots, E_{n+1} correspond to AC operation in time intervals $[t_0, t_1), [t_1, t_2), \dots, [t_n, t_{SL})$, where n is an inspection number, t_{SL} is specified life (SL), i. e. AC retirement time. States E_{n+2}, E_{n+3} , and E_{n+4} are absorbing states: AC is discarded from service when the SL is reached or fatigue failure (FF) or fatigue crack detection (CD) take place. In corresponding matrix for operation process of AL the states E_{n+2}, E_{n+3} and E_{n+4} are not absorbing but correspond to return of MC to state E_1 (AL operation returns to first interval). In matrix of transition probabilities of AC, P_{AC} , there are three units in three last lines in diagonal (bias), but for corresponding lines in matrix for AL, P_{AL} , the units are in first column, corresponding to state E_1 . Using P_{AC} we can get the probability of FF of AC and cumulative distribution function, mean and variance of AC life and the same characteristics under condition of absorption in specific absorbing state. Using P_{AL} we can get the stationary probabilities of AL operation $\{\pi_1, \dots, \pi_{n+1}, \pi_{n+2}, \dots, \pi_{n+4}\}$. Here π_{n+3} defines the part of MC steps, when FF takes place and MC appears in state E_{n+3} . But if we need to know the number of FF in one time unit, i.e. the intensity of FF, λ_F , then we need to use theory of SMP with reward. In economic approach the gain of this process $g = \sum_{i=1}^{n+4} \pi_i g_i$, where $g_i = \begin{cases} a(n) \cdot u_i + b \cdot q_i + c \cdot v_i, & i = 1, \dots, n+1, \\ d, & i = n+2, \dots, n+4 \end{cases}$; u_i, q_i, v_i , $i = 1, \dots, n+1$, are probabilities of successful transitions from one to the following interval, to E_{n+3} and E_{n+4} states; $a(n) = a_1 t_{SL} / (n+1)$ is the reward, related with successful transitions from one operation interval to the following one (it is supposed that all interval are equal, a_1 defines reward of operation in one interval); b and c are the rewards related with transitions from any state E_1, \dots, E_{n+1} to state E_{n+3} (FF takes place) and E_{n+4} (CD takes place) correspondingly; $(-d)$ is the cost of acquisition of new AC after SL, FF or CD and transition to E_1 takes place. For $b = c = a(n)$, $a_1 = 1$ and $d = 0$ value g_i defines the mean time in E_i if time transition to state E_1 is equal to zero. Then $Q_j = \pi_j g_j / g$ defines the part of time which SMP spends in state E_j , $j = 1, \dots, n+1$; $L_j = g / \pi_j$ defines the mean return time for state E_j ; specifically, L_1 is a mean time of renewal of AL operation in first interval, L_{n+3} is a mean time between FF; the intensity of fatigue failure $\lambda_F = 1 / L_{n+3}$. The problem of inspection planning is the choice of the sequence $\{t_1, t_2, \dots, t_n, t_{SL}\}$ (in case of equal inspection interval and fixed t_{SL} , choice of n) corresponding to maximum of gain under limitation of AC failure probability (or intensity of fatigue failure). Minimax decision, based on observation of some fatigue crack during full-scale fatigue test of airframe, is offered for this problem solution. Numerical examples are given.

PATTERNS RECOGNITION BASED ON STRUCTURAL EQUATION MODELS IN MULTI-DIMENSIONAL DATA WAREHOUSE OF PSYCHOLOGICAL DATA

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Keywords: structural equation model, statistical databases, decision support system, knowledge representation, data warehouse, multidimensional pattern recognition

A numerous quantity of multi-dimensional data in data warehouses (DWHs) revealed some problems in the organization of data as well as in supporting data mining techniques for making precise decisions. Relevant patterns are not so easy to be extracted from a large DWH. The relational and multi-dimensional spaces of DWHs with a suitable approach and a large number of pre-computations can be used to represent the aggregation space of OLAP (On-Line Analytical Processing) models.

Our recent research work has proven the benefits of using conceptual modelling of data warehouses integrated with data mining techniques, based on linear equation methods. Data mining methods make progress from a simple discovery of frequent patterns and regularities toward knowledge-based and interactive decision support processes in subject-oriented and integrated data warehouses (DWHs). Distinct tasks require different data structures and various data mining exercises.

The proposed approach using Structural Equation modelling support repository analysis and pattern recognition processes. The multidimensional decision support system is integrated with data mining technologies of psychological profile data warehouses. Ensembles of diverse and accurate classifiers are constructed on the base of multidimensional classification methods and revealing sophisticated relations between variables of psychological data analysis, factor analysis.

The paper describes an approach to integration of some class of the linear equation models integrated with multiple statistical analysis and knowledge representation to recognize of information patterns in data warehouses. The introduced analysis methods allow us to practice control and forecast the main psychological tendencies as well as decision support in different prevention means. The application results are demonstrated by the criminal analysis of EU Accession Countries.

A DISCRETE CHOICE MODEL FOR A PREFERRED TRANSPORTATION MODE

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Keywords: discrete choice model, transportation, coaches, railways

The entry of Latvia in the common European market and the political integration of Latvia in the EU has forwarded qualitatively new requirements to passenger transportation – high mobility support, intermodality, passenger’s comfort and rights support, and also, new requirements to interaction of transport and environment. “Rīgas Starptautiskā Autoosta” being a leader in the area of passenger bus transportation services in Latvia provides the international, intercity and regional trips. Recent studies on the role of buses and coaches seem to confirm the already excellent safety, environmental and social record of bus and coach transport [1]. In Latvia this mode of transport is in competition with railway (and private cars also) in Latvia that’s why the management of factors, which influence on passengers’ choice, is very important from the all points of view [2].

In this research we constructed two discrete choice models [3,4] for predicting a preferred transportation mode for Riga-Daugavpils two-ways travels. The first model allows predicting the choice among using a car and using public transport, and the second model built for the choice among using a bus and using a train. Both models have a high percent of correctly classified cases (92.06% and 86.27%, respectively).

A discrete choice model predicts a decision made by an individual (such as mode or route choice.) as a function of any number of variables. In the research we investigated the influence of a wide range of factors to passenger’s choice, estimated their marginal effects. Discovered key factors and their influence directions can be used for improving the services of bus and railway carriers and stations.

References

1. Gromule, V., Yatskiv, I. Coach Terminal as an important element of transport infrastructure. International Scientific Conference “Transbaltica 2007”, Vilnius 11-12 April 2007, *Transport*, Vol. 22, No 3, 2007, pp. 200-206. (Vilnius: Technika)
2. Gromule, V., Jackiva, I. Information System Development for Riga Coach Terminal. In: *Proceedings of the Conference on System Science and Simulation in Engineering, Venice, Italy, November 21-23, 2007*. Venice, 2007, pp. 170-175.
3. Greene, W.H. *Econometric Analysis, fifth edition*. NJ: Prentice Hall, Upper Saddle River, 2003. 1024 p.
4. Ben-Akiva, M., Lerman, S. *Discrete Choice Analysis: Theory and Application to Travel Demand (Transportation Studies)*. Massachusetts: MIT Press, 1985. 384 p.

THE USE OF R ENVIRONMENT FOR THE STATISTICAL ANALYSIS AND THE CONSTRUCTION OF REGRESSION DEPENDENCES

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Keywords: R environment, regression analysis, kernel estimations

Now the significant amount of publications [1,2,3] about opportunities of language and software of R environment for the statistical analysis of data forces to pay to it the most steadfast attention. R environment is freely distributed according to license GNU, it is developed and accompanied by statisticians group, known as R Development Core Team [5]. In the given work the review of R users' opportunities is done. The initial organization of environment in which operators of language are carried out in the lines, from a command line, looks rather unusually. There are many publications [3] where updating environment the various routine operations are automated and graphic environments are offered. The brief review of such publications also is done in the present work.

The basic applicability of R environment is the realization of classical and modern statistical methods. Some of these means are built in basic set R, but many of them are delivered as packages using Comprehensive R Archive Network (CRAN) [6], – unique enough resource in the Internet. Now it is known more than 2400 packages delivered with R, which contain modern means of the decision of various statistical problems.

The problem of construction nonlinear regression dependences of variable Y from independent variable X remains as topical. On an example of this class of problems we show the opportunities of language means R, moreover we offer our own approach for the decision of similar problems. In this work the so-called kernel construction tools of nonlinear regresses [4] are discussed and their comparison with usual estimations of a method of the least squares is done. For realization of such kernel estimations the modern programs of environment R is used [4], which allow to choose the so-called “bandwich” – width of a window – value, which allows to receive regression kernel estimation in the “best” way. In the present work it is also demonstrated that in package R it is convenient to realize specific nonlinear regression models of binary type – logit and probit models.

The introduction of package R in practical work of engineers for forecasting various parameters and processing of every possible statistical data is rather expedient and effective.

References

1. Crawley, Michael J. *The R Book*. John Wiley & Sons, 2007. 939 p.
2. Dalgaard, P. *Introductory statistics with R*. New York: Springer, 2002. 267 p.
3. Heiberger, Richard M., Neuwirth, Erich. *R Through Excel*. New York: Springer, 2009. 340 p.
4. Racine, Jeff & Li. Nonparametric estimation of regression functions with both categorical and continuous data, *Journal of Econometrics, Elsevier*, Vol. 119(1), 2004, pp. 99-130.
5. R Development Core Team. *R: A language and environment for statistical computing. R Foundation for Statistical Computing*. Vienna, Austria, 2005. ISBN 3-900051-07-0, URL: <http://www.R-project.org>
6. <http://cran.r-project.org/>

POSSIBILITIES OF MMPP PROCESSES FOR BURSTY TRAFFIC ANALYSIS

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Keywords: Markov modulated Poisson process, anomalous events, bursty traffic

The modern sensor and storage technologies allow us to record and save increasingly detailed pictures of human behaviour. Examples include logs of user navigation and search on the Internet, RFID traces, security video archives, and loop sensor records of freeway traffic. These time-series often reflect the underlying hourly, daily, and weekly rhythms of natural human activity. At the same time, the time-series are often corrupted by events corresponding to bursty periods of unusual behaviour. Examples include anomalous bursts of activity on a network, large occasional meetings in a building, traffic accidents [1].

Markov modulated Poisson processes (MMPP), that are a subclass of the doubly stochastic Poisson processes described by J.Grandell (1976), can be used to model time-varying arrival rates and important correlations between interarrival times. Despite these abilities MMPPs are still tractable by analytical methods [2].

MMPPs are most frequently seen in queuing theory, but it has some interesting applications. For example, the MMPPs have been used by S.L.Scott and P.Smyth (2003) for analysis of Web surfing behaviour and by S.L.Scott (2002) for telephone network fraud detection [3].

In this paper we describe the possibilities of MMPPs to represent correlated streams and bursty traffic. The model using MMPP is constructed. The numerical results are received and analysed, the conclusions are drawn. The prospects of application of model using MMPP for such problems are estimated.

References

1. Ihler, A., Hutchins, J., Smyth, P. *Learning to Detect Events with Markov-Modulated Poisson Processes*. ACM Trans. Knowl. Discov. Data 1, 3, Article 13 (December 2007).
2. Bolch, G., Greiner, S., de Meer, H., Trivedi, K.S. *Queuing Networks and Markov Chains: Modelling and Performance Evaluation with Computer Science Applications*. John Wiley&Sons, 2006. 878 p.
3. Scott, S.L., Smyth, P. *The Markov Modulated Poisson Process and Markov Poisson Cascade with Applications to Web Traffic Modelling*. *Bayesian Statistics 7*. Oxford University Press, 2003.

SPATIAL COMPETITION AND COOPERATION EFFECTS ON EUROPEAN AIRPORTS' EFFICIENCY

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Keywords: spatial stochastic frontier, airport efficiency, competition, cooperation

During the recent decade airports' efficiency became a subject of a significant number of researches [1, 2, 3]. Many researches are based on the modern frontier approaches (stochastic frontier, data envelopment analysis and others) to efficiency estimation. Generally frontier methods do not utilise information about a spatial structure and therefore could be inefficient in case of significant spatial effects. In this paper we apply spatial modifications of the stochastic frontier model to European airports' data and find momentous spatial effects of competition and agglomeration.

Usually researchers consider a spatial structure as a source of competition [4, 5] – airports compete with neighbour airports for passengers. More airports available for people in a given area mean a higher level of airports' competition and should lead to higher airports' efficiency levels. This approach is correct, but an influence of neighbour airports is not limited with the competition only, cooperation effects are also possible. Passengers carried by adjacent airports can be considered as a resource for a particular airport, because they can use it for other flights. Also development of adjacent airports spills over the area development and can have positive effects on a given airport. In this research we try to estimate both competition and cooperation effects separately. Competition effects are included into the model as a completion pressure indicator, calculated in [5]. Following [4], we evaluate cooperation effects by using a distance-weighted number of passengers carried by neighbour airports as a resource for a given airport, which can enhance airport's productivity and efficiency.

Spatial effects (measured as a number of passengers carried by neighbour airports) can be included into the stochastic frontier model in different ways:

- they can be used as a resource and therefore included into a specification of an efficiency frontier;
- they can be considered as parameters related with individual airport's efficiencies;
- a spatial matrix can be used to prevent the heteroskedasticity in model's residuals.

We apply all three approaches in this research and observe a significant influence of the spatial structure.

The research data set includes characteristics of European airports' activities from 2003 to 2007.

References

1. Starkie, D. *Aviation Markets: Studies in Competition and Regulatory Reform*. Farnham: Ashgate Publishing, 2008. 246 p.
2. Strobach, D. Competition among airports and overlapping catchment areas – an application to the state of Baden-Wurttemberg. In: *Competition in the European Airport Industry, German Aviation Research Seminar Series*, No 4, 2008, 27 p.
3. Pels, E., Nijkamp, P., Rietveld, P. Access to and competition between airports: a case study for the San Francisco Bay area, *Transportation Research, Part AL Policy and Practice*, Vol. 37, No 1, 2003, pp. 71-83.
4. Tveteras, R. and Battese, G. E. Agglomeration Externalities, Productivity, and Technical Inefficiency, *Journal of Regional Science*, Vol. 46, No 4, 2006, pp. 605-625.
5. Pavlyuk D. Spatial competition pressure as a factor of European airports' efficiency, *Transport and Telecommunication*, Vol. 10, No. 4, 2009, pp 8-17.

REGIONAL TOURISM COMPETITION IN THE BALTIC STATES: A SPATIAL STOCHASTIC FRONTIER APPROACH

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Keywords: spatial stochastic frontier, efficiency, competition, regional tourism, transport network

Recently the estimation of regional tourism competitiveness has drawn significant researchers' attention [1]. Competition and cooperation of country regions as tourist destinations plays an important role in overall regions' development, but identification of these two interrelated phenomena is not so straightforward. The economic theory postulates [2] that sometimes better to locate a business near to competitors (and to form a cluster or an agglomeration), because the resources spent by competitors (for example, advertisements) increase business' productivity and efficiency. In this paper we consider spatial cooperation effects on tourism for regions of the Baltic States (Latvia, Estonia, Lithuania) and also estimate regional inefficiencies of tourist attraction.

Relatively country regions, which locations are obviously unchangeable, "distances to competitors" are the matter of transport networks. The development of inter-regional transport networks makes regions "closer", and strengthens competition and cooperation effects. In the suggested model we use information about the transport network in terms of travel times between regions by car, railways and coaches.

We apply the stochastic frontier approach [3] for estimating regional inefficiency levels. In this approach regions are considered as economic units which use their resources for attracting tourists. The resources include tourism infrastructure (hotels capacity), labour force (employment in tourism-related economic sectors), natural attractors (a sea-side and national parks), heritage objects and museums, and transport accessibility. Transport accessibility is considered on two levels – distances to capitals/airports and regional transport network quality. Using the stochastic frontier model we ascertain a significant level of inefficiency in some of considered regions.

We take a spatial structure [4] into account and include it into the model using a spatial weight matrix. This matrix defines distances between regions and in this research we construct it in two possible ways – using the inverse Euclidean distance and using travel times (subject to transport networks). We discovered the significant influence of the spatial structure both on an efficiency frontier and on regions' inefficiency values, and also an essential impact of including transport network parameters into the model on the results.

Panel data used in the research includes information received from national statistical offices about 26 districts in Latvia, 15 counties in Estonia and 10 counties in Lithuania from 2005 to 2008 years.

References

1. Hong, W.-C. *Competitiveness in the Tourism Sector*. Heidelberg: Physica-Verlag, 2008. 133 p.
2. Fujita, M. and Thisse, J.-F. *Economics of Agglomeration: Cities, Industrial Location, and Regional Growth*. Cambridge: Cambridge University Press, 2008. 480 p.
3. Kumbhakar, S. C. and Lovell, C. A. K. *Stochastic Frontier Analysis*. Cambridge: Cambridge University Press, 2003. 333 p.
4. Anselin, L. *Spatial Econometrics: Methods and Models*. Dordrecht: Kluwer Academic Publishers, 1988. 284 p.

STATISTICAL PREDICTIVE INFERENCES FOR EXTREME VALUE DISTRIBUTIONS BASED ON CENSORED LIFE DATA

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Keywords: extreme value distribution, type II censored data, pivotal quantities, predictive inferences

Technique for using censored life data from extreme value distributions to construct prediction bounds or intervals for future outcomes is described. In particular, new-sample prediction based on a previous sample (i.e., when for predicting the future failure time of a unit in a new sample there are available the failure data only from a previous sample), within-sample prediction based on the early-failure data from a current experiment (i.e., when for predicting the future failure time of a unit in a sample there are available the early-failure data only from that sample), and new-within-sample prediction based on both the early-failure data from that sample and the data from a previous sample (i.e., when for predicting the future failure time of a unit in a new sample there are available both the early-failure data from that sample and the data from a previous sample) are considered. In order to construct prediction bounds or intervals for future outcomes, the invariant embedding technique representing the exact pivotal-based method is used.

TECHNIQUE OF IMPROVING STATISTICAL DECISIONS FOR INVENTORY PROBLEMS UNDER PARAMETRIC UNCERTAINTY AND CONSTRAINTS

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Keywords: inventory problem, parametric uncertainty, constraints, pivotal quantity, equivalent predictive inferences

The aim of the study is to show how the statistical inference equivalence principle (SIEP), the idea of which belongs to the authors, may be employed in the particular case of finding the effective statistical decisions for the multi-product inventory problems with constraints. To our knowledge, no analytical or efficient numerical method for finding the optimal policies under parametric uncertainty for the multi-product inventory problems with constraints has been reported in the literature. Using the (equivalent) predictive distributions, this paper represents an extension of analytical results obtained for unconstrained optimisation under parametric uncertainty to the case of constrained optimisation. A numerical example is given.

THE RESEARCH OF OPTIMISATION CRITERION BASED ON THE CLUSTER CENTROIDS APPLICABILITY FOR HIGH DIMENSIONALITY DATA CLUSTERING

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Keywords: clustering, text documents, vector space model, the optimisation criteria

In this work the optimisation criteria based on the cluster centroid that is used for large dimension data clustering (text documents) are studied. In the article [1] the results of 7 optimisation criteria researches for text documents clustering are described. In the article a criterion based on the centroid of the clusters was mentioned, and its study was conducted.

The concepts that are used in clustering of text documents are viewed in this article. Also the submission of text documents in a Vector Space Model and the concept of a measure of similarity of text documents are described. The article discusses the applicability of the external optimisation criterion V_1 , which is calculated as follows:

$$V_1 = \sum_{i=1}^k \sum_{j=1}^k \cos(C_i, C_j) \rightarrow \min, \quad (1)$$

where

- k – number of clusters, in which a collection of documents should be broken;
- C_i and C_j – centroid vector of the i -th cluster and j -th cluster;
- $\cos(C_i, C_j)$ – cosine function between two vectors.

The criteria are studied on an experimental basis. For the testing five collections of text documents (from 205 to 1658 documents) were created. The findings and recommendations can be put into practice in the development or systems use in automatic clustering of text documents.

References

1. Zhao, Y., Karypis, G. *Criterion Functions for Document Clustering*. University of Minnesota, Department of Computer Science / Army HPC Research Centre Minneapolis, MN 55455 Technical Report, No 01-40, 2002.
2. Kogan, J., Nicholas, Ch., Teboulles, M. *Grouping Multidimensional Data*. Springer, 2006, pp. 211-237.
3. Kogan, J. *Introduction to Clustering Large and High-Dimensional Data*. Cambridge, 2007, pp. 155-160.

MODIFIED APPROACHES TO PATTERN RECOGNITION VIA THE FISHER DISCRIMINANT RATIO

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Keywords: Fisher's discriminant ratio, linear discriminant function, pattern recognition, modified approaches

Fisher's linear discriminant analysis is a widely used multivariate statistical technique with two closely related goals: discrimination and classification. The technique is very popular among users of discriminant analysis. Some of the reasons for this are its simplicity and needlessness of strict assumptions. In its original form, proposed by Fisher, the technique assumes equality of population covariance matrices, but does not require multivariate normality. However, it has optimality properties only if the underlying distributions of the groups are multivariate normal. In practice, we often are in need of analysing data samples which are not adequate for Fisher's linear discriminant function (LDF) such that the distributions of the groups are not multivariate normal or covariance matrices of those are different or there are strong multi-nonlinearities. It is also easy to verify that the discriminant rule obtained can be very harmed by only a small number of outlying observations. Outliers are very hard to detect in multivariate data sets and even when they are detected simply discarding them is not the most efficient way of handling the situation.

Therefore, the need is for procedures that can accommodate the outliers and are not strongly affected by them. In addition, a good classification procedure should result in few misclassifications. In other words, the chances, or probabilities, of misclassification should be small. Another aspect of classification is cost. An optimal classification procedure should, whenever possible, account for the costs associated with misclassification.

Moreover, it may be that one class or population has a greater likelihood of occurrence than another because one of the populations is relatively much larger than the other. Then an optimal classification rule should also take these "prior probabilities of occurrence" into account.

Taking into consideration the above facts, we propose in this paper two modified approaches to pattern recognition via the Fisher discriminant ratio: (i) Approach to pattern recognition based on the maximum separation ratio, and (ii) Approach to pattern recognition based on the minimum expected cost of misclassification. These approaches include the improved classification procedures that allow one to take into account the cases, which are not adequate for Fisher's LDF.

APPLICATION OF CHI-SQUARE TEST OF INDEPENDENCE IN THE UTILIZATION OF POSTAL AND TELECOMMUNICATION SERVICES

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Keywords: marketing survey, chi-square test of independence, postal services, telecommunication services, regional disparities, measures of association

In the introductory part of this paper there is characterized a marketing survey of utilization postal and telecommunication services in regional entrepreneurial environment. The survey was realized in within the framework of the project No I16-07-140 titled “Marketing Survey of Utilization Postal and Telecommunication Services in Regional Entrepreneurial Environment” at the University of Zilina in 2008. It was focused on recovery of relevant information about provided postal and telecommunication services and about customer’s satisfaction with these services.

The methodology of the CHI-Square test of independence between two qualitative statistic figure values is elaborated in the next part of this paper. This methodology is applied to the results of marketing survey that are presented in three groups – internal test of independence, cross test of independence and test of independence in the regional context.

In the internal test of independence, both qualitative statistic figure values relate to postal services or both qualitative statistic figure values relate to telecommunication services. In the cross test of independence, the first qualitative statistic figure value relates to postal services and the second qualitative statistic figure value relates to telecommunication services. In the test of independence in the regional context, the first qualitative statistic figure value relates to postal or telecommunication services and the second qualitative statistic figure value relates to a selected region.

I have chosen the following five regions in the Slovak Republic: Bytca, Cadca, Kysucke Nove Mesto, Namestovo and Zilina. By the test of independence in the regional context regional disparities could be identified. Those regional disparities could be used as groundwork for suggestions and recommendations for the postal and telecommunication services quality increasing.

On the each identified pair of qualitative statistic figure values CHI-Square test of independence was applied. It defined null hypothesis about their independent. Then the assumption of rejecting or failing to rejecting the null hypothesis was defined. In the case of rejecting the null hypothesis the degree of association was defined by one of the measures of association (Phi coefficient, Contingency Coefficient, Cramer’s V or Tschuprow’s T).

ANALYSIS OF TRAFFIC FLOWS ON THE BORDER LATVIA (EU) AND COUNTRIES OF CIS

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Keywords: traffic flows, border crossing, descriptive statistics, analysis of variance, the flow rate

Latvia is a corridor between the CIS and EU countries, and transit – one of the most profitable sectors of the state budget, and has all the prospects for enlargement. More than 90% of cargo handled at ports of Latvia is in transit; and the points of departure or destination of these goods – the CIS countries. Objective: to obtain the laws describing the flow of cargo transport through the application of methods of statistical analysis.

For the data used for statistical analysis package Statistica 8. As the input data, the data about the intensity of traffic flows through the border checkpoints on the border of Latvia-Belarus and Latvia-Russia. Period of study: June 2008-June 2010 for three groups of vehicles: cars, trucks and buses. As a part of this work data processing only for trucks are carried out.

The study was carried out data processing:

- Conversion tables;
- Encoding;
- Analysis of gaps, etc.

There were the descriptive characteristics of the streams, built their generalized characteristics.

Aggregated data revealed patterns of change in the intensity of the flow of trucks, depending on various factors:

- Time of the day
- Days of the week
- Time of the year
- Schedules of other modes of transport
- Economic situation in the country.



Session 3

Intelligent Transport Systems

COVERAGE EVALUATION APPROACHES FOR INTELLIGENT TRANSPORTATION SYSTEMS BASED ON ANISOTROPIC SENSOR NETWORKS

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Keywords: Intelligent Transportation System, anisotropic sensor, sensor network, coverage, service area

Safety of road travel is of the most considerable tasks solvable by means of intelligent transportation systems (ITS), particularly, due to mutual interaction of sensor nodes, forming a sensor network. In respect to ITS sensor network integrates both mobile vehicles with on-board sensors, and stationary sensors, located near the road. Thus at monitoring of driving safety two communication models take place: vehicle-to-vehicle or infrastructure-to-vehicle.

A fundamental issue for each wireless sensor network is coverage problem. Most known investigations, concerned with optimal (in sense of ensuring of necessary coverage level at every point in service area) deployment of networks' nodes, i.e., with optimal network topology, study the problem on the assumption that wireless network service area is formed by isotropic (omnidirectional) sensors [1-3]. Service area of an isotropic sensor represents a disk. At the same time, sensors in ITS' sensor networks mainly are non-isotropic. It means that service area of such sensors instead of disk form represent a directional sector. As a result, network topologies suggested for networks of isotropic sensors become far from optimal. Possible approaches for efficient placement of wireless network nodes on condition that service area is constructed from anisotropic sensors are discussed at present work. Problem is examined from two points of view: as a probabilistic task, as well as a task of computational geometry. Within the scope of the problem, usage of Centroidal Voronoi Tessellation is examined. Possible ways of its generating are analysed: Lloyd' algorithm and MasQueen's method. While Lloyd's method is a deterministic, MasQueen's method represents another, probabilistic approach.

The investigation is resulted in some algorithms and considerations for near to optimal deployment of anisotropic nodes within ITS' network service zone.

References

1. Tsilker, B., Pezhenkov, E. Coverage Improvement Strategies for Wireless Networks. In: *Proceedings of the 7th International Conference "RELIABILITY and Statistics in Transportation and Communication" (RelStat'07), October 2007*, pp.294-305.
2. Tsilker, B. Coverage Ensuring Improvement in Heterogeneous Wireless Networks. In: *Proceedings of the 7th International Conference "RELIABILITY and Statistics in Transportation and Communication" (RelStat'08), October 2008*, pp. 294-305.
3. Dhillon, S.S., Chakrabarty, K. Sensor Placement for Effective Coverage and Surveillance in Distributed Sensor Networks. In: *Proceedings of the IEEE Wireless Communications and Networking Conference, 2003*, pp. 1609-1614.

THE REINFORCEMENT FRAMEWORK OF DECISION SUPPORT SYSTEM FOR LOCALIZATION AND MONITORING OF INTELLIGENT REMOTE BIO ROBOTS

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Keywords: multiple agent system, decision support system, knowledge representation techniques, fuzzy logic, neural networks, Petri nets

The paper analyses the possibilities of integration of different technological and knowledge representation techniques for development of the reinforcement framework for remote control of multiple agents as wheelchair typed robots. Some technological solutions are discussed for recognition of localization of moving objects by using mobile technologies. Large-scale of multi-dimensional recognitions of emotional diagnosis of disabled persons often generate large amount of multi-dimensional data with complex recognition mechanisms, based on integration of different knowledge representation techniques and complex inference models.

The problem is to reveal main components of diagnosis as well as to construct the flexible decision-making models. Sensors can help to record primary data of monitoring objects; however the recognition of abnormal situations, clustering of emotional stages and resolution for certain type of diagnosis is oncoming issue for bio-robot constructors. The prediction criteria of diagnosis of emotional situation of disabled persons are described using knowledge based models of neural-networks. The research results present the development of multi-layered framework architecture with integration of artificial agent's and support components for recognition diagnosis and control of further actions by using mobile technologies.

The method of fuzzy neural networks control of speed of wheelchair type robots working in real time by providing movement support for disabled individuals is presented. The fuzzy reasoning by using fuzzy logical Petri nets is described for defining of physiological state of disabled individuals by recognition their emotions during their different activities. Some new possibilities of recognition of moving object location are introduced in the system.

COMPUTING PARALLELIZATION EFFICIENCY ESTIMATION IN THE INTELLIGENT TRANSPORTATION SYSTEMS

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Keywords: intelligent transportation system, parallelization, efficiency, metrics

Considerable achievements in computing and telecommunication area make possible in a new way solve a wide spectrum of transportation problems, affected in the concept of intelligent transportation systems (ITS). In a technical aspect such sort systems represent a set of interacting computational nodes, equipped with various sensors, and can be treated as distributed computer systems. The distributed structure of ITS supposes parallelization of solvable transportation tasks and their distributed realization.

The concept of efficiency of parallelized calculations presupposes a few aspects. Three such aspects are picked out in the work: calculation speed, efficiency of system scaling, and efficiency of parallel computations as compared to sequential ones. Proper metrics for each group are offered, allowing numerical characterization of certain aspect of parallelized computations. As such metrics the index of parallelism and speedup (PI and S), efficiency and utilization (E and U), redundancy and compression (R and C) are examined.

The peculiarity of intelligent transportation systems is in, that a large volume of communications is typical for them, substantially telling on the indexes of the system. Influence of communication overheads on the total efficiency of the system is analysed in the work.

The question of private indexes integration into a single integral index, characterizing the quality of ITS realization, is examined. Applicability of the suggested metrics and their evidence is illustrated by examples.

References

1. Voevodin, V.V., Voevodin, V.I.V. *Parallel Computings*. SPb.: BHV, 2002. 608 p.
2. Tsilker, B.Y., Orlov, S.A. *Organization of Computers and Systems, 2. ed.* SPb.: Piter, 2010. 686 p.

ANALYSIS AND DEVELOPMENT OF SEGMENTATION METHODS BASED ON VIDEO SURVEILLANCE DATA FOR IMAGES OF TRANSPORT VEHICLES DETECTION

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Keywords: segmentation, computer vision, detection, tracking, transport vehicles

Urbanization in different countries leads to increase of traffic. This calls for creation of intelligent transport systems of traffic control. Such systems allow effectively regulating traffic streams by collecting data about them, like: quantity of vehicles, their speeds, etc. For data gathering, currently, different types of sensors are used, like: laser, radio, induction, pressure, video and sound sensors [1]. These kinds of sensors require significant financial resources for installation and maintenance. Most of these sensors require additional construction work done on the road bed and surrounding structures. For some cities this is inappropriate or not affordable.

In the proposed study, the possibility of using mobile video detection system to measure traffic is discussed. This mobile system consists of a notebook and simple web-camera, which is the cheapest version of the video sensor. Video data processing is done by stages: detection, segmentation, classification and tracking [2]. Algorithm for finding and identifying vehicles on each frame of video stream is proposed. Algorithm is based on finding "mass centre" of all "good features" on each video frame. This allows identifying vehicles and helps to escape noise and unwanted motions on the frame.

The results of video detection of moving vehicles from records of the video records are shown. The restrictions on the usage of mobile video detection are imposed.

References

1. *Sensor Technology*. <http://www.tfhr.gov/its/pubs/06108/02a.htm#ref11>
2. *Features of algorithms for analysis of television images*. <http://www.polyset.ru/article/st705.php> (in Russian)

ARCHITECTURE ESTIMATION FOR LOGISTICS AND TRANSPORT SOFTWARE

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Keywords: software architecture, architectural styles and patterns, logistics and transport software, coupling, cohesion, FP-metrics.

Software architecture design and estimation play the key role for logistics and transport software development process. Unfortunately, at the moment there are no any effective methods for the software architecture quality estimation. Thus the software engineer relies on his own experience or the experience and architecture quality evaluation of other experts during the architecture design stage. Another approach is to take a look from the structural organization point of view, so it's obviously that the major part of architectures uses some set of the common architectural styles and patterns. The architectural styles and patterns express a fundamental structural organization of software systems and software behaviour. They influences to its base characteristics as well. Such usage of the proven and tested approaches allows increasing the software quality and reducing a budget and potential risks.

The analysis of the typical logistics and transport software allows picking out the most representative architectural features and characteristics. Based on that analysis the most useful architectural styles and patterns were selected for such software types.

For the selected architectural styles and patterns quantitative metrics must be obtained to being able make a decision regarding its influence on software architecture. During the architecture design stage the architectural styles and patterns are treated as a "black box", therefore the complexity metrics should be based on indirect measures instead of direct ones. In addition to the complexity metrics, inner (cohesion) and outer (coupling) relations of architectural styles and patterns can be measured.

This paper results allows making a conclusion regarding the usage of some architectural styles and patterns for the logistics and transport software.

References

1. Orlov S.A. *Technologies Software Development: a textbook for universities, 3rd ed.* SPb.: Piter, 2004. 527 p.
2. Fenton, N.E., Pfleeger, S.L. *Software Metrics: A Rigorous and Practical Approach, 2nd ed.* PWS Publishing, 1998.
3. Buschmann, F., Meunier, R., Rohnert, H., Sommerlad, P., Stal, M. *Pattern-Oriented Software Architecture, Vol.1: A System of Patterns.* Wiley, 1996.

THE PROBLEM OF E-MAIL GATEWAY PROTECTION SYSTEM

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Keywords: phishing, shingle, „white” and „grey” lists, SPAM filtration

Nowadays the problem of protection from undesirable message via e-mail is very urgent. Statistics claim that about 90% of all electronic mail constitutes SPAM, which leads to enormous losses for the companies all over the world. Other results of SPAM are numerous phishing attacks and spreading of viruses [1], which also increase the financial losses of the companies. Analysing the situation it is clear that at moment the task of undesirable post blocking has not been completely solved.

To illustrate this the article gives the most popular methods of protection against SPAM, as well as offers the testing results for the above mentioned methods of post server protection for Windows and Unix systems.

The new additional method of SPAM filtration and its algorithm are offered in the article. The given method of message checking on SPAM is based on the shingle's algorithm [2], as well as on the notion of the queues for „white” and „grey” lists.

The offered method is realised as software. Further, the analytical and scale models research of the above mentioned filtration method is performed.

The article gives the results of comparison of this method and [3] Bays filtration method, studies the possibilities of cooperation of the two methods, which would increase the effectiveness of SPAM filtration.

References

1. Maxim, L. *E-mail Breakage, spam and hackers attacks on Internet e-mail systems*. Moscow: Mayor, 2008. 192 p. (In Russian)
2. Lenkov, S.V. *Information security methods and facilities. Volume 2. Information security*. Saint-Petersburg: Ariy, 2008. 334 p. (In Russian)
3. Tobkin, C., Kligerman, D. *Check Point NG/Ah. Next Generation with Application Intelligence Security Administration*. Rockland: Syngress Published, 2004. 628p.



Session 4

Transport and Business Logistics

PROBLEMATICAL POINTS IN THE E-TRADE SYSTEM

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Keywords: logistics, e-trade, e-business, supply chain, costs

The article examines problematical points of the e-trade system related to costs and impact of e-trade to logistics supply chain. It designates major traditional and e-trade differences highlighting its problematic issues and possible advantages. The article emphasizes that the electronic trading system is associated with both positive and negative aspects. Advantages most likely to occur because of higher virtual options to the consumer, saving time and reducing costs incurred while searching for the product in a real environment. The negative aspects – lack of trust of e-trader, a long waiting time for the return of bad items.

Emergence of the World Wide Web created favourable conditions for the rise of the e-business. Currently e-business includes all the activities related to commerce transactions – regular business operations as well as new business operations that might take place only in virtual surrounding.

Up-to-date trade organization often seeks for the new forms to attract customers and create more favourable conditions for them to purchase goods. One of the newest forms is e-trade. The fact that households that have personal computers in Lithuania are growing, and this allows assuming that the number of people using e-trade services increase. It is therefore necessary to estimate and review the potential problems caused by the e-trade system.

References

1. Massagli, Meegan K. *E-tail vs. retail: the future of the downtown regional shopping center*, 2000. Available – <<http://dspace.mit.edu/bitstream/handle/1721.1/32193/48527194.pdf?sequence=1>>.
2. Rowley, J. Product Search in E-shopping: A Review and Research Propositions, *Journal of Consumer Marketing*. 2000. 17(1): 124–135.
3. McGann, R. *Online Holiday Purchases to Grow Growing Security Concerns*. 2004. A.C. Nielsen Research. Available – <<http://www.clickz.com/clickz/stats/1710433/online-holiday-purchases-grow-despite-growing-security-concerns>>.
4. Balabanov, I. T. *Elektroninė komercija*. St. Petersburg: Piter. 2001. 335 p.
5. Lietuvos Respublikos elektroninės prekybos įstatymas, 2001.
6. Chopra, Sunil and Jan A. Van Mieghem. *Which E-business is right for your supply chain?* 2000. Available – <<http://www.kellogg.northwestern.edu/faculty/vanmieghem/htm/e-business-scmr-april26.pdf>>.

ENHANCING MANAGEMENT RELIABILITY: UNDERTAKING THE RESPONSIBILITY OF BUSINESS

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Keywords: diagnostics, feature, transfer, effect, adjustment, controllability

Approach, oriented to the increase of business reliability is considered in [1, 2, 3] research proceedings. It is based upon the integration of business evaluation platforms within the frameworks of developed administrative potential diagnostics system. The decision-making in such system is conducted from the position of solid result achievement [4]. Mechanisms of feature deviation recognition of management system from established positions, set up by the elements of goal setting, are used as means of diagnostics [5]. This recognition is oriented to reproduction of administrative system features, considering the properties, that preserve their values in the established limits co-operating with external environment.

The flow of this system is in its adjustment to the business environment. Possessing this orientation, management system supports steady business functioning in accordance with its requirements. The great number of scenarios, related to managers responsibility for business, is not taken into consideration in this situation. These scenarios, in total, act as limitations for enterprises in creation of cost value. Thereby, preconditions for considering the management system at a higher organization level, than business system, are established.

Transfer of the management system to a new level of organization is oriented to acceptance of unity of actions of four effects, considering the differentiation of spheres responsibility between participating parties [6]. This allows not only to uncover the mechanism of cost value production, but also to understand the new mission of functioning enterprise, that takes place in development of system function. Adjustment of system function to solving new task is related to the increase of controllability in the area of diversity of different enterprise functioning scenarios. In case of scenario appearance, that is related to the administrative system transfer to unstable status with lack of stabilization measures, the losses appear, and specify the unreliability of management. The value of these losses is calculated through the cost value of enterprise. Thus, management reliability is determined by taking into consideration the elements of appearance of losses in administrative work and ability of organization to pick the appropriate scenario of quality development from the common amount of existing scenarios.

Effectiveness of the offered mechanism is tested in conditions of operating multimodal transport enterprise.

References

1. Kopitov, R., Leonov, E. Securing business from the standpoint of practical monitoring, *Transport and Telecommunication*, Vol. 3, No 2, 2002, pp. 71-80, (in Russian).
2. Kopitov, R., Labeyev, V., Faingloz, L. Technology Securing Reliability of Business: Additional of Extended Abstracts. In: *Proceedings of the 8th International Conference "Reliability and Statistics in Transport and Communication" (RelStat'08), 15-18 October 2008, Riga, Latvia*. Riga: TTI, 2008, p.21.
3. Kopitov, R. Enhancing Business Reliability: Improving Value-Based Management by Measuring Investment Attractiveness. In: *Proceedings of the 9th International Conference "Reliability and Statistics in Transport and Communication" (RelStat'09), 15-18 October 2009, Riga, Latvia*. Riga: TTI, 2009, p.21.

- Statistics in Transportation and Communication” (RelStat’09), 21-24 October, 2009, Riga, Latvia. Riga: TTI, 2009, pp. 211-221.*
4. Kopitov, R. Estimation of the Investment Attractiveness of the Existing Enterprise Under the Conditions of Changing Goal Setting. In: *Proceedings of the International Symposium on Stochastic Models in Reliability, Safety, Security and Logistic*, Beer Sheva-Riga, 2005, pp. 213-216.
 5. Kopitov, R. Self-Regulated and Adapted to Changes Performance Management Model. In: *Proceedings of the International Symposium on STOCHASTIC MODELS in RELIABILITY ENGINEERING, LIFE SCIENCE and OPERATIONS MANAGEMENT*. Industrial Engineering and Management Department, SCE - Shamoon College of Engineering, 2010, pp.552-563.
 6. Kopitov, R. Understanding the paradox of the superposition of a new information space for robust activity management. In: *ABSTRACTS of the 2nd International Symposium SPACE & GLOBAL SECURITY OF HUMANITY, Riga, Latvia. 5-9 July 2010*, Riga: TTI, 2010, pp. 123-124 (in Russian).

SECURITY REQUIREMENTS AND POSSIBILITIES OF RISK EVALUATION IN E-FINANCIAL PAYMENT SYSTEMS

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Keywords: Electronic financial system, e-safety, e-payments, risk evaluation, e-security requirements, e-crimes

Technological development of information technologies and expansion of information systems enables increased usage of electronic payment methods. Electronic banking systems provide fast, safe enough and relatively low-cost operations. Reimbursement for goods and services using electronic instruments is increasing. New ICTs enables development of new electronic security technologies. Safety support systems – the authenticity, authorization, confidentiality, control, auditing, integrity, and minimal benefits for electronic payment must be designed and applied according to safety requirements and standards that must be always updated and improved.

European Union focuses on data protection of physical and juridical persons in order to keep electronic services secure and trusted. EU legal acts, which determine the financial payment involving data and information security standards and criteria, are important for all EU member countries.

Electronic banking systems ensure prompt and adequate performance of the safe financial transactions. Virtual currency transfers and payments for goods and services using electronic instruments, are increasing in large scale. Technological development of an electronic payment increases possibilities of quick and quality transfers, but cyber-security requirements and their implementation technologies have a great responsibility. Despite all security measures threats to the security of electronic payments is real and very serious. Systems "cracking" tools and techniques are no less technologically advanced than their countermeasures. Most developed countries around the world are focusing on "sensitive" information security. One of the categories of this kind of information is financial data.

The article discusses the risk factors when assessing safety measures for financial payment. Analysing some of the ways in which software and hardware measures can be used for retrieving personal data of fudging up electronic payment instruments, e-disclaiming of users of financial systems and thereby directing them into dangerous content websites.

DEVELOPMENT OF STRATEGIC MARKETING SOLUTIONS IN CIRCUMSTANCES OF RAPIDLY CHANGING EXTERNAL ENVIRONMENT

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Keywords: strategic marketing management, matrix ‘demand for creativity (novelty) by consumers’, cluster, discriminate, matrix analysis, market map

In the context of global economical crisis modern business environment becomes more sophisticated, changes rapidly and develops under the conditions of uncertainty, suggesting implementation of crisis management technologies. Technologies offered by modern strategic marketing and implementation of governmental economy regulation elements allow easing consequences of turbulent development, uncertainty and risks for the needs of business structures.

Assessment of macro environment factors influence, and strategic marketing solutions elaborated on their basis shall allow business structures setting a competitive position for the current period and finding anchors ensuring strategy elaboration and corrections. Strategy of differentiated marketing discovers and deals with target customers whose problems the company is able to solve better than a competitor, assessing priorities and preferences of their customers during the selection process.

These conditions require novelty of solutions; still the creativity should be based on actual opportunities of a market in question.

Basing upon the well-known matrix ‘Creativity and efficiency of managerial solutions’ [1], the author suggests own matrix ‘Creativity – demand for novelty (creativity) by consumers’ (Figure 1).

Creativity level of managerial solutions			
Maximal	2 Quality improvement strategy (corporate image strategy, sector leader strategy)	4 Benchmarking strategy (ultimate quality strategy of new goods, global leader strategy)	
Minimal	1 Proven quality strategy (product brand strategy)	3 New products strategy (innovator image strategy, niche leader strategy)	
	Minimal	Maximal	Demand for novelty by customers

Figure 1. Managerial solutions creativity matrix

Each quadrant provides an opportunity to define a clear organization development strategy under conditions of a market in question taking into account special options for creative solutions targeted to certain characteristics of market and environment.

The author has studied opportunities of its implementation for some business structures, namely, for a large corporate representative of gambling business in Latvia. Implementation of cluster analysis [2] allowed to provide a description of a consumer profile from rational and emotional point of view, revealing their special features for compulsive gamblers in several cities, thus allowing to use Strategy 1 (proven quality strategy) for such specific type of business as gambling.

In the circumstances of crisis the importance of assessing situation in a competitive market is emerging. By order of Competition centre (Latvia) the author has studied the competition problems at milk processing industry market in Latvia (2007). For this purpose the author has used a unique combination of research methods: cluster analysis in revealing main competition problems inside the Latvian milk processing industry, allowing to define clusters – companies depending on their reaction to macro environment factors; discriminate and matrix analysis (Yefremov-Zade method [3]) – competitive positions at the Map of milk products manufacturing market. Managers and independent experts (both of large and small Latvian enterprises) admit that already in years of economical exuberance the market showed a severe macro environment influence (economy, law, competition in the field). The Conservator strategy has been detected only for market leader, and other market players showed strategies of a Dry leave, Farmer and Walking corpse [3], implemented under conditions of extremely unattractive environment. Under those conditions recommendations to implement strategic management of the sector and to ensure targeted support for Latvian business has not gained a response from governmental bodies. Without implementation of strategic management from the government side each company shall find its position at the Market map, but will not see the situation in general. Only presence of independent research and regulative bodies can ensure an opportunity to collect and to use information for detection of efficient strategy under circumstances of crisis economy and with a creativity matrix a company can implement a necessary creativity level of marketing solutions.

References

1. Smirnov, E.A. *Development of managerial decisions*. Moscow: UNITY, 2002. (In Russian)
2. Bakhmane, L. Cluster Analysis as the Method of Subject Segmentation of European Development Funds of Small and Medium-Sized Business in Latvia. In: *Reliability and Statistics in Transportation and Communication (RelStat'05)*. Riga: TTI, 2005.
3. Efremov, V.S. *Business Strategy. Concepts and methods of planning*. Moscow: Finpress, 1998. (In Russian)

USE OF SWOT-ANALYSIS FOR INSURER RISK MANAGER

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Keywords: risk management, insurer, SWOT-analysis

Insurance business like any other business activity needs management: planning, organizing, motivation and control. In modern terms the insurance companies play in a specific insurance market where they offer various insurance products and services to a customer in conditions of fierce competition of the limited insurance market of Latvia and the existing economic crisis. Insurance activity is impacted by the whole replenishment process. Attention to insurer risk management is a fundamental precondition for the efficient functioning of the insurance system in Latvia and ensuring of the financial obligations fulfilment by an insurer. Insurance activity differs considerably from other types of business activity. The main difference of insurance business is an insurer's striving to take risks of various economic subjects. In terms of increasing competition in the insurance service market, an objective necessity of an adequate evaluation of an insurer's activity and insurer risk management appears [1,2]. There exists a direct connection between risks taken by the insurance company (insurance risks) and risks related to the insurance activity conduction.

Activity of an insurer in terms of the market economics demands a high level of management, without which it is impossible to ensure the achievement of goals of this insurer, its competitiveness and constructing the strategy of an activity [3]. Specificity of management sphere in the insurance business pre-defines a necessity to single out its special direction in management – insurance management. In a narrow sense the insurance management represents the insurer risk management functioning in terms of competitive economic environment that includes task setting, choice of measures and development of methods of their achievement. An insurer determines the insurer real business via its specific motives and preferences directed by the insurance interest. Reasoning from the existing insurance interests, an insurer creates a certain package of the competitive insurance products that is orientated to satisfaction of insureds' demands. Professional management of insurance activity that is performed in terms of market relations and is directed to obtaining of maximum profit with rational use of all existing resources is impossible without the insurance market analysis, application of the modern methods of activity evaluation and multi-factor decision making.

Specificity of the insurance management is conditioned by peculiarities of the insurance activity. The process of the insurance policies sale always assumes a direct contact with a future insured that is why it is difficult to standardize the operational technologies. Due to its specific character the insurance activity differs by its high riskiness. At that, the strategic management possesses a quite wide choice of own tools, one of them the SWOT-analysis is that is an assessment of the inner strength of a company and its weaknesses as well as its opportunities and threats [4, 5]. It is a method of the strategic survey obtaining of a company's situation. The SWOT-analysis obeys a main principle – a strategy must provide a good compliance of the inner opportunities of a company (its strong and weak sides) with its outer situation (partially reflected in its opportunities and threats). In the very general sense the SWOT- analysis is aimed to identification, structurization and comparison of already existing strong and weak sides of a company, probable events in the market (opportunities-threats), which attachment, may promote or impede the implementation of the analysed idea, structure, process, event. On the basis of the

SWOT-analysis a general forecast of an insurer development is elaborated. Again, it is performed individually or by outsourcing for the period, for which the strategic plan is considered. This forecast is made by various parameters: by insurance premium amount, by market structure (corporate or retail insurance), insurance branches, and insurance market tendencies. The performed analysis, as well as a positioning of market opportunities and risks by its influence on a company and probabilities of their performance allow making an assumption about the situation development relating to a certain insurer in the national insurance market. Depending on a forecast and the environment analysis the insurance company determines its share in the market, segments of market, priority regions and products-locomotives. In the paper the activity of a certain insurance company "A" in the insurance market of Latvia is examined. A place of the given insurance company in the insurance market of Latvia and opportunity of competition with leaders of the insurance market is determined. Practical use of the SWOT-analysis and opportunity to use results of the analysis allows the top managers of the insurance company to take the adequate decisions and to manage risks of an insurer in a certain situation. Taking into account the analysis results the suggestions for improving the activity of the insurance company "A" have been developed on the basis of strong sides and maximum levelling of weak sides. Top management success in the insurance company risk management lies in the knowledge and use of strategic tools as the original puzzles for constructing a general system of the strategic management of activity and risks of an insurer by its skilful combining.

References

1. Pickford, D. *Risk Management / Transl. from English by O.N. Matveeva*. Moscow: Vershina Ltd., 2004. 352 p.
2. Goncharenko, L.P., Filin, S.A. *Risk Management: Manual, 3rd edition / Edited by Oleynikov*. Moscow: KNORUS, 2008. 216 p.
3. Kurgin, E.A. *Insurance Management: Insurance Company Activity Management*. Moscow: RosKonsult, 2005. 304 p.
4. Bolshakov, A.S. *Modern Management [Text]: Theory and Practice / A.S. Bolshakov, V.I. Mikhailov, 2nd edition, corrected and added*. StPetersburg: Piter, 2002. 411 p.
5. Daft, R. *Management, 6th edition / Transl. from English*. StPetersburg: Piter, 2006. 864 p.: il. (Series MBA Classics)

ANALYSIS OF THE FACTORS INFLUENCING DECISION-MAKING ON ORGANISING ENTERPRISE OWN ACCOUNTANCY SERVICE OR SIGNING CONTRACTS FOR ACCOUNTANCY SERVICES TO DECREASE THE ACCOUNTANCY RISKS LEVEL

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Keywords: accountancy system, accountancy service, quantitative indices, summarized costs, risks probability

For any enterprise performing the entrepreneur activities and subordinating to the Regulations of the Republic of Latvia in the field of business, taxation and accountancy it is very significant to distinguish between making accountancy independently or signing contracts for accountancy service performed by the specialized accountancy firm. This choice should be based on the quantitative analysis of the total summarized costs for creating its own accountancy and for monthly payments for the accountancy firm services.

The solution of this task is complicated by the fact that besides these quantitative indices of the summarized costs, it is necessary to take into consideration a number of risks occurring in both cases. Thus, the entrepreneur has to define the priorities of importance and the probability of occurring risks.

The risks of the entrepreneur activities can be classified according to different principles, but the risks of the accountancy can be divided into:

- financial losses risks;
- unreliable information risks;
- lost benefits risks.

The final decision would be taken by the enterprise in favour of creating and affording its own accountancy only in case when the common costs for accountancy are considerably less than the common costs for using services of the accountancy firm, i.e. if

$$\left(\frac{C_{\Sigma}}{C}\right)_{Own_account.} < \left(\frac{C_{\Sigma}}{C}\right)_{Account.firm}$$

In the opposite case the strategy of attracting the specialized accountancy firm should be preferred.

Thus, the answer to the main question could be found in comparing the expressions:

$$(C_{\Sigma} / C)_{Own_account.} \gg (C_{\Sigma} / C)_{Account.firm}$$

or in its full appearance with consideration of the assumed level of risks occurred in the accountancy system:

$$(2 - p_1) \gg 1 + \frac{(1 - p_1)A}{12t_r [1 + K^1(\frac{a}{K})]} + K_0(1 - p_1). \quad (1)$$

The value A in the given expression is less than as a rule. Besides, in case of increasing the probability of reducing the value of risk from the level $P = P(t)$ to $P_1 = P_1(t)$, the value $K^1 =$

$= \ln p / \ln p_1$ is considerably increasing. Taking into account that the term of the financial and taxing audit, as a rule is more than 1 year, that is $t_y > 1$, it could be certified that the value $A < 1$.

Concerning the second addendum K_0 of the expression, it is less than 1 ($K_0 < 1$). Thus, if K_0 is close to 1, it means that the cost of losses for creating and affording the accountancy including the additional costs for buying necessary computerized equipment and providing the adequate qualification of accountants is approaching the sum of costs for paying for the services of the specialized accountancy firm, it means that affording its own accountancy firm is not worth while. In other words, if K_0 is close to 1, it should be more economically profitable to sign the contract for the services of the specialized accountancy firm.

The experience of the developed foreign countries demonstrates that in the majority of cases their enterprises prefer to sign contracts with the specialized accountancy firms. Quite probably, the decisive factor in this case would be the comparatively low price of services of these accountancy firms in contrast to high losses of the enterprise own accountancy. This practice is not very typical for many Latvian enterprises. This fact is often connected with the so-called "commercial secret" which cannot be entrusted to the other competitive firm.

Summarising the above-mentioned material, it should be notes that a number of the additional economic indices can considerably influence this or that choice of the enterprise and its decisions. These indices should be taken into consideration in every concrete case in the form of additional addenda of the used inequalities.

References

1. Ivanov, A.P. *Computational parameters and economic problems*. M.: Statistics, 1996. 186 p.
2. Petryakov, N.Ya., Rotar, V.I. *Uncertainty and management of economic systems*. M., 1985.
3. Adair, J. *Effective innovation: how to stay ahead of the competition*. London: Basingstoke, Pan Books, 1996. 292 p.
4. Baker, M., Hart, S. *Product strategy and management*. London: Prentice Hall, Europe. 1998. 507 p.

MECHANISMS OF FUNDAMENTAL CHANGES IN INTERVAL UNCERTAINTY REMOVAL PROCESS IN CONTEXT OF ORGANIZATIONAL STRUCTURE MANAGEMENT

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Keywords: acknowledgement, environment, principals, responsibilities, losses, management ability, criteria, circumstances

The task of organizational structure management is oriented to provide the stable enterprise functionality in circumstances of partial acknowledgement about stated environment parameters and no information about participating parties' behaviour principles. To find the solution it is just needed to disclose the uncertainty defining the unfamiliar parameters intervals by maximizing the goal function of every joined participant of organizational structure, when different reactions concerning the behaviour of environment principles occur. The basement for stated reactions is the stimulus, which shows the preferences of participants, taking into consideration the existing relationships and allocated responsibilities.

The interval evaluations presence is forming the needed scenario variety, which helps to disclose the uncertainty of organizational structure building process. The etalon role is usually given to hierarchical structure with strictly defined elements, which provide the basic characteristics of taken responsibilities. When redirecting the responsibilities, not only the organization is changing, but also the management ability is decreasing. Those losses are evaluated taking into consideration the commensurable with time expenses, spent on recovering the defined losses. The classification of recovering procedures in context of value potential allows configuring the risk zones from the management loss approach view. On such defined zones basement the management mistakes systematisation criteria are developed.

The mentioned criteria allow the enterprise to enter the new qualitative acknowledgement level. That is achieved when prevailing adaptation hypothesis is declined because of the external environment requirements, and is replaced by collective recognition, judgment and generalization of complicated cases. The circumstances for continuous fundamental changes in agreed and defined in advance environment are formed this way.

The configuration of such class circumstances is investigated on the acting multifunctional transport enterprise basement.

MOTIVATIONAL MANAGEMENT MECHANISMS IN PROBLEMS OF SUSTAINABLE FUNCTIONING OF THE ENTERPRISE

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Keywords: property, irrationality, stimulus, knowledge, changes

Sustained enterprise operation is represented by property of management system to concur with the established signs before and after the changes caused by effect of key factors [1]. At such interpretation the management goal is turned out to revealing of system parameters based on which is carrying out the choice estimation of the best of multitude alternatives options. The task solution is focused not on tracing of parameters significances in prescribed limit, and on maximisation of objective function of management subjects. It occurs at research of norms of their rational conduct accepted with allowance of elements of irrational motives.

The availability of an irrational basis allows revealing the contents of target utility of management subjects. Its disclosing is carried out within the limits of a united contour of management system fulfilling of the reorganized actions which are conducted at various combinations of stimulus and responses. The motivational management mechanisms are considered as stimulus. Their use is directed for the coordination of the participating party's interests. Such coordination is conducted in the order fundamental principles of management [2] with principles of motivational management [3]. The received results testify about transition to new level of being kept informed. Thereupon the prerequisites are formed, allowing replacing traditional technicians of planning by procedures of fundamental changes [4]

Elaboration and approbation of procedures is conducted as a part of active versatile transport agency.

References

1. Kopitov, R. Managerial principles as the foundation of the control style transformation. In: *Proceedings of the Conference "Insights into the Sustainable Growth of Business"(MMRC2009), 19 - 21 November, 2009, Vilnius, Lithuania.*
2. Kopytov, R. The Principles of Management: taking current liabilities. Riga: TTI, p. 175. (In Russian)
3. Zhilaev, Y. Principles of Motivational Management. *Research and Technology – step into the future*, Vol. 5. No 2. 2010. ISSN 1691-2853. (In Russian)
4. De Gues, A. *The Living Company: Habits for Survival in a Turbulent Business Environment*. Boston, Mass.: Harvard Business School Press, 1997.

OPTIMISATION OF THE SUPPLY CHAIN PROCESS FOR THE LOGISTICS CENTRE

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Keywords: decision making, supply chain, dynamic programming

In this paper the problem of decision-making process for the new supply and distribution channel of the Logistic centre is solved.

For the successful business development the management of the Logistic centre decides to create and develop the new supply chain way for raw materials and sales of ready-made goods. It is necessary to make certain decisions regarding relating parts of supply chain process. Therefore the model with different possible scenarios of development has been created.

Process is divided into three stages: *the first stage* is choosing the producer of basic material, *the second stage* include the delivery of basic materials to the final goods production place and *the third stage* is the selling process of ready-made goods.

Concerning decision-making process presented as a net structure, which repulsed the next and future decisions, regard creation of basic material supply chain and sales of readymade goods.

Two aspects, such as maximum probability of the best effect achievement and average profit maximization are taken as the criteria for effectiveness of making decisions.

Consequently, the task consists in the taking decision regarding the way selection from choosing the raw materials till final products creation that allows getting the maximum profits to the company.

This task could be solved by using the method of dynamic programming supposed to make decisions step by step. In this case it means to make decision for each unit individually.

Using the programming language MathCAD 14 there is created the special program, which allows making the corresponding calculations.

The solution of the real task for Logistics centre in Latvia is showed in this paper as the numerical sample of decision-making process for the new supply and sales channel development for the logistics centre in order to get the maximum profit.

ORGANIZATIONAL STRUCTURE EVALUATION MECHANISMS BASED ON CLASSIFICATION FEATURES

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Keywords: organizational structures, organizational design, structure type, hierarchical structure, organic structure, principles

In variety of works, devoted to organizational structures' research, the authors result different classifications of organizational types. Often these classifications contradict with each other, but in general it is possible to allocate some common features of different authors' approach. The majority of researchers show a kind of consecutive transformation from strict hierarchical structures → to flexible organic types.

The purpose of this article is to investigate the various management schools' approach difference when considering the effective organizational structure designing problem, as well as to give the own interpretation of organizational structures' types classification, taking into account the revealed distinctions. It is needed to point out straight away, that the main author's aim is not the creation of own original classification. The main aim is to look at this problem from the point of view of mentioned various management schools perception.

Such perception is focused on new thinking formation, allowing not only to develop viable Organizational Structures, but also to raise the enterprise intellectual capital.

The trend on the use of such terms as restructuring, etc., shouldn't lead to unconsidered and unreasonable actions in this field. First of all, it is necessary to understand clearly, what decisions exist in the field of organizational designing, to which consequences (positive and negative) these decisions can lead.

Even this is not enough. Then conducting the organizational designing, it is necessary to be guided by philosophy, special organizational thinking. Until now, the Organizational Structure was considered to be formed mechanically for business processes. This is an error. The principles lie in basement.

The special (own) understanding of principles by the organization is a kind of organizational philosophy. Proceeding from these principles understanding, the specific rules and standards base of the organization is formed, which should be embodied in all business-processes, proceeding in the company. The most effective embodiment of principles, rules and standards in business-processes is reached by optimal Organizational Structure.

POSSIBILITIES OF USING THE ECONOMETRIC METHODS IN FORMING THE TARIFFS FOR ROAD TRANSPORTATION

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Keywords: freight transportation, tariffs, transportation costs, regulatory parametric methods

When transporting goods by road, the tariff schemes and the level of tariffs are determined directly from the carrier. In practice, the following three tariff schemes are used [1]:

a) Scheme with the payment of the consignment. This scheme is usually used by the carrier if the operating conditions provide the necessary factors for profitable operation of the motor vehicles loading.

b) Scheme with the payment of motor vehicles. According to this scheme the client pays for the car-hours of work and it is used in cases where operating conditions do not provide sufficient commercial load of motor vehicles.

c) Scheme with the individual contractual payment. This scheme is provided for using the consultations with the customer consolidating and simplifying measuring transport services (haul, race, delivered containers, etc.) for which the calculation and tariff fees are performed.

The fundamentals of the transport tariffs formation are the level and the structure of the cost of transportation. The cost of transport is the main economic indicator of the efficiency of vehicles. The actual cost of transportation is determined by the ratio of the total costs associated with the implementation of transportation to the volume of the transport work.

The measurements of the transport work for trucks are turnover (W) or range (L), depending on the form of payment for the transportation services.

The costs associated with the implementation of transport should be grouped in the following way:

a) Variable costs (AVC_l), depending mainly on the path (l) of the motor vehicles in the performance of transport and therefore determined per kilometre. The variable costs include fuel costs, the cost of lubricants, the cost of restoration and repair of tires, the cost of maintenance and repair of motor vehicles;

b) Fixed costs (AFC_t) are not directly related to the implementation of specific transportation and do not depend on the performance of motor vehicles on the line of fixed costs and they are calculated per hour of motor vehicles (t). The fixed costs include overhead costs and depreciation;

c) Wages of drivers (TC_p), which are determined according to the scheme adopted for this type of transport system of remuneration. The wages may depend on the implementation of transport work, hours worked and other factors.

The magnitude of the cost of transport of the particular form of transport in the light of the above groups of indicators can be determined by the formula:

$$C_{tkm} = \frac{TC_p + AFC_t \cdot t + AVC_l \cdot l}{W} \quad (1)$$

For convenience, when planning transportation costs, all the costs for each type of motor vehicles can be normalized and conditionally reduced to one kilometre (S). Then the calculated value of the transportation costs can be determined by the formula:

$$C_{tkm} = \frac{S}{q \cdot \gamma_d \cdot \beta} \quad (2)$$

where q – load capacity of the vehicle, t ;
 γ_d – dynamic coefficient of lift;
 β – coefficient of mileage.

The tariff schemes and tariffs, in general, can be differentiated by the carrier and clients, by the types of goods, by the type of traffic, depending on the used vehicles. In any case, it is to be paid additionally and provides its clients with the initial-end operations (loading and unloading, storage, packing goods, etc.).

Thus, the wage boards for the transportation of cargo are mediated by the presence, action and taking into account the large number of parameters that reflect each specific shipment. With an overall uniformity of transport services in the conditional delivery of cargo from point A to point B – all traffic can be regarded as a parametric number of homogeneous processes differing drastically by the techno-economic parameters.

The analysis of the cost of transportation makes it possible to establish that its value varies with the techno-economic parameters. This relationship can be extended to value ratio. Setting tariffs allows using the dependences found in the individual contract system to use standard-parametric methods of pricing [2]. The possibilities and limitations of the application in the formation of road freight tariffs are reflected in the following methods: specific indices, regression analysis, points, aggregating.

The method involves the selection of specific indicators of the fundamental parameter whose value largely determines the overall size of the tariff transportation charges. The measurement and enforcement of the costs to one kilometre can use this value as the basis of the unit price of one kilometre and then apply it in determining the size of tariff transportation charges. The applications of this approach are very limited because they do not take into account all the other techno-economic parameters, not mentioning the relationship between supply and demand, assuming that they are stable and unchangeable.

The method of regression analysis is used to determine the variation rate of changes in several above-mentioned cases, technical and economic parameters of transport as well as in the construction and alignment of value relations.

$$P = f(X_1, X_2, \dots, X_n, \varepsilon), \quad (3)$$

where X_1, X_2, \dots, X_n – techno-economic parameters,
 ε – random component, conditioned by the stochastic nature of dependence.

Quantifying of the relationship between the changes in the effective (P) and (X_i) factors of symptoms is based on the regression analysis.

The points method is based on the fact that the expert estimates the significance of parameters for carrying cargo and each parameter is assigned to the certain number of points, the summation of which gives the assessment of the relevant quality parameters of transport. The aggregating method is the summation of charging fees for certain elements of the transport process included in the parametric range.

References

1. Blauwens, G., De Baere, P., Vande Voorde, E. *Transport Economics, Third Edition*. Antwerpen. 2008. 519 p.
2. *Prices and pricing* / Ed. by V.E. Esipova. SPb.: Piter, 2004. 560 p. (In Russian)

THE ECONOMETRIC ANALYSIS OF MERGES AND ABSORPTION PROCESSES IN LATVIA

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Keywords: mergers and acquisitions, restructuring, motives transactions, statistical analysis

After Latvia's entry into EU processes of merges and absorption became more active essentially. Only for the last three years 260 Latvian enterprises have replaced proprietors. The econometric analysis is necessary to determine, what factors influence the sums of transactions of merges and absorption in Latvia to a greater or lesser extent.

Research is carried out on a basis of the regression analysis with use of the program SPSS 17.0 for processing of the statistical information.

The following parameters are used for carrying out of the analysis: 1) the countries, which took part in transactions M&A in Latvia within three last years; 2) the sums of transactions. Among the factors influencing processes of merges and absorption, an index of competitiveness, gross national product per capita, rate of inflation, political instability, an index of corruption perception, economic freedom, distance from Latvia are examined.

The correlation matrix designed for definition of the importance of included variables, has shown, that two from seven variables appeared significant, it is an index of competitiveness and an index of corruption perception.

The regression equation on gathered data was constructed.

References

1. Evans, F., Bishop, M. *Valuation for M&A*. John Wiley&Sons, Inc., 2004.
2. <http://rating.rbc.ru>
3. <http://www.heritage.org/index>
4. <http://www.icgg.org/>>



Session 5

Innovations in Education and Research

THE USE OF MULTI-USER VIRTUAL ENVIRONMENTS IN THE FIELD OF EDUCATION

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Keywords: education, e-learning, MUVE, Second Life

The development of information and communication technologies (ICT) has brought about a revolution in many fields. Arduous tasks that once had to be carried out manually are today performed with one click of the keyboard. This trend is naturally reflected also in education. Few people today would be able to imagine education without the use of the most modern resources. What has been once just a dream for many people is now becoming a reality.

The long-term development of education has taken place on two fronts. On the one hand, education has been once the privilege of the wealthy but now we are standing on the threshold of a new era in education that is bridging the gap between the rich and poor, between different religions, races, etc. Education is one of the fundamental human rights.

On the other hand – the advances in information and communication technologies have a deep impact also on the development of the forms and modes of learning. Traditional education came to be complemented by ICT-enhanced learning at the end of the 20th century. This new form of learning is known as electronic learning or e-learning – a favoured term in our hectic age. Electronic learning has undergone an evolution. Some optimists hoped that e-learning would replace traditional education. But time has shown that a teacher's presence in the teaching process remains important. The original aim – to use only e-learning in providing students with education – has therefore not been achieved. However, e-learning as a complementary form of education has found a place in every educational institution as it is not just confined to teaching but is basically also a method of collecting, processing, sharing and providing information.

The evolution is still in progress. Educational institutions are now competing for students, aspiring to offer a high-quality, attractive, tailored product. One response to this challenge is education in virtual worlds with all its advantages and drawbacks. Multi-user virtual environments (MUVE) can be used in the field of e-learning to simulate real situations and for lectures, exercises, virtual meetings, conferences, etc. What distinguishes this from classic e-learning is increased interactivity, the possibility of virtual face to face communication in real time and the simulation of real environments with 3D graphic objects. Education in the virtual environment overcomes various obstacles and surpasses distances.



Session 6

**Applications
of Mathematical Methods
to Logistics and Business**

CONSTRUCTION AND INVESTIGATION OF MATHEMATICAL MODEL FOR MAXIMIZATION OF DIVISIBLE PRODUCTION'S VOLUME UNDER LIMITED RESOURCES AND CURRENCY

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Keywords: model of Leontief, the duality theory, optimum planning of manufacture

Questions of use and distribution material and manpower are extremely important as their decision in many respects defines production efficiency. Research of some problems connected with given circle of questions, is possible by means of the theory of interbranch (interprocess) balance of Leontief [1,2] (the so-called model "Input-Output"). Really, we will compare to each i -th ($i = \overline{1, n}$) branch/process the number $l_i \geq 0$ ($i = \overline{1, n}$) expressing necessary expenses material and manpower at individual intensity of given technological process/branch. Depending on the purpose of modelling the number, l_i ($i = \overline{1, n}$) can be measured either in units of quantity of used material resources, or in man-hours. If to designate a vector of expenses material and/or in manpower through $l = (l_1, \dots, l_n)$ it is possible to present technology of such modified model of Leontief in pair (l, A) , where the matrix $A = \{a_{ij}\}_{i,j=\overline{1,n}}$ describes technology at individual intensity of work of all branches, and is the main matrix of model of Leontief

$$x - xA = c, \tag{1}$$

where $x = (x_1, \dots, x_n)$ is a vector of intensity (total release); x_i ($i = \overline{1, n}$) means the volume of total output of i -th ($i = \overline{1, n}$) branch/process (i.e. intensity of i -th branch/process); c is a free rest material and/or manpower.

In the Leontief's model (1) the basic question is optimum planning of manufacture for the period $[T_s, T_e]$. However, as it is visible from system (1), this basic question is formulated on the contrary: at the set vector c of final consumption it is required to define a necessary vector of total release. In other words, in model (1) it is required to solve system of the equations at the set vector c and a matrix A . By consideration of a statistical variant of model (1) which is not considering background of process of manufacture, it is natural to assume that the unique limiting factor of manufacture is the total amount $L > 0$ of industrial resources. If the operating mode of the economic system described by model (1), is set by the vector of intensity x , in a new situation not any vector of intensity $x \geq 0$ which is also a vector of total release, will be admissible (see [3]). Therefore, it is impossible to bring an attention to the question on satisfaction of any final demand $c \geq 0$: The system decision $x - xA = c$, $(x, l) \leq L$ exists not at any non-negative vector c . In this connection the important fact is definition of structure of a final demand and for this purpose it is possible to formulate an extreme problem: provided that the vector $c \geq 0$ sets final demand structures, instead of a final demand, it is required to define the optimum plan from a problem

$$\begin{cases} V \rightarrow \max, \\ x - xA \geq Vc, \quad (x, l) \leq L, \quad x \geq 0, \end{cases} \quad (2)$$

which can be interpreted as aspiration to maximise quantity of let out "complexes" c . The maintenance of a problem (2) is rational distribution of industrial resources, and thus, if the technological matrix A is productive, i.e. if the non-negative vector of intensity x exists for any vector $c \geq 0$ of a final demand the problem (2) is admissible.

In the given work the following economic-mathematical optimising problem is investigated: the enterprise for manufacture of grain products plans to let out qualitatively new product (X for example, dietary bread), manufacture of individual quantity which demands $n \in N$ raw materials kinds. The analytical group of the enterprise has established the following initial information:

1) The quantity of i -th ($i = \overline{1, n}$) raw materials, necessary for manufacture of individual quantity of a product X , is equal to $a_i \in [a_i^{(1)}, a_i^{(2)}]$, where $[a_i^{(1)}, a_i^{(2)}]$ ($i = \overline{1, n}$) is a piece, in which the variation of used quantity of i -th ($i = \overline{1, n}$) raw materials is limited and is comprehensible i ($i = \overline{1, n}$) to manufacture the individual quantity X ;

2) The rests of i -th ($i = \overline{1, n}$) raw materials at the enterprise on the end of current month will be equal to b_i ;

3) Cost of individual quantity of i -th ($i = \overline{1, n}$) raw materials is equal to c_i ;

4) The quantity of the money resources, which enterprise can spend for purchase of additional volumes of raw materials during current month, is equal to FR .

It is required to define, what kinds of raw materials and in what quantity should be bought by the enterprise to provide the maximum volume of output of the product X next year?

In the given work, being based on the Leontief's model of (2), the mathematical model of the above-formulated economic-mathematical problem is developed:

$$\begin{cases} W(x) = V \rightarrow \max; \\ \begin{cases} x_i - a_i \cdot V \geq -b_i \quad \forall i = \overline{1, n}; \\ \sum_{i=1}^n c_i \cdot x_i = FR; \\ x_i \geq 0 \quad \forall i = \overline{1, n}, \end{cases} \end{cases} \quad (3)$$

where V is unknown planned volume of product's output; x_i ($i = \overline{1, n}$) is the purchase volume of the i -th ($i = \overline{1, n}$) raw materials. Constructed mathematical model (3) is universal in the following point of view: in this model any manufactured divisible product can be taken (loose or not loose), for example, product bread bakeries; heaters for walls and floors; paper products; cement; paints, etc.

Besides, in work, using duality theories, the analytical decision of the constructed model is found, and, the way on which there is an analytical decision of the constructed model, allows asserting that the found analytical decision possesses property of stability concerning small errors of the initial data. In other words, the method of finding the optimum output, chosen in the given work, is a self-regulating method for the found decision, continuously depends on all initial data without any exception.

In the work the software product with clear and convenient interface also is developed for computer realisation of the constructed model, and by means of this software, the product numerical experiments with the real economic initial data are made.

References

1. Leontief, V.V. *General economic problem of interindustry analysis, vol. 1.* (Selected works in 3 volumes). Moscow: Economics Publisher, 2006. 407 p.
2. V.V.Leontief. *Advanced study on the basis of "Input-Output" methodology, Vol. 2* (Selected works in 3 volumes), Moscow, "Economics" Publisher, 2006, 543 pp.
3. S.A.Ashmanov. *Mathematical models and methods in economics*, Moscow, Lomonosov Moscow State University Press, 1980, 201 pp.

A COMBINED METHOD OF THE MULTI-CRITERIA FAILURE CRITICALITY ANALYSIS OF THE COMPLEX OBJECTS' ELEMENTS

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Keywords: failure criticality, complex object, multi-criteria analysis, theory of experiment planning, linguistic variables

Due to the increase of the structural and functional complexity of the analysed objects and systems in the theory of reliability in recent time, ever growing popularity is given to the methods, which account not only the numeric values of the indicators of the constituent elements' reliability but also more general evaluations of the elements' failures influence on the objects' functioning, namely, evaluations of the failure criticality. Ranging the elements according to the degree of their failure criticality, determining the most critical elements makes possible to concentrate efforts on perfecting of the assemblies, which play a key role in supporting the complex objects (CO) functioning.

The failure criticality of the complex objects' elements is a vector property for which evaluating there is used a number of partial indicators, such as [1]: degree of damage of the failure consequences; probability of failure; resistance of the element to the external unfavourable factors; degree of reserving; controllability of the element state; length of the failure risk probability period; possibility of the failure localization.

The above indicators may have both quantitative and qualitative character and for their measurement there may be used different types of scales. In a general case, each indicator presents a linguistic variable.

Detecting critical elements under these conditions is a task of a multi-criteria choice. For resolving the multi-criteria uncertainty there have been developed different methods usually connected with using convolutions of different types [2]. It is using of convolutions that conditions the main disadvantages of the given methods. Two of these disadvantages are the most serious in reference to the considered task:

- there is not accounted the non-linear character of the indicators' influence on each other and on the generalized indicator of the failure criticality of the CO element;
- in building the integral indicator there occurs smoothing of the partial indicators values of the elements' failure criticality.

The suggested method of solving the task of the multi-criteria failure criticality analysis of the CO elements' failures, based on a combined method of a fuzzy logic conclusion and of the methods of the experiment planning theory [3], is free of the above disadvantages.

The resulting indicator of the element failure criticality is presented in the form of a polynomial which accounts both the influence of the separately taken indicators and the influence of the indicators' aggregations (of 2, 3, etc.). Calculation of the polynomial coefficients is made on the basis of processing the expert information and the corresponding linguistic variables quantitatively measured by fuzzy numbers. An additional advantage of the method is detection of contradictory utterances in the expert information.

The results of the calculating experiments show a substantial increase of trustworthiness of the evaluations of the CO elements' failure criticality with the application of the suggested method.

References

1. Afanasjev, V.G., Zelentsov, V.A., Mironov, A.N. *Methods of analysis of reliability and failure criticality of the complex systems*. St. Petersburg: MO, 1992. 99 p. (In Russian)
2. Sokolov, B.V., Pavlov, A.N., et al. *Military systems engineering and systems analysis*. St. Petersburg: MO, 1999. 408 p. (In Russian)
3. Nalimov, V.V. *Experiment Theory*. Moscow: Nauka, 1971. 208 p. (In Russian)

MODELLING OF MULTIMODAL FREIGHT TRANSPORTATION SYSTEM

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Keywords: multimodal transportation, cargo, route, logistics system, efficiency index

Current trends of development of the international system of freight transportation are characterized by essential increase of multimodal transportation in total amount of transportation of cargo. Usage of several types of transport in multimodal transportation makes a management of transportation, loading and warehousing processes, in which various executors and various facilities are involved, significantly more complicated. Thus, considering great transportation volumes, miscalculations in the organization and management of these processes lead to considerable material and financial losses.

Search for optimal decisions in realization of multimodal freight transportation should be based on a set of the initial data and be done using modern mathematical methods and computer engineering. Taking into consideration a complicated structure of multimodal transportation, high dynamics and rapidity of transport processes, the random factors influencing these processes and geographical dispersion of participants of the transportations, the task of the present research is development of the general-purpose approach to the mathematical description of the multimodal transportation system. First of all, such formalization is required, for management of multimodal transportation processes and searching for optimum decisions in freight transportation.

In the presented paper *multimodal transportation* is considered as a set of *logistics systems* (LS). Each logistics system is considered to be a route of transportation, which is characterized by a set of indices. The part of indices is determined, the part is stochastic. To estimate the efficiency of transportation the system of indices including cost, duration, reliability of transportation of cargo and its safety is used. It is easy to notice that the offered indices have the various physical natures and are measured by different physical magnitudes. Furthermore, cost and durations of transportation are quantities, but reliability and safety, estimated by experts, are qualitative characteristics. For conversion of quality indices to quantitative ones it is offered to use Harrington's desirability function.

To calculate LS indices, decomposition of system, including three basic steps, is performed [1]. *On the first step*, the logistics system is divided into a set of subsystems. *On the following step* the subsystems are presented as a set of logistics functions (LF). *On a final step* each logistics function is presented as a set of logistics operations (LO), which are characterized by own set of indices. Set theory apparatus and methods of network planning are used to describe considered elements of LS [2].

The constructed system of sets allows making calculations of efficiency indices of LS. Besides, these calculations are made "from below-upwards", starting from the bottom level (level of LO) and finishing by the top level (level of LS), namely $LO \rightarrow LF \rightarrow LS$. It is necessary to underline that cost indices at the next level of hierarchical transportation system are calculated by simple summation of corresponding indices of the previous level. However, calculation of time indices in the system is connected with certain difficulties. It is necessary to take into account factors like shifts of separate operations (functions) for fixed time, parallel and consecutive performance of separate operations (functions) and so forth. With this aim, LF and

LC are presented by the weighed graphs in which edges are corresponding elements of appropriate hierarchy level (i.e. LO and LF accordingly), when calculating time indices of functions and subsystems.

Two approaches to formation of optimality criterion of multimodal freight transportation system are proposed in the paper.

The first approach recognizes that various indices (delivery time, reliability of delivery, safety of cargo, etc.) can be estimated in expression in terms of value. It allows constructing a generalized cost criterion of total costs for realization of multimodal transportations, which unites a set of local criteria, among them:

- direct cost for freight transportation, i.e. expenses for cargo transportation, reloading and warehousing, customs operations, documentation, etc.;
- losses appearing as a result of delay in delivery schedule (including penalties for non-fulfilment of the delivery terms and the lost and-or half-received profit);
- losses from cargo loss, and deterioration of its consumer properties (partial or full damage of cargo, which reduces its cost);
- expenses for capital freezing (they are defined taking into account cost of transported cargoes and time of delivery);
- the losses related to currencies' exchange rates fluctuations;
- expenses for additional insurance of cargo;
- expenses for stock holding in case of irregular deliveries.

It is recommended to use one of classical methods of optimisation to solve an optimisation problem with an integrated criterion, including linear programming, dynamic programming, etc.

The second approach considers a multicriterion problem of multimodal transportation. To solve the problem authors suggest using a method of "consecutive concessions", which considers a priority of criteria [1].

To illustrate the offered approaches the example of calculation of multimodal freight transportation from Shanghai to Moscow for two alternative routes is considered in the paper.

References

1. Lukinsky, V. *Models and methods of the theory of logistics: The manual*. St. Petersburg.: Piter, 2008. 424 p. (In Russian)
2. Novitsky, N. *Network planning and production management: A Study book for higher schools*. Moscow: Mir, 2004. 159 p. (In Russian)

DECISION SUPPORT SYSTEM IN THE FIELD OF URBAN TRANSPORT ECOLOGY

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Keywords: urban transport, ecology, monitoring, decision support system, data warehouse

The current environmental degradation in major cities is connected with the permanent increase of urban traffic and production volumes, etc. All this poses new requirements both to management of municipal economy and urban development as such [1]. Searching optimal solutions on environmental situation management implies using up-to-date mathematical methods and computer technologies. An important role in this issue is imparted to the establishment of an information system supporting the decision-making process [2]. The system should provide for the collection and accumulation of various statistical data received across different channels of information, including various kinds of ecological monitoring stations, automatic meteorological stations, manual input of data obtained as a result of various measurements, etc.

The ecological monitoring system examined in this article is a complicated system with a number of specific features exercising an essential influence upon the efficiency of its operation. Among them, the following should be mentioned first of all:

- intensive dynamics and impermanence of all the processes;
- the dependence of functioning processes upon a variety of random factors such as modes and velocity of transport, the height of adjacent buildings, weather conditions, and some others;
- stringent requirements to accuracy and regularity of data-generating process;
- considerable demands for financial, labour, and material resources;
- the complicated network of ecological monitoring stations for which management and planning processes are organized.

The features enumerated above pose special requirements to ecological decision support system (EDSS) with respect to transport since even some minor errors in the data used can result in making wrong decisions on the improvement of urban ecological situation. This essentially reduces the efficiency of ecological monitoring system in general, and can lead to gross financial losses.

The investigations conducted in the field of applying modern database technologies allow one to improve the existing analysis information systems and accelerate the development of the new generation of these systems for EDSS. Such systems should be developed through using Data Warehouse Technologies, On-Line (interactive) Analytical Processing (OLAP), Data Mining, and Temporal Database [3–5].

The main advantages of EDSS suggested in this work are as follows:

- the efficient processing of large data volumes coming from various information sources;
- ensuring data validity in the process of data conversion into EDSS;
- development of a set of alternative mathematical models and using them simultaneously; the models serve as a basis for the development of various behaviour scenarios with respect to ecological monitoring systems without any essential increase of the stored data volumes;

- a quick analysis of a large number of possible case scenarios, with different combinations of controls and exposures, and working out offers concerning ecological monitoring system control in various situations;
- supporting the background data, with a possibility of getting access to all available versions of objects.

Integration of all constituent parts of monitoring in a single analysis and information system developed through using the cutting-edge computer technologies minimizes their integration costs, reduces the data exchange and conversion time, and excludes any losses of information – therefore, increasing reliability and efficiency of the systems created. The obtained results are of universal character and can be used in EDSS of various applications.

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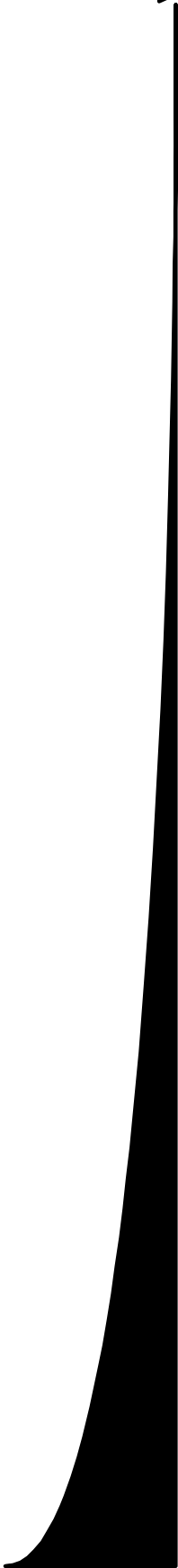
References

1. Israel, Y.A. *Ecology and environmental monitoring*. Moscow, Gidrometizdat, 1984. 560 p. (In Russian)
2. Izmalkov, V.I. *Ecological safety, methods of forecasting anthropogenic contamination and grounds for chemical monitoring development*. St. Petersburg, 1994. 131 p. (In Russian)
3. Kopytov, E., Demidovs, V. Effective Access to Historical data in Temporal Databases. In: *Conference Proceedings of the International Workshops on Harbour, Maritime and Multimodal Logistics (HMS & MAS 2003), September 18-20, 2003, Riga, Latvia*. Riga: RTU, 2003, pp. 235-241.
4. Kopytov, E., Demidovs, V., Petoukhova, N. Principles of Creating Data Warehouses in Decision Support Systems of Railway Transport. In: *Computing Anticipatory Systems: CASYS 2003 – the Sixth International Conference: Conference Proceedings 718*. New York: the American Institute of Physics, pp. 497-507.
5. Date, K. J. *Introduction into database systems. 7th edition / Translated from English*. Moscow-St. Petersburg-Kiev: The ‘Williams’ Publishing House, 2001. 1072 p. (In Russian)



Session 7

Intelligent Transport Systems (Electronics)



SYNTHESIS OF EVEN-ORDER PHASE FILTERS

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Keywords: synthesis, phase filter, digital filters

The method of synthesis of odd-order duo-channel phase filters, which uses the theory of quadripoles, is described in the paper [1]. However, the base principle of such method does not allow its easy use for even-order duo-channel phase filters synthesis, unfortunately.

Using the theory of quadripoles, the fundamental opportunity of synthesis of even-order phase filters is described in this article. The frequency and performance characteristics are provided. Additionally, the special cases of significant simplification of realizations during modelling of such phase filtration system in real time are given. Finally, the possibility of design of even-order duo-channel phase filters on bilines is shown.

References

1. Mamirov, T. *Realization of robust recursive digital filters on phase units: Bachelor paper*. Riga: Transport and Telecommunication Institute, 2001.
2. Mamirov, T. Digital Phase Units with Complex Multipliers, *Transport and Telecommunication*, Vol. 4, No 1, 2003, pp. 34-39. ISSN 1407-6160.

POTENTIAL ACCURACY OF ESTIMATION OF EARTH-IONOSPHERE WAVEGUIDE PARAMETERS THROUGH DELAYS OF REFLECTED WAVES

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Keywords: electromagnetic radiation, ionospheric waveguide, hop model, distance, effective heights, delays, lightning discharge, atmospheric

Ionospheric layers and Earth surface creates a spherical waveguide, which should be exert significant influence on features of electromagnetic fields propagating in it. At relatively low frequencies (ELF, VLF and LF bands) the ground and the lower ionospheric layer (D in daylight or E in nighttimes) are rather good conductors. It is known electromagnetic fields cannot penetrate deeply into that media. Consequently, geometric dimensions, namely, the distance between radiating and receiving points and the effective heights of the waveguide, become the main factors, which determine characteristics of propagation.

There are methods for evaluation these dimensions from receiving signal only. If the distance is not larger ~ 1500-1700 km, a hop model of propagation would be discussed. It is supposed the received signal consists of a ground wave and some waves reflected from D or E ionospheric layer. The inherent features of waveguide in this case should be appeared as delays, or times of arrivals, of that reflected waves. Earlier we have been proposed to estimate these delays analysing the received signal with pseudocepstral method used Huang-Hilbert decomposition. In this work the brief of that method is considered.

After estimation of delays one can obtain some system of equations with unknown quantities, which are the distance and effective reflecting heights for ionospheric waves. The system is underdefined since the number of equations is lesser on 1 than the number of unknown quantities. To overcome these difficulties some methods are considered based on approximation of difference of effective reflecting heights with some common physical considerations, Fermat theorem, in particular. The iterative algorithm for evaluating of length and effective heights of ionospheric waveguide is developed too. For verification, the atmospheric was selected generated by a lightning discharge with known distance. Perhaps, this algorithm is the way to solve the problems, as for passive location of these discharges by analysis of inherent electromagnetic radiation from lightning, as for ionosphere diagnostics.

Decisive importances are in errors of solving of the underdefined system. The errors in estimations of distance and effective heights are considered. If digital processing of receiving signals is used these errors strongly depend from sampling. It is established the error for distance depends on evaluated distance non-monotonously. There are minima in middle distances with positions depending upon the heights. These errors increase as long as height of reflected layer is reduced. Thus, they would be larger in the daylight than in the nighttimes. Extremely great errors of distance estimation should be observed with influence of ionospheric perturbations by strong ionisation factors. It is found the errors of effective heights estimation may be smaller up to one order than the errors of distances. Proper plots are listed. It is showed the values of considered errors have not to exceed some percents in usual cases.

It is proposed the method to replace the hop model by some equivalent antenna array analysis. One can be sure the base dimension of that array is not small in wavelengths scales, even in ELF, VLF and LF bands. Perhaps, an explanation for relatively high accuracy of estimation of waveguide parameters results from this fact.

ON REFLECTION OF ELECTROMAGNETIC WAVES FROM A RANDOMLY INHOMOGENEOUS MEDIUM

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Keywords: Fresnel coefficient, local random inhomogeneities, probability density, the Fokker-Planck equation

The problem of reflection of a horizontally polarized plane electromagnetic wave from a dielectric layer with randomly inhomogeneous dielectric permittivity is considered. Namely, the dielectric permittivity is presumed to be complex and consists of a constant background part and a fluctuating part, depending on the vertical coordinate z :

$$\varepsilon = \beta + \tilde{\beta}(z) + i\alpha + i\tilde{\alpha}(z)$$

In contrast to the previous works on such a problem [1, 3], fluctuations of both the real and the imaginary part of the dielectric permittivity are taken into account. They are presumed to be delta-correlated and mutually independent (both statistically and functionally) random functions. Under these assumptions, the Riccati's equation for the complex Fresnel coefficient is obtained and, consequently, differential equations for U and φ , where U and φ determine the Fresnel coefficient:

$$R = \frac{\sqrt{U-1}}{\sqrt{U+1}} e^{i\varphi(z)}.$$

The probability density P of the random function U is then formally introduced via delta-function [3] and the Fokker-Planck equation for this probability density is then obtained, taking into account the above mentioned equations for U and φ . To get rid of the trigonometric functions in this equation, this is averaged over the period of the fast variations of these functions, which ultimately yields the Fokker-Planck equation for P :

$$\begin{aligned} \frac{\partial P}{\partial z} = & 2\gamma \frac{\partial}{\partial U} \left[P(U^2 - 1) \right] + 4(b^2\sigma^2l + a^2s^2r) \frac{\partial}{\partial U} \left[(U^2 - 1) \frac{\partial}{\partial U} (P(U^2 - 1)) \right] + \\ & + 2(b^2\sigma^2l + a^2s^2r) \frac{\partial}{\partial U} \left[(U^2 - 1) \frac{\partial}{\partial U} (U^2 P) \right] + 2(a^2\sigma^2l + b^2s^2r) \frac{\partial}{\partial U} \left[(U^2 - 1) \frac{\partial P}{\partial U} \right] \end{aligned}$$

where

σ^2, l are dispersion and correlation length of $\tilde{\alpha}$,

s^2, r are dispersion and correlation length of $\tilde{\beta}$;

$kq = \eta + i\gamma$, where k is the wave-number in free space, $q = \sqrt{-\sin^2 \theta + \beta + i\alpha}$, where θ is the incidence angle;

$$a = \frac{2\gamma}{|q|^2}, b = \frac{2\eta}{|q|^2}.$$

The stationary solution, which corresponds to the case of an infinitely thick dielectric layer, of this “shortened” Fokker-Planck equation is then found (assuming absence of probability density flux across the boundary) and is either a trigonometric or a power function of U , which depends on relationship of the medium's parameters.

The result obtained takes into account random inhomogeneities within the irradiated medium and is therefore of worth from the viewpoint of remote sensing of media with strong volume scattering, such as multiyear sea ice and some others.

References

1. Zernov, N.N. *Abstracts of papers presented at XIV All-union conference on radio-wave propagation, pt. 2.* Moscow, 1984. (In Russian)
2. Risken, H. *The Fokker-Planck equation: methods of solution and applications.* Berlin, 1984.
3. Klyatskin, V.I. *Stochastic equations and waves in random-inhomogeneous media.* Moscow, 1980, pp. 199-201. (In Russian)

RECONSTRUCTION OF THE ROADWAY INNER STRUCTURE ELECTRO-PHYSICAL CHARACTERISTICS

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Keywords: radar, roadways, radar monitoring, inverse problem, genetic algorithm

Roadway – a complex layered structure. Damage to the roadway arises under the influence of traffic loads and climatic factors. Monitoring of roadway is capable of detecting hidden processes and symptoms (formation of voids, soil moisture changes, changes in the filtration of water in the soil and so on) that precede the visible destruction of the road. The results of monitoring can determine the best action and the necessary volume of repair and reconstruction of the roadway.

At the present time methods of radar subsurface probing are widely used to investigate objects both natural and artificial origin [1,2]. Determination of electro-physical characteristics of the medium according to the subsurface probing is the inverse problem of subsurface probing. The features of the solution of the structural inverse problem of subsurface radar sounding in the frequency domain method of selection using genetic algorithm were investigated in [3-5]. Reconstruction of roadway electro physical characteristics is a definition of electrical parameters of roadway layers by solving the inverse problem of radar probing.

The number of layers of the roadway and the materials from which they are performed, vary significantly depending on the purpose of the roadway (roadway type) [6,7]. Five models of the roadway were used in carrying out research: trunk roadway, local roadway, sidewalk, runway and temporary road. Each model is described by the electro physical characteristics of several layers of road coverage and of several layers of road base. Electrical properties of each layer: thickness h , conductivity σ and relative dielectric constant \mathcal{E} , and the range of possible values of these characteristics [6,7].

The inverse problem of reconstruction the electrical parameters of the roadway is solved in the frequency domain method of selecting the parameter vector $\vec{P} = \{p_1, p_2, \dots, p_n\}$, where p_i - electrophysical characteristic of one of the layers, and n - the number of parameters, which depends on the number of layers in the model of the roadway. A genetic algorithm with the parameters given in [3-5] was used to find the parameter vector \vec{P} . It is important to choose the type of informative features in solving the inverse problem [2]. Influence of electrical parameters of the roadway to aim function changes was investigated using the spectral density and modulus of the spectral density of the reflected signal as a informative feature. The spectral density of the reflected signal was selected as informative feature for the reconstruction of the electro physical characteristics of the roadway. If you use this informative feature, aim functions more sensitive to changes of electro physical characteristics of the investigated roadway.

Reconstruction of electro physical characteristics of the roadway for the following conditions:

- there is a priori information about the structure and electrical properties of layers of the roadway;
- there is no a priori information about the type of roadway;
- there are voids in the top layer of the base of the roadway.

The main results of these experiments are following:

- if a priori information about the structure of the roadway relative error of reconstruction of thickness and relative dielectric constant layer of roadway is less than 5%, but the relative error of reconstruction of the same characteristics for the layers of road base may reach 10%;
- if the absence of a priori information about the type of roadway the relative error of reconstruction of electro physical characteristics of the roadway reaches values that can not satisfy the practical point of view;
- the influence of thickness of the layers of the roadway on the relative error of the restoration of electrical parameters of the roadway was investigated;
- capable of identifying the voids in the road base has been shown.

References

1. *Subsurface Radar* / M. Finkelstein, V.I. Karpukhin, V.A. Kutev, V.N. Metelkin; Ed. by M. Finkelstein. Moscow: Radio and Communications, 1994. 216 p.
2. *On Subsurface Radar: Collective monograph* / Ed. by A. Grinev M.: Radio, 2005. 416 p.
3. Krainyukov, A., Kutev, V. Intelligent system for radar monitoring of transport communications. In: *Proceedings of the 7th International Conference “Reliability and Statistics in Transportation and Communication (RelStat’07), 25–27 October 2007, Riga, Latvia”* Riga: Transport and Telecommunication Institute, 2007, pp. 312-320.
4. Krainyukov, A., Kutev, V. Model-based results of inverse problem solution for radar monitoring of roadway coverage. In: *The International Conference „Modelling of business, industrial and transport systems“, 07–10 May 2008, Riga, Latvia”*. Riga: Transport and Telecommunication Institute, 2008, pp. 169-176.
5. Krainyukov, A., Kutev, V., Opolchenov, D. Reconstruction of the roadway coverage parameters from radar subsurface probing data. In: *“The 8th International Conference “Reliability and Statistics in Transportation and Communication (RelStat’08), 15–18 October 2008, Riga, Latvia”*. Riga: Transport and Telecommunication Institute, 2008, pp. 146-154.
6. *Road conditions and operating requirements for the design of cars – pavement* – <http://www.usecar.ru/page22.html>
7. *Construction machinery and equipment directory. Clothing carriageway.* – <http://stroy-technics.ru/article/odezhda-proezzhei-chasti-dorogi>



Session 8

Aviation

SIMULATION OF SITUATION AT THE BRATISLAVA AIRPORT AFTER APPLICATION OF CREATED REGULATION FORMULA OF ECONOMIC REGULATION OF AIRPORT CHARGES

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Keywords: *directive of EU, airport charges, simulation, regulation formula, Slovak airports*

In March 2009 the European Parliament and the Council issued the Directive on Airport Charges-Directive 2009/12/EC, which is a common framework regulating the essential features of airport charges. EU presents the necessity of economic regulation of airports and airport charges in Europe, but is the economic regulation the right way for Bratislava Airport and airports in the similar position? This paper explains the situation of Slovak airports and their approach to economic regulation of airport charges. The paper describes the simulation of situation at the Airport Bratislava after application of a regulation formula of economic regulation of airport charges considered as the most appropriate for Slovak airports especially Airport Bratislava. The regulation formula is based on the research of the authors.

DEVELOPMENT AND INVESTIGATION OF THE UNSTEADY 3D MATHEMATICAL MODEL FOR CONTINUED ECOLOGICAL MONITORING IN THE AIRPORT AREA

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Keywords: noise pollution, dynamics of sound-wave propagation, system of PDE with small parameters, continuous mathematical model, finite-difference approximation

The report is based on a Master's thesis, which is dedicated to the development and research of unsteady 3D mathematical models for constant monitoring of the environmental situation of air and water in areas near the airport (airport "RIX", city of Riga is used as an example). We mainly consider noise (acoustic) pollution – the annoying noise of anthropogenic origin, which violates the vital activity of living organisms and humans.

Large tonnage aircrafts with powerful turbojet and turboprop engines, the increase of intensity of their flights, growth of the park and expansion of the scope of civil helicopters leads to significant "noisiness" of vicinity of the airport and territories under the air routes. Aircraft noise, which has a significant impact on noise regime within the airport and in the vicinity, depends on the direction of the runways and aircraft routes, flight intensity during the day, seasons, types of aircrafts based at this airport, and other factors. With intensive 24-hour operation of airports noise levels reach 80 dBA in the daytime and 78 dBA at night time, with maximum levels ranging from 92 to 108 dBA. Noise monitoring in the airport area and timely preparation of up-to-date maps of noise pollution (airport acoustic passport) – is a necessary condition for the standardization of the airport to ICAO standards.

To address the problem of environmental monitoring of noise influence in dynamics, the use of mathematical modelling of propagation of acoustic waves (noise pollution) with the construction of the contours of aircraft noise in real time is proposed. Sound meter installed at airports, record discrete values of noise level at the control points (usually the noisiest). By processing the data using mathematical tools, with a priori data about the topography of the airport zone, we obtain a detailed model of the spread of noise.

In this research the following continuous mathematical model describing noise emission with consideration for environmental factors is constructed:

$$\begin{cases} \frac{\partial^2 u(t, x)}{\partial t^2} + \varepsilon_1 \cdot \frac{\partial u(t, x)}{\partial t} = \Delta u(t, x) + \rho(t, x), & x \in D, t \in (0, T], \\ \frac{\partial^2 \rho(t, x)}{\partial t^2} + \varepsilon_2 \cdot \frac{\partial \rho(t, x)}{\partial t} = \Delta \rho(t, x) + u(t, x) + F(t, x), & x \in D, t \in (0, T], \\ u(t, x)|_{t=0} = u_0(x), & x \in \bar{D}, \\ \rho(t, x)|_{t=0} = \rho_0(x), & x \in \bar{D}, \end{cases}$$

$$\begin{cases}
 u(t, x)|_{x_i=l_1^{(i)}} = u_1^{(i)}(t), \quad i = \overline{1,3}, \\
 u(t, x)|_{x_i=l_2^{(i)}} = u_2^{(i)}(t), \quad i = \overline{1,3}, \\
 \left. \frac{\partial \rho(t, x)}{\partial x_i} \right|_{x_i=l_1^{(i)}} = \rho_1^{(i)}(t), \quad t \in [0, T], \\
 \left. \frac{\partial \rho(t, x)}{\partial x_i} \right|_{x_i=l_2^{(i)}} = \rho_2^{(i)}(t), \quad t \in [0, T],
 \end{cases} \quad (1)$$

where $x = (x_1, x_2, x_3) \in \overline{D} \stackrel{\text{def}}{=} [l_1^{(1)}, l_2^{(1)}] \times [l_1^{(2)}, l_2^{(2)}] \times [l_1^{(3)}, l_2^{(3)}]$, $D = \overline{D} / \partial D$; $l_1^{(i)} (i = \overline{1,3})$ and $l_2^{(i)} (i = \overline{1,3})$ are respectively original and finitesimal coordinates for edges of the 3D parallelepipedic airport area/zone \overline{D} , where expansion of noise pollution is investigated; $t \in [0, T]$, T is the end of the time segment during which the process is investigated; numeric parameters $\varepsilon_i (i = 1, 2)$ are relaxation coefficients; the function $u(t, x) = u(t, x_1, x_2, x_3) \in C^{2,2} \{[0, T] \times \overline{D}\}$ characterizes "quantity" of acoustic pollution (i.e. weighted-noise power) in the spatial point $x \in \overline{D}$ at the time point $t \in [0, T]$, and this function is unknown; the function $\rho(t, x) = \rho(t, x_1, x_2, x_3) \in C^{2,2} \{[0, T] \times \overline{D}\}$ characterizes environment density (i.e. density of the parallelepipedic area \overline{D}) in the spatial point $x \in \overline{D}$ at the time point $t \in [0, T]$, and this function is also unknown; the initial functions $u_0(x)$, $x \in \overline{D}$ and $\rho_0(x)$, $x \in \overline{D}$ are assumed to be specified, moreover, $u_0(x) \in C\{\overline{D}\}$, $\rho_0(x) \in C\{\overline{D}\}$; the boundary functions $u_j^{(i)}(t) \in C\{[0, T]\}$ ($i = \overline{1,3}; j = 1, 2$), $\rho_j^{(i)}(t) \in C\{[0, T]\}$ ($i = \overline{1,3}; j = 1, 2$) are also assumed to be a priori prescribed functions; the given function $F(t, x)$ describes an external sources intensity that have an impact on the environment density $\rho(t, x)$ at $(t, x) \in [0, T] \times D$.

It is required to unique determine sought functions $u(t, x) \in C^{2,2} \{[0, T] \times \overline{D}\}$ and $\rho(t, x) \in C^{2,2} \{[0, T] \times \overline{D}\}$ from the model (1) under the requirement that the appropriate consistency constraints are fulfilled for original and boundary functions.

In prospect, we plan to develop software applications for calculating the propagation of noise, with subsequent analysis of the effectiveness of the model, approximation of data and determination of aircraft noise exposure contours, on the basis of the model. It is assumed as a series of field measurements of noise in the area of the airport of Riga is to be held for obtaining the statistical data and it's comparison with the values obtained by modelling. The model and the data analysis will help in creating a dynamic system of monitoring the noise level in the airport area and its surroundings, identifying violations of noise pollution level for aircrafts on take-off and landing mode of the engine.

SELECTION OF THE DIAGNOSTIC PARAMETERS FOR CONTROLLING AND DIAGNOSING THE GAS-TURBINE ENGINE WITH REGRESSION ANALYSIS

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Keywords: aircraft engine, diagnostic information, diagnostic parameters, regression analysis

Aircraft engine is a complicated technical object possessing a considerable number of factors, somehow influencing the gas-turbine engine functioning and being very difficult for accounting. The number of factors, which are measured in the modern aircraft engines, can reach the range some from tens to hundreds, but not all these parameters include the necessary diagnostic information. In the course of maintenance it is necessary to emphasize only the parameters having the most significant information on the engine performance. It means that the primary task is to select the diagnostic parameters of great informative value.

The choice of the diagnostic parameters and characteristics is defined, as a rule on the base of the analysis of the registered information by means of special facilities registering the flight and ground data. The optimisation of the diagnostic parameters choice is performed taking into account the peculiarities of the engine construction as the object of the diagnostics, the analysis of the functional connections of aggregates and systems, engine failures and the relationships between engine performance and its present state [1]. Such approach to the definition of the diagnostic parameters is built on the base of the analysis of the occurred damage. This analysis is usually carried on by the specialists-experts utilizing the heuristic methods. The diagnostic value of parameters is defined according to the rules of the cause-and-effect relations [2]. They are opposed to the formal methods of solutions based on exact mathematical models.

Such approach to defining the diagnostic parameters has both advantages and disadvantages. The main disadvantage is that before damaging the parameters are not ranged according to the extent of their significance for engine controlling and diagnosing. The work shows that using the multiple regression analysis, it is possible to reveal the most informative parameters and to check up the value of these parameters by means of different statistical criteria [3, 4].

References

1. Novikov, A.S., Paikin, A.G., Sirota, N.N. *Monitoring and diagnostics of technical condition of gas turbine engines*. Moscow: Nauka, 2007. 469 p. (In Russian)
2. Lozitsky, L.P., Stepanenko, V.P., et al. *Practical diagnostics of aircraft gas turbine engines*. Moscow: Transport, 1985. 103 p. (In Russian)
3. Gringlaz, L., Kopytov, E. *Mathematical statistics with examples of problem solving on the computer: Textbook, 2nd ed.* Riga, 2002. 236 p. (In Russian)
4. Yatskiy, I.V. *Multivariate Statistical Analysis: Classification and Dimensionality Reduction: Textbook of the Course "Computer Statistics", 2nd ed.* Riga: Institute of Transport and Telecommunication, 2004. 207 p. (In Russian)

THE DECISION ACCORDING TO CRITERIA IN THE EXPERT SYSTEM INFERENCE ENGINE FOR AIRLIFTING

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Keywords: artificial intelligence, expert systems, basis of knowledges, inference engine, basis of fact, transport, airlifting, failure evaluation.

In this article there is described a basic concept of the inference engine designed using decision according to criteria, the basic concept of an artificial intelligence and the main parts of expert systems (designed and created myself) especially – Communication module, Basis of knowledge, Inference engine, Basis of facts, Module for getting information. There are results of described expert system in praxis in the airports and hardware and software requirements for expert system realization.



Session 9

Simulation

SIMULATION OF PRODUCTION LINE AND WAREHOUSE MANAGEMENT BASED ON *RFID* TECHNOLOGY THROUGH 3D MODELLING AND ANIMATION

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Keywords: RFID technology, 3D models, warehouse management, simulation

This article primarily deals with simulation of production line and warehouse management based on RFID technology, through 3D modelling and animation. It describes the various components of RFIDlab (Laboratory for goods and services automatic identification), which consists of a production line and warehouse management based on RFID technology. In the article, there are characterized and described the processes that are taking place in the laboratory as well as used technologies.

The RFID technology is complex, combining a number of different computing and communications technologies to achieve the desired objectives. Each object, which has to be identified, is stuck inside of a small object known as an RFID tag. RFID tag has a unique identifier, through which you can store additional information of an object. Equipments, which are known under the name of RFID readers wirelessly, communicate with RFID tags with a view to identify RFID tags attached as well as the possibility to read and update information stored in the RFID label.

In the article processes by the production line and warehouse management are described. There 3D models and animations created to capture the whole process in the laboratory is set up and described in the given article.

References

1. Kolarovszki, P., Vaculík, J. Reálny proces automatickej identifikácie tovarov a služieb a transferu poznatkov – *RFID LAB*. In: *Pošta, Telekomunikácie a Elektronický obchod*. [online], 2010, roč. 5, č. 1 [cit. 2010-3-8]. Dostupné na internete: <http://ks.utc.sk/casopis/pdf/I2010/I-2010.pdf>. ISSN 1336-8281.
2. Kolarovszki, P. *Využitie RFID u národných poštových operátorov*: dizertačná práca. Žilina : Žilinská univerzita v Žiline, Fakulta prevádzky a ekonomiky dopravy a spojov, Katedra spojov; 2009. 166 s.
3. Vaculík, J. a kol. *Multimédiá*. Žilina: Žilinská univerzita v Žiline, 2006. 250 s. ISBN 8080706042.
4. Koenigsmarck, von A. *Cinema 4D R10*, Computer Press a.s. , 2008, BRNO. ISBN 978-80-251-2056-9.
5. Dúbravka, V. *Multimediálne spracovanie RFIDlab – Laboratória automatickej identifikácie tovarov a služieb*, Diplomová práca, 2010.

APPLICATION OF DISCRETE RATE APPROACH FOR TRAFFIC FLOW SIMULATION

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Keywords: discrete rate, mesoscopic models, traffic flow

The classical scientific literature dedicated to transport modelling emphasizes three levels of detalization on which traffic model could be created [1, 2]. These levels are the following: microlevel, mesolevel and macroscopic level. Microscopic and macroscopic modelling are well known, widely used and have exact definition. The example of using simulation on microscopic level and on macroscopic level could be observed in the following references [3, 4, and 5]. Accordingly [2] the micromodels are characterized by traffic flow detailed description and also by infrastructure detailed description. The objects of the modelling for this level are crossroads, groups of crossroads, bridges, flyovers, traffic circles, etc. The main application is the decision-making on the strategic level. The traffic flow on macroscopic level is presented in general and is associated with fluid flow (hydrodynamic model) or with gas (gasodynamic model) [1]. Transport infrastructure is presented with the low level detalization: crossroads – nodes, streets as links which connect nodes. The objects of modelling are districts of the city, city, regions of the country, country, etc. Output data are presented with the average values and could be used for decision making on strategic level.

The term “mesoscopic modelling” itself, is interpreted by different scientists in different ways. In general under mesoscopic traffic flow models should be understand models where traffic flow is described with high level of detalization, but at the same time flow behaviour and flows interaction are presented with the low level of description [6].

In [7, 8] is shown how new simulation approach called by authors “mesoscopic simulation” has been applied for traffic flow simulation. All the described models were implemented using Microsoft Excel and VBA. But the practical application concerns that to construct more sophisticated models Microsoft Excel and VBA could not be used.

The main goal of this paper is to present examples of application of discrete rate approach of the ExtendSim simulation software for traffic flow simulation. This approach is similar with the implemented in [7, 8]. The literature survey showed that mainly discrete rate approach is used in logistics, but not in transport area. So the tasks of the study is to present main techniques of model implementation using discrete rate approach and to apply this approach for traffic flow simulation on the base of numerical example.

References

1. Kutz, M. *Handbook of transportation engineering*. McGraw-Hill Professional, 2004. 1000 p. ISBN 9780071391221
2. Hall, Randolph W. *Handbook of transportation science*. Springer, 1999. 532 p. ISBN 9780792385875
3. Savrasovs, M. Development of Liepaja city macroscopic model for decision-making, *Transport and Telecommunication*, Vol. 8, No 2, 2007, pp.38-46.
4. Yatskiv, I., Yurshevich, E., Savrasov, M. Investigation of Riga Transport Node Capacity on the Basis of Microscopic Simulation. In: *Proceedings of the 21st European Conference on Modelling and Simulation (ECMS 2007), 2007, Prague, Czech Republic*. Prague, 2007, pp.584-589.
5. Yatskiv, I., Medvedev, A., Savrasov, M. Analysis and Forecast of the Urban Public Transport Flow in Jurmala City. In: *Proceedings of the 7th International Conference, Reliability and Statistics in Transportation and Communication, 2007*, pp.79-93.
6. Burghout, W. *Hybrid Microscopic-Mesoscopic Traffic Simulation: Doctoral Dissertation*. Stockholm, Sweden: Royal Institute of Technology, 2004.
7. Savrasov, M., Toluyew, Y. Transport system’s mesoscopic model validation using simulation on microlevel. In: *Proceedings of the 8th International Conference, Reliability and Statistics in Transportation and Communication, 2008*, pp. 297-304.

MACROSCOPIC TRANSPORT MODEL DATA 3D VISUALISATION USING KML

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Keywords: 3D, macroscopic transport model, KML, visualization

Visualization and animation plays a big role in simulation. They could be use for data presentation and even for model calibration. Speaking about transport models, mainly visualization and animation are applicable for models created on microscopic level. Both 2D and 3D animation could be constructed and used for presentation purposes. Macroscopic transport models at the moment mainly use only 2D data representation. From one hand it does not overload model with details and from the other hand information presented in 3D is still perceived very well by human brain.

The main goal of this paper is to demonstrate a possibility of macroscopic model 3D data visualization using modern information technologies. The demonstration is done using transport model development simulation software PTV VISION VISUM [2] and using keyhole mark-up language (KML) [1]. As the representation environment is used Google Earth. Tools and technologies mentioned above were selected because of the following reasons: VISUM is a modern simulator which supports COM interface and scripting; KML elegant and powerful XML based language for displaying geographical data and visualization; Google Earth supports KML and provide flexible environment for visualization and animation.

The process of macroscopic data visualization could be presented by the following steps: 1) simulation model execution, to obtain data; 2) script running for construction KML file; 3) KML file loading into Google Earth Application; 4) browsing of data.

Describing mentioned-above steps in details, the following comments could be added. 1) Model execution is provided by standard possibilities of simulation software in our case by PTV VISION VISUM; 2) script for construction of KML file could be created using VISUM possibility to implement Python based scripts as add-ins; 3) generated KML file is a XML file expressing geographic annotation and visualization references. KML file could be loaded into desktop installation of Google Earth application or to Google Earth browser add-in; 4) Data browsing could be done in Google Earth or using Google Earth add-in for browsers. The second variant opens new possibilities in sharing model data across the Internet not as static images, but as interactive viewing of the model.

The proposed idea of macroscopic transport model data 3D visualization using keyhole mark-up language could be a new good tool for data presentation and data sharing across the Internet. Another good possibility, that such kind of macroscopic 3D models could be interactive.

References

1. KML Tutorial – http://code.google.com/intl/en-EN/apis/kml/documentation/kml_tut.html
2. PTV VISION VISUM Official Manual, 2008.

RESEARCH OF CALL-CENTRE OPERATION INDICES ON THE BASES OF QUEUING THEORY AND SIMULATION MODELS

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Keywords: call-centre, analytical model, simulation model, traffic

Nowadays call-centres are effective and indispensable communication means for both the companies and their clients [1].

In spite the great spectrum of call-centres, analytical Erlang's models are still being used [2]. These models, previously showed to advantage, can not be adjusted to the complexity of the devices and specific character of modern call-centres. Consequently, these models can't adequately reflect the operation processes of call-centres.

The article studies the real work of a call-centre with the built into monitoring system which lets estimate the quality and parameters of call-centre operation based on statistical data.

For the call-centre research the following models have been used [3]:

- M/M/N/N;
- M/M/N;
- M/M/N/N+c
- and etc.

None of the above mentioned models showed the results completely coinciding with the data received from the real system in all range of loading.

Further the research of the call-centre is carried out based on simulation model realised on GPSS language. The task of such model creation is very complex and labour consuming.

The article offers the graphs of analytical and imitation models and shows that simulation model gives the best and most adequate characteristics of the real system in all range of loading.

References

1. Roslyakov, A.V., Samsonov, M.Yu., Shubayeva, I.V. *Call Service Centres*. Moscow: Eco-Trends. 2002. (In Russian)
2. Krylov, V.V., Samohvalova, S.S. *Theory of tele-traffic and its applications*. Saint-Petersburg: BHV, 2005. (In Russian)
3. Zarubin, A.A. Call- and contact centres. Evolution of technologies and mathematical models, *Vestnik Svyazi*, No 8, 2003. (In Russian)

SUPPLY CHAIN SIMULATION IN EXTEND SIM ENVIRONMENT

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Keywords: inventory control, supply chain, simulation, Extend Sim package

In the given paper a stochastic single-product inventory control model for the chain “producer – wholesaler – customer” is considered. We have to take into account that the sum of total costs for goods ordering, holding and losses from deficit per time unit should be minimal. In proposed criteria total costs are sum of corresponding costs (losses) for all subjects taking part in the ordering process, in our case for customers and wholesaler.

Figure 1 shows a basic diagram of the following supply chain “producer – wholesaler – customer” with two stages in ordering process: the first stage is executed by customer and the second one – by wholesaler [1].

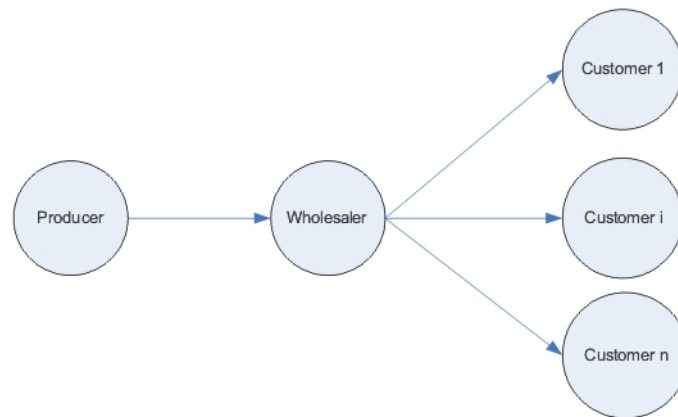


Figure 1. Chain of product ordering

The strategy of the *first stage* executed by customer is based on a model with fixed reorder point and fixed order quantity. The demand for goods D_i of customer with number i is Poisson process with intensity λ_i . Time L_i of goods delivery from wholesaler to i -th customer has normal distribution with parameters μ_i and σ_i . The policy of order forming for i -th customer is as follows. A new order is placed in the moment of time, when the stock level falls till certain level r_i . The quantity r_i is called as *reorder point*. The order quantity q_i is constant. We suppose that $q_i \geq r_i$. Note that order quantity q_i and reorder point r_i are *control parameters* of the first stage model. We suppose that the wholesaler has his own storehouse with definite quantity of goods Q . If customer's order quantity is less than quantity of production in the stock ($q_i < Q$) the wholesaler performs this order in full volume at once. Otherwise, when demand order quantity exceeds the value of stock quantity ($q_i \geq Q$), the customer will receive only part of goods, and there is the situation of deficit of $q_i - Q$ units of products in wholesaler's storehouse.

The strategy of the *second stage* is realized by a wholesaler. We assume that producer supplies its production to wholesaler according fixed schedule. In this case we consider ordering

process with fixed period of time between the moments of placing neighbouring wholesaler's orders; and order quantity is determined as difference between the fixed stock level S and quantity of goods in the moment of ordering r (see Fig.2). The lead time L has a normal distribution with a mean μ_L and a standard deviation σ_L . We suppose that lead time essentially less as period of the cycle: $\mu_L + 3\sigma_L \ll T$.

The considered models are realized using simulation method with the help of the package ExtendSim 8. An ExtendSim model is created by adding blocks to a model worksheet, connecting them together, and entering the simulation data. Each type of block has its own functionality, help, icon, and connections. Each instance of a block has its own data [2].

ExtendSim includes a relational database for organizing and centralizing simulation information. The use of a database in a model allows the modeller to separate the data from the model structure. This database has become a core feature in ExtendSim models, large and small. In many cases, the ExtendSim model building process begins with the conceptualisation of the database. Once the database design has been completed, the model is built to support the data organization. This approach leads to more scalable and better organized models.

The numerical examples of problem solving are presented in the paper.

The suggested simulation approach gives:

- the clearness of the presentation of results; first of all, it touches the case of analysis of total expenses dependence on one control parameter with fixing others;
- the possibility of finding optimum solution of an inventory problem in the case when realization of analytical model is rather difficult;
- the descriptive user interface and ability to control any necessary parameter of the model.

References

1. Kopytov, E., Greenglaz, L., Tissen, F. Inventory control model for the chain “producer – wholesaler – customer”. In: *Proceedings of the international symposium on stochastic models in reliability, safety, security and logistics, Beer Sheva, 2005*. Beer-Sheva, 2005, pp 204-207.
2. Muravjovs, A. Inventory control system simulation in EXTENDSIM, *Research and Technology – step into the future*, Vol. 3, No 2, 2008, pp. 21-22 (in Russian). ISSN 1691-2853.

ARTIFICIAL NEURAL NETWORKS FOR ADAPTIVE MANAGEMENT TRAFFIC LIGHT OBJECTS AT THE INTERSECTION

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Keywords: traffic light, adaptive steering, simulation, neural network, MLP

Key nodes of the road network of the city are the intersections. It is the greatest losses that are observed as the use of the roadway. Analysis of traffic conditions shows that the intensity of traffic on the approaches to the crossing is not constant, but subject to change during the day with a peak period (one or two). Furthermore, even with constant intensity, the movement of vehicles is random; there are variations in the number of cars approaching the intersection for the same periods of time.

If slow change of the traffic the optimal duration of the cycle and phases, calculated for the conditions of the peak period for the rest of the time of day are not optimal, are typically too large, leading to unnecessary support for transport.

In this regard, more actively developed various systems that adaptively take into account changes in traffic flows. One of the directions of development of such systems is the use of neural network approach to the management tasks [1]. To implement adaptive management the authors suggest the following model of the adaptive system (Fig. 1).

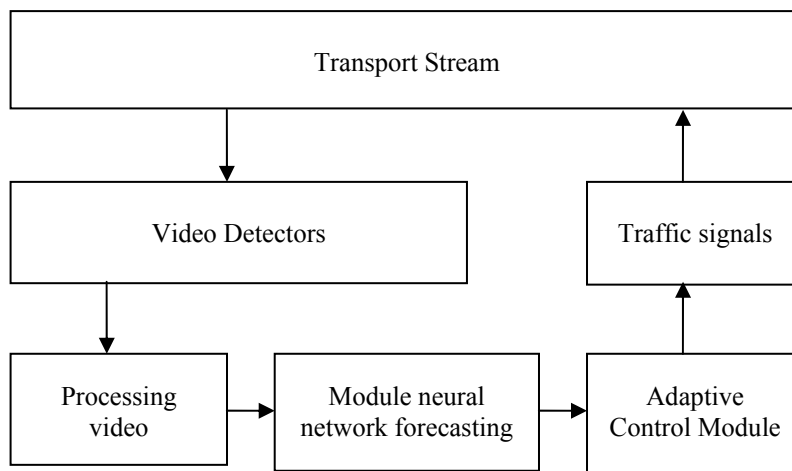


Figure 1. Model adaptive control

With video detectors read off on the state of traffic flow. Based on this information, the software module calculates the intensity of traffic flow q . In the operation of the intensity is

continuously fed to the prediction module, where as a result of the module is the future value of intensity. Based on this value, calculated the length of the new traffic light cycle.

With strict regulation length calculation traffic light cycle is in the process of setting controller [2]. The proposed model of a set of initial data for the calculation will be updated at iteration of the traffic light cycle.

References

1. Protodiakonov, A.V., Shvets, S.E., Fomin, A.N. Evaluating the effectiveness of traffic light control at the intersection using adaptive neuro-fuzzy control system. In: *Materials of the Conference "Neuroinformatics -2010", Vol. 1.* 2010, p. 208-217.
2. Kremenets, Y.A. *Technical Traffic Control.* Moscow: Transport, 1990.
3. Vrubel, Y.A. *Traffic Organization, Vol. 2.* Minsk, 1996.
4. Golovko, V.A. *Neural networks: training, organization, application. Neurocomputers and their applications: Proc. Manual.* Moscow, 2001.
5. Pavlov, S.V. *Technology forecasting complex observed time series: dissertation ... Cand. Technical. Science: 05.13.01.* Krasnoyarsk, 2007.



The 11th International Conference
RELIABILITY and STATISTICS
in TRANSPORTATION and COMMUNICATION (RelStat'11)
19-22 October 2011. Riga, Latvia

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The purpose of the conference is to bring together academics and professionals from all over the world to discuss the themes of the conference:

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- Reliability and Safety of Transport Systems
- Rare Events and Risk Management
- Modelling and Simulation
- Intelligent Transport Systems
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DEADLINES AND REQUIREMENTS

Submission of abstracts:	26 April	2011
Acceptance of abstracts:	5 May	2011
Submission of final papers:	25 June	2011
Acceptance of final papers:	5 July	2011

Abstracts (about 600 words in length) and papers submitted for review should be in English and, should present a clear and concise view of the motivation of the subject, give an outline, and include information on all authors (the full name, affiliation, address, telephone number, fax number, and e-mail address of the corresponding author).

Submitted abstracts and papers will be reviewed. Accepted and invited papers will be published in the proceedings of the conference and in the journal "Transport and Telecommunication" (ISSN 1407-6160).

Instruction for papers preparing can be found on the conference WWW page: <http://RelStat.tsi.lv>.

INVITED SESSIONS (workshops)

Proposals for invited sessions (workshops) within the technical scope of the conference are accepted. Each proposal should describe the theme and scope of the proposed session. The proposal must contain the title and theme of the session and a list of paper titles, names and email addresses of the corresponding authors. Session proposals must be submitted by **1 June 2011**.

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The registration fees will be **Euro 100** before 6 August 2011, and **Euro 150** after this date. This fee will cover the participation in the sessions, coffee breaks, daily launch, hard copy of the conference proceedings.

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Riga is the capital of the Republic of Latvia. Thanks to its geographical location, Riga has wonderful trade, cultural and tourist facilities. Whilst able to offer all the benefits of a modern city, Riga has preserved its historical charm. It's especially famous for its medieval part – Old Riga.

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ACCOMMODATION

A wide range of hotels will be at the disposal of participants of the conference and accompanying persons (http://eng.meeting.lv/hotels/latvia_hotels.php).

FURTHER INFORMATION

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