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ABSTRACTS

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Contents

Plenary Session

Artificial Intelligence and Data Analysis Applications in Intelligent Transportation Systems
Enrique Onieva .................................................................................................................. 2

SMART-PT: Adaptive Public Transport for a Smart City
Itzhak Benenson .................................................................................................................. 3

Session 1. Transport for Smart City

Socio-Economic Aspects of Free Public Transport
Tarmo Tuisk, Gunnar Prause ............................................................................................... 6

Evaluation of the Quality of Public Transport Stops
Ivana Olivková .................................................................................................................... 7

Environmental Safety of City Transport Systems: Problems and Influence of Infrastructure Solutions
Irina Makarova, Ksenia Shabenkova, Vadim Mavrin, Kirill Magdin .................................. 8

Tram Service Quality and Its Impact on The Passengers’ Modal Choice in Constantine City (Algeria)
Mouloud Kelf, Salim Boukebbab, Mohamed Salah Boulahlib .......................................... 9

Problems of the Warsaw Metropolitan Area in Shaping the Principles of Sustainable Transport Development
Cezary Krysiuk, Gabriel Nowacki, Jacek Brudalak ................................................................ 10

Feasible Path Planning Algorithm for City Road Network
Paulius Skačkauskas, Edgar Sokolovskij ............................................................................. 11

Factors Affecting the Efficiency Indicator of the Public Transport System – Case Study
Franciszek J. Restel, Łukasz Wolniewicz ......................................................................... 12

Directions of Development of Eastern Poland’s Transport Infrastructure by the Example of the Lublin Province
Bartosz Zakrzewski, Jacek Brudalak, Gabriel Nowacki, Krzysztof Olejnik ......................... 14

Power Plant Optimal Operation Time Approach in Best Energy Mixture Model with Simulation Analysis
Tatiana Endrjukaite, Alexander Dudko, Kunihiko Okano, Hiromi Yamamoto .................... 15

Decision-Making Process for Choosing Technology of Diesel Bus Conversion into Electric Bus
Kristine Malnaca, Mikhail Gorobetz, Irina Yatskiv (Jackiva) ............................................. 16

Session 2. Statistics and Modelling in Transport Applications

Exploring Women Travel Behaviour in the Region of Žilina from Large Scale Mobility Survey
Ghadir Pourhashem, Luboš Buzna, Tatiana Kováčiková, Martin Hudák ................................ 18

Assessment of Inventory Indicators for Nomenclature Groups with Rare Demand
Valery Lukinskiy, Vladislav Lukinsky, Anna Strimovskaya ............................................... 19

Multi-Agent Approach to Optimization of Tariffs for the Air Navigation Service
Igor Bessmertny, Nikolai Sukhikh ..................................................................................... 20
Spatiotemporal Feature Selection for Urban Traffic Flow Forecasting
Dmitry Pavlyuk, Edgars Mertens ................................................................. 22

Application of Direct Partial Boolean Derivatives and Binary Decision Diagrams in Identification of Minimal Cut Vectors
Patrik Rusnak, Miroslav Kvassay, Elena Zaitseva .................................................. 24

Exploring the Potential of Social Media Content for Detecting Transport-Related Activities
Dmitry Pavlyuk, Maria Karatsoli, Eftihia Nathanail .................................................. 26

Simulation Model of Check-In Management Regarding the IATA Level of Service Standards
Artur Kierzkowski, Tomasz Kisiel, Maria Pawlak .................................................. 28

Investigation of Contemporary Neuroevolution Methods
Elena Yurshevich, Angelina Soboleva ........................................................................ 30

Reduction of Dimensionality of Feature Vectors in Subject Classification of Text Documents
Tomasz Walkowiak, Szymon Datko, Henryk Maciejewski ........................................ 32

Combinatory Method of Optimization of Regional Basing of Mobile Units of Commercial Unmanned Aircraft Vehicles
Nikolajs Sulima ........................................................................................................ 34

Data Preparation Framework Development for Markov-Modulated Linear Regression Analysis
Irina Yatskiv (Jackiva) and Nadezda Spiridovska ....................................................... 35

Natural Language Processing Knowledge Network Approach for Interactive Highlighting and Summary
Alexander Dudko, Tatiana Endrjukaite, Yasushi Kiyoki ........................................... 37

Baltic Sea Region States in the Logistics Services’ Market: Key Success Factors
Elena Cherniavskaya .................................................................................................. 38

Session 3. Intelligent Transport Systems

Use Cases and Introductory Analysis of the Dataset Collected Within the Large Network of Public Charging Stations
Milan Straka, Ľuboš Buzna ....................................................................................... 40

Influence of Constructive Materials of Road Cover on Magnetic Field Dispersion of Wireless Power Transmission Systems
Rodions Saltanovs, Alexander Krainyukov ............................................................... 41

Speed Management in Zones of Crosswalks
Antonina Korzhova, Denis Kapski ............................................................................ 43

The Performance Wall of Large Parallel Computing Systems
János Végh, József Vásárhelyi, Dániel Drótos ................................................................ 44

Session 4. Telematics

Availability of Applications in Container-Based Cloud PaaS Architecture
Igor Kabashkin ........................................................................................................... 46

Increasing the Efficiency of the Wireless Charging System for Mobile Devices That Support Qi Standard
Aleksandr Krivchenkov, Rodion Saltanovs .............................................................. 47

A System of Data Processing as Two-Phase Queueing System
Iakov Dalinger ........................................................................................................... 49

3D-Reconstruction of Human’s Face in Person’s Identification Problem from Video Stream Data
Fyodor Panchuk, Alexander Grakovski ....................................................................... 50

Significant Simulation Parameters for RESTART/LRE Method in Teletraffic Systems of SDN
Elena Ivanova, Teodor Iliev, Grigor Mihaylov, Ventsislav Keseev, Ivaylo Stoyanov ................................................................. 51
Feasibility Study of Modern Intelligent Methods Application for Digital Forensics
Aleksandr Krivchenkov, Boriss Misnevs, Dmitriy Pavlyuk ................................................................. 53

Using Impact-Oscillatory Loading and Nanotechnologies for Improving Mechanical Properties
of Two-Phase Titanium Alloy VT23
Mykola Chausov, Pavlo Maruschenko, Oleugas Prentkovskis ............................................................ 54

Employment of SiC MOSFETs and GaN – Transistors for of Wireless Power Transmission Systems
Rodions Saltanovs, Alexander Krainyukov ................................................................................................. 56

Off-The-Shelf Convolutional Neural Networks Low-Light Object Detection Comparison
Przemyslaw Śliwiński, Jacek Mazurkiewicz, Jaroslaw Sugier, Tomasz Walkowiak, Krzysztof Helt ...... 58

Performance Evaluation of Event-Driven Software Applied in Monitoring Systems
Jaroslaw Sugier, Tomasz Walkowiak, Jacek Mazurkiewicz, PrzemyslawŚliwiński, Krzysztof Helt ....... 59

Checkers Player Next Move Aided System
Agata Filar, Jacek Mazurkiewicz ............................................................................................................... 61

Required Depth of Electricity Price Forecasting in the Problem of Optimum Planning of Manufacturing
Process Based on Energy Storage System (ESS)
Aleksandr Krivchenkov, Alexander Grakovski, Ilya Balmages .............................................................. 63

Session 5. Smart Solutions for Supply Chain Management
Operational Simulation-Based Decision Support in Intralogistics Using Short-Term Forecasts
Marcel Müller, Tobias Reggelin, Stephan Schmidt ..................................................................................... 66

Choosing the Localisation of Loading Points for the Cargo Bicycles System in the Kraków Old Town
Vitalii Naumov, Jakub Starczewski ....................................................................................................... 68

The Role of Reverse Logistics in the Transition to a Circular Economy
Irina Makarova, Ksenia Shubenkova, Anton Pashkevich, Vladimir Shepel`ev ........................................ 69

Increasing the Adequacy of Management Decision Making for Choosing Intermediaries
in Supply Chains
Valery Lukinskiy, Vladislav Lukinskiy, Darya Bazhina ............................................................................. 71

The Analysis of Logistics and Supply Chain Management Organizational Structures on Russian Market
Victor Sergeyev .............................................................................................................................................. 72

The Possibilities of Supplying Processing Lines with the Material
Juraj Vaculík, Ema Havranová, Ivan Otto .................................................................................................. 73

Blockchain Application for Supply Chain Management
Genady Gromovs, Eduard Shevtshenko, Alex Norta, Mika Lammi ......................................................... 74

How Logistics is Connected to Industry 4.0
Béla Illés, Jánoš Végó ............................................................................................................................ 76

Session 6. Sustainable Aviation and Maritime Transport
Integrating Air Cargo Road Feeder Services into Green Transport Corridors
Anatoliy Beifert, Gunnar Prahau .............................................................................................................. 78

Condition Monitoring of Helicopter Main Gearbox Planetary Stage
Aleksey Mironov, Deniss Mironovs ........................................................................................................... 79

Research and Practical Application of Vibration Transfer Functions in Diagnostics of Jet Engine
Aleksey Mironov, Pavel Doronkin, Deniss Mironovs ................................................................................ 80

Measurements of the Parameters of a Broadband Satellite Data Channel in the SAVSAT Ship System
Aleksandr Krivchenkov, Aleksej Skrunds ................................................................................................. 81

Assessment of Management Opportunity of Aircraft Spare Parts for Maintenance
Murat Amelov, Alexander Medvedev ....................................................................................................... 82
Multi-Layered Approach to the UAV Collision Avoidance System
Dmitrij Lancovs ........................................................................................................84

Small and Medium-Sized Ports in the Digital Boom: The Case of Smart Growth and Sustainable Value
Creation in the Regions
Laima Gerlitz ......................................................................................................... 86

Implementation of a Multiple Remote Tower
Darius Bazaras, Vaidotas Kandroška, Giedrė Rakauskiene, Jonas Vytautas Jusionis .......... 88

Session 7. Reliability, Safety and Risk Management

Safety Status on Road Transport System in the European Union
Gabriel Nowacki, Krzysztof Olejnik, Bartosz Zakrzewski ............................................. 90

Innovative Solution of Security System at International Airport
Bohdan Paszukow ...................................................................................................... 91

Risk Management in Crisis Management Process
Natalia Moch, Robert Maciejczyk ............................................................................. 92

Safety Problems in the Implementation of Paying Transactions without Cash
Robert Maciejczyk, Natalia Moch .............................................................................. 93

Information Support Systems for Crisis Management
Bogusław Jagusiak, Anna Chabasińska ...................................................................... 94

Dimensions of Security System Complexity and Risk Detection Praxis
Arnold Warchal ........................................................................................................ 95

Testing of the Drivers Ability to Assess the Distance on the Road While Driving
Krzysztof Olejnik, Marcin Lopuszyński, Gabriel Nowacki, Bartosz Zakrzewski .............. 96

Fatigue Life Dependence on Non-Uniform Hardening Effect after Surface Rolling
Aleksei Kurashin, Vitalijs Zaharevskis, Olegs Kovzels ............................................... 97

Identification of Reliability Models for Non-Repairable Railway Component
Jaroslaw Selech, Karol Andrzejczak ........................................................................... 98

Generalised Gamma Distribution in the Corrective Maintenance Prediction of Homogeneous Vehicles
Karol Andrzejcak, Jaroslaw Selech ............................................................................ 99

Impact of Sulphate Reducing Bacteria on Biocorrosion of Pipe Steels
Miroslava Polutrenko, Pavlo Maruschat, Olegas Prentkovskis, Anatoliy Tymoshenko,
Olena Maruschat ...................................................................................................... 100

Session 8. Sustainable Transport Interchange

Conceptual Models for Better Interoperability between Road and Rail Transport in Lithuania
Aidas Vasilis Vasiliauskas, Virgilia Vasilienė-Vasiliauskiene, Jolanta Sabatytė .................. 102

Techniques for Smart Logistics Solutions’ Simulation: A Review
Ioannis Karakikes, Efthia Nathanail, Mihails Savrasovs ........................................... 104

Possible Consequences of the Implementation of Transport Integration in the Riga Planning Region
Julius Uhlmann ......................................................................................................... 105

Environmentally Friendly Transport Interchanges: Active Travel Accessibility and Policy
Vissarion Magginas, Efthia Nathanail, Giannis Adams, Maria Tsami, Irina Yatskiv (Jackiva),
Evelina Budilovich (Budilovića) .............................................................................. 107

A Cross-Case Analysis of Riga Interchanges’ Information Services and Technologies
Irina Yatskiv (Jackiva), Evelina Budilovich (Budilovića), Iveta Blodniece, Efthia Nathanail,
Giannis Adams ......................................................................................................... 109
Optimization of Interaction of Automobile and Railway Transport at Container Terminals
Vladimir Shepelev, Leonid Zverev, Zlata Almetova, Ksenia Shubenkova, Elena Shepeleva.........................111

Unsupervised Learning-Based Stock Keeping Units Segmentation
Ilya Jackson, Aleksandrs Avdeikins, Juris Tolujevs ..................................................................................113

Evaluation of the Impact of the Number of Picking Locations on the Total Cost of Warehouse
Raitis Apsalons, Genady Gromov...........................................................................................................114

Session 9. Transport Economics and Policy

The Socio-Economic Impact of Green Shipping: A Holistic View from the Baltic Sea Region
Gunnar Prause, Karin Reinhold, Marina Järvis, Eunice O. Olaniyi, Sigrid Kalle, Ülle Lahe ...............................116

Impact of Joining the European Union on the Development of Transport Policy in the Republic of Latvia
Juris Kanels ..................................................................................................................................................118

Assessment of SECA–Related Administrative Burden in the Baltic Sea Region
Eunice O. Olaniyi, Gunnar Prause ...........................................................................................................120

Aivars Rubenis, Aigars Laizāns, Andra Zvirbulē ..................................................................................121

Assessment of the Influence of Social-Cultural Environment in the Context of Global Logistics
Darius Bazaras, Ramūnas Palšaitis, Kristina Čižiūnienė, Artūras Petraška, Karolis Kaminskas .................122

Session 10. Innovative Economics

Who are Latvian Women Entrepreneurs of Small Businesses? A Preliminary Study
Kristine Uzule, Ishgaly Ishmuhametov, Irina Kuzmina-Merlino..................................................................124

Tourism Trends and a New Distribution Method of Latvian Domestic and Inbound Tourism Services
Kristina Mahareva ........................................................................................................................................126

Linkage between Management of Long-Lived Non-Financial Assets and Performance of Latvian Companies Listed on the Baltic Stock Exchange
Ieva Kozlovska, Irina Kuzmina-Merlino ......................................................................................................127

The Continuity of Local Governments in Poland during Disasters
Krzysztof Szwarc, Piotr Zaskórski .............................................................................................................128

Business Continuity Assurance in Creative Industries
Jacek Woźniak, Piotr Zaskórski ................................................................................................................130

The Mechanism for Creating an Effective International Strategic Alliance in the Field of Air Transportation
Nataliya Kazakova, Elena Shuvalova, Alisa Chemarina, Artem Nikanorov, Irina Kurochkina, Elizaveta Sokolova .................................................................................................................................132

The Principles of Creating a Balanced Investment Portfolio for Cryptocurrencies
Svetlana Saksonova, Irina Kuzmina-Merlino ............................................................................................134

An Information-Theoretic Approach to Financial Decision Making
Alexander Gubenko, Alexander Masharsky, Michel Verlaine ....................................................................135

The Problems of Changing Rules of Foreigners Employment in Poland
Małgorzata Walendzik, Cezary Krysiuk, Rafał Kopezewski, Arkadiusz Matysiak ..........................................136

Management of Liquidity and Profitability in Commercial Banks
Natalia Konovalova ....................................................................................................................................137

Corporate Income Taxation: Challenges of E-Commerce Platforms
Māris Jurušs, Sigita Ragucka-Ragovska, Monta Sandore ........................................................................138
Session 11. Education and Training in Engineering

On Higher Education Realities: Supporting Education and Research
Yulia Stukalina, Milan Pol ................................................................. 140

Developing a Marketing Strategy for a Higher Education Institution in the Agenda of Customer-Driven Education
Olga Zervina, Yulia Stukalina ............................................................. 141

E-Learning and E-Teaching Effectiveness: Academic Staff Perception
Jekaterina Bierne, Anna Svirina, Jelena Titko ........................................ 142

Supporting Lifelong Learning in Transportation Industry – Alliance E-Learning Approach
Irina Yatskiv (Jackiva), Mihails Savrasovs, Nadezda Pizika, Evelyn Fischer .......................................................... 144

Logistics Management Games for Actors of Geographically Distributed Supply Chains
Tobias Reggelin ....................................................................................... 146

Application of Process Approach to Knowledge Management in Education Institutions: Competence Centres
Natalia Salienko, Victoria Klyueva ....................................................... 147

Conflict Management in the Educational Process at the University
Oksana Pozdnyakova, Anatoly Pozdnyakov ........................................... 149
Plenary Session
ARTIFICIAL INTELLIGENCE AND DATA ANALYSIS APPLICATIONS IN INTELLIGENT TRANSPORTATION SYSTEMS

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Keywords: artificial intelligence, big data, machine learning, intelligent transportation systems

The increase in the use of mobile devices, such as smartphones or tablets, and the possibility of tracking the location of people and objects in a simple and cheap way, has substantially increased the availability of spatiotemporal data. Also the current cities are increasingly sensorized, in order to capture relevant information regarding traffic and movement of citizens within them. For this reasons, it became necessary to develop tools that allow processing, analysing and exploiting this information.

Accurate estimation of the future state of the traffic is an attracting area for researchers in the field of Intelligent Transportation Systems (ITS). This kind of predictions can lead to traffic managers and drivers to act in consequence, reducing the economic and social impact of a possible congestion. Due to the inter-urban traffic information nature, the task of predicting the future state of the traffic requires, in most cases, a non-linear patterns search in the input data. In recent years, a wide variety of models has been used to solve this problem in the most accurate way. Due to that, models generated to provide information about the future state of the road are, usually, incomprehensible to a human operator, making impossible to give him/her an explanation about the causes of the prediction. Given the capacity of fuzzy rule based systems to explain the reasoning followed to classify a new pattern, the advantages and disadvantages of such approaches are explored in this work.

This talk will provide an overview of problematic in the area of data analysis in transport problems, as well as how artificial intelligence solutions can help both users and operators. In particular, the use of bio-inspired metaheuristics and fuzzy rule based systems are presented.
SMART-PT:
ADAPTIVE PUBLIC TRANSPORT FOR A SMART CITY

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Keywords: smart transportation; public transport; transport simulations; adaptive transport; evolutionary algorithms; big data

Information and Communication Technologies (ICT) provide new opportunities to accommodate the increasing demand for transport without large investments in the physical infrastructures. However, public transport (PT) networks remain stable for many years, governed by a cumbersome assumption that residents have fixed and habitual activity and travel patterns. In the long term, this causes increasing reliance on public funds and inhibits service intensification. Stuck in this vicious circle, a fixed PT system cannot accommodate users' gradually and naturally changing spatiotemporal activity patterns. Instead of being relevant today and in the future, PT services accommodate well the demand of the past.

Current developments in ICT allow individual end users to adapt to the PT operator through timetable and real-time arrival time information. We aim to investigate the necessary next step, which is to ensure that PT operators are able to adapt via ICT to the changes in user's demand and its spatiotemporal attributes. The present stagnant PT will develop into a SMART-PT: evolutionary system adapting its services to the changing end-user demand under the operators' (and regulator) supervision. SMART-PT is an innovative concept for reinventing the public transport system by gradual transition of the currently inflexible PT into a self-adaptive and evolving intelligent system that will stimulate the evolution of the entire transport system.

Via big ICT data supplied by mobile phone, PT smartcard providers and PT vehicle GPS a context-aware SMART-PT will recognise emerging passengers' flow, estimate their variation in space and time and, appropriately, decide on the suitable operational model (co-modal combinations) sufficient to accommodate this flow. Smart-PT will modify service routes and frequencies at a rate acceptable by the public - once in several months to supplement services of high demand, while less frequently used services will be gradually substituted with more flexible ones e.g., from a fixed bus route to a flexible paratransit service. The Smart-PT framework will be made fully adjustable to any geographical region that possesses a standard municipal ITS infrastructure.

The paper discusses SMART-PT concept and presents a coupled co-evolutionary system for establishing evolving PT network. The system consists of the evolving PT network, which slow adaptation to the evolving demand evolution is governed by the Evolutionary Algorithms (EA) acting at two levels – one of a separate PT line and the other of the entire PT network. The system is coupled to the MATSim agent-based model environment that simulates fast passengers' adaptation to the changing PT network by changing their daily transportation modes and activities. We discuss the main components of the EA: (1) Establishment and evolution of the PT line and stops based on agents' daily trajectories as revealed from the mobile phone data records and (2) Evolution of the network as a whole by introducing new PT lines and modes. We present the results of the analysis of human mobility data, the algorithmic components and the examples of the PT network evolution following the development of the city and evolution of demand.
Session 1

Transport for Smart City
SOCIO-ECONOMIC ASPECTS OF FREE PUBLIC TRANSPORT

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Keywords: digitalisation, free public transport, social-economic analysis, sustainability

Since the 1. January 2013 the public transport is free for residents of the City of Tallinn. People registered outside Tallinn who want to use the public transport have to pay for trips. Parallel, Tallinn City Governance raised the parking tariffs in the city centre which caused an increase of using of the public transport by 10% and a decrease of car traffic in the city centre by 6%.

Currently, the greening of urban transport enjoys a high rank on the political agenda in a lot of European and even some cities are thinking to follow the example of Tallinn. Literature review reveals that scientific papers are focussing mainly on ecological aspects whereas socio-economic studies are neglected. The paper will present insights in social, economic and political aspects which are related to the experience of free public transport in Tallinn. Furthermore, the paper will highlight the role of digitalisation in public transport and discuss the influence of the Estonian e-governance system for the success of the Tallinn case.
EVALUATION OF THE QUALITY OF PUBLIC TRANSPORT STOPS

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Keywords: public transport, methodology, evaluation of the quality, public transport stops

The role of the public transport is to secure transportation requirements at the required qualitative level. The quality of the public transport plays a significant role primarily in relation to the utilization of private automobile transport. The only solution that can help encourage decreased use of private automobiles in urban areas is a high level of quality of passenger transportation.

The issues involved in the evaluation of the quality of services has begun to be reflected in many areas, and transportation is no exception (Hayes, 1998; Hill et al., 2003; Nenadáš et al., 2004). Issues related to quality began to be applied in transportation later than in other service sectors (European standard EN 13816, 2002), (European Standard EN 15140, 2006). For these reasons listed, a method for evaluating transportation quality from the viewpoint of the passenger was created (Olivková, 2016).

 Stops are the gateway to public transport, a place where citizens hesitate if to use public transport services. It depends on the quality of the stops whether the public transport offer is attractive to passengers. According to the quality analysis of the provided services in public transport, which has been carried out in previous years, the quality of public transport stops is one of the most problematic.

This article presents a detailed description and explanation of the theoretical aspects of the public transport quality evaluation methodology devised for evaluation of the quality of public transport stops. The methodology was experimentally verified by conducting a transportation passenger satisfaction survey, which took place in 2017. Quality criteria were assessed by passengers in a questionnaire. This article presents the results of implemented methodology applications, including analysis of the survey using SWOT analysis. Finally, the advantages and opportunities of the practical application of the methodology are assessed.

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References

ENVIRONMENTAL SAFETY OF CITY TRANSPORT SYSTEMS:
PROBLEMS AND INFLUENCE OF INFRASTRUCTURE SOLUTIONS

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Keywords: transport emissions, sustainable transport, simulation

Globalization processes have led to the realization of the need to find transition ways a new economy model. In the world community there is increasing awareness of the impact of the linear model on the well-being of the planet, and sense of urgency as we see the ultimate ramifications on society and the environment. Depletion of resources, climate change, negative impact on the environment are factors that raise the issue of responsibility to future generations for the life on Earth preservation. These are challenges of a planetary scale.

The level of motor transport negative impact on the environment is to a large extent determined by the transport infrastructure state.

Efficiently functioning infrastructure allows to reduce transport costs, affect the speed of passenger and freight traffic, reduce capacity limitations and increase the availability of transport services to the public. The article notes that the level of development of transport infrastructure leads to increased the negative impact of the motor transport complex on the environment. For the analysis of the state of the transport infrastructure from the point of view of environmental safety, it is preferable to use simulation modelling to study behaviour and evaluate various strategies that ensure the functioning of the transport system.

The article shows the results of the research of the most problematic section of the city road network. The developed simulation model for choosing the optimal configuration of the road network is presented. When constructing the simulation model, the data of full-scale surveys of the structure and intensity of the city’s traffic flows were used. There surveys were performed with parallel measurements of the quality of atmospheric air.

In addition, it was proposed to apply traffic lights with adaptive control at the section depending on the traffic density. The general scheme of the feedback within the traffic light control system is presented. his model allows the traffic light parameters change within the following areas: time of each tact, the count of stages, the number of control cycles, the availability of additional sections, the number of modes, time frame of modes, availability of the night mode, availability of the automatic mode, consideration of the monitoring data (if control centre has wireless communication). The results of the experiment on the model indicate the possibility of a significant improvement in traffic parameters in the section of the road network.

The environmental effect of the proposed measures is calculated. o, according to our calculations, the change in the configuration of the road section will lead to a reduction in CO emissions by 18.6%, NOX by 8.2%, CxHy by 17.9%, SO2 by 15.4% with an increase in the average speed of motor vehicles by 20%. Thus, the improvement of the road infrastructure provides the greatest effect of reducing the negative impact on the environment at comparable costs.
TRAM SERVICE QUALITY AND ITS IMPACT ON THE PASSENGERS' MODAL CHOICE IN CONSTANTINE CITY (ALGERIA)

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Keywords: tram, service quality, passengers, modal choice, performance, traffic congestion

All around the world, the tram has become the symbol of the renewal of urban public transport. This mode knows a new golden age in cities that prefer sustainable mobility. While modernizing the mobility offer, the tramway can give a decent image to the urban area and by its important capacity of transporting, the tramway contributes to meet the increasing mobility demands.

Without an optimal operation and a better service, the tramway can’t be an efficient means of transport that may help in decongesting road traffic. Passengers would prefer to use vehicles than trams, therefore road traffic will increase, which will complicate more the state of traffic in cities.

This study is based on the opinion of tram users. The main objective is to show the strong characteristics that attract population to use trams as a mean of transport and to show the weaknesses in order to improve them so as to reach the maximum satisfaction of users.

In addition, this article attempts to show the preferred means of transport for passengers who travel on the same line as the tramway.

The results show that despite the different advantages of the tram, the population is not all satisfied about its exploitation and its service quality. Almost 40% of passengers, declare that they prefer using particular cars or taxi than a tramway and this could complicate the road traffic situation in the future.

Finally, solutions to ameliorate the performance of the tram and its services' quality are presented. Which may contribute to attract more tram users and to reduce traffic congestion in urban areas.
PROBLEMS OF THE WARSAW METROPOLITAN AREA IN SHAPING THE PRINCIPLES OF SUSTAINABLE TRANSPORT DEVELOPMENT

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Keywords: sustainable development of transport, Warsaw Metropolitan Area /WMA/, transport problems

Problems of sustainable transport development in the European Union (EU) have been discussed for a long time in its transport policy and reflected in various documents, already in the Treaty of Rome, in art. 2 "harmonious development" which is included in the tasks of the European Community. These documents present definitions, principles and guidelines for implementing the principles of sustainable transport development in individual EU member states.

Practice shows that implementation of the principles of sustainable development is not easy, as indicated by various available analyses and studies of transport systems operating in EU member states. In Poland, also activities are undertaken related to the implementation of these principles into the transport systems of the country, large urban centres, metropolitan areas or cities. Due to the continuous development of transport and ways to implement it, there are still many problems that constitute a barrier that is often not easy to overcome (even financial).

The article points out the problems of implementing the principles of sustainable transport development in the Warsaw Metropolitan Area (WMA).

The article was based on research carried out at the Motor Transport Institute in Warsaw, entitled: "Formation the transport system of the Warsaw Metropolitan Area" and research carried out for the Ministry of Development under the Operational Program Technical Assistance No. POPT.02.01.00-00-0021/15-00, Support for the strategic coordination institution of the Partnership Agreement in 2015-2016, entitled: "Analysis of the impact of the built road infrastructure on the level of economic activity in the surrounding territorial units".

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FEASIBLE PATH PLANNING ALGORITHM FOR CITY ROAD NETWORK

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Keywords: autonomous ground vehicle, path planning, Dubins path, optimization, city road network

Because of the huge interest from the researchers and the industry, autonomous vehicles have become one of the most advancing research fields. Respectively, the future of autonomous vehicles, i.e., the realization of the envisaged benefits, such as increased driving safety or improved transportation efficiency and public acceptance, will depend on their ability to safely move in real road networks and various traffic scenarios. Due to this reason, this paper presents an effective path planning algorithm to generate a feasible and safe path in a city road network. The proposed algorithm is based on the Dubins path approach, a network map of a selected road and a set of waypoints, which represent intersections and their geometry. In order to ensure path feasibility and safety in a city road network, an objective function with inequality constraints is proposed. The performance of the proposed algorithm was demonstrated while applying the algorithm to different road networks of a selected city. The feasibility of the planned path was proven by executing experimental drives with an autonomous test vehicle in an enclosed lot, while imitating the moving in a city road network.
FACTORS AFFECTING THE EFFICIENCY INDICATOR OF THE PUBLIC TRANSPORT SYSTEM – CASE STUDY

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Keywords: timetable, efficiency indicator, optimization, public transport, vehicle scheduling

In the paper, the problem of determining the crew efficiency indicator was analysed. The crew working time factor determines which part of the driver work is spent on driving the vehicle. The value of crew working time utilisation index is directly proportional to the communication time and inversely proportional to the operation time, which consists of the communication time and the stopping time. This factor is therefore a measure of the effective working time. The value of the crew working time utilization coefficient we in public transport must be within the range of 0÷1, however, achieving unity is difficult in practice, and often impossible. The limits of the coefficient value were checked. In terms of the theoretical values the Wroclaw City case was studied. Differences between theoretical and empirical values were identified. Their genesis was found and guidance for constructing the timetable was provided. The designers constantly take measures to increase the value of this coefficient, for example by operating several lines by one vehicle. Increasing the length of communication lines - despite making them more susceptible to traffic disruptions - increases the achievable value of the efficiency index, as the length of the course does not affect the time required to perform duties on the loop. The highest values of the indicator are obtained on working days, when the planned transport is the highest. As the number of vehicle kilometres per day decreases, it becomes more difficult to achieve rational index values. Crew working time utilisation index is strictly dependent on the provisions of the Act about Working Time of Drivers.

There are communication lines in Wroclaw City with low frequency of running, not exposed to the influence of traffic disruptions and operating small passenger streams. In such cases, taking into account the costs generated by the vehicle in motion (e.g. fuel, tyre and fluid consumption), it may sometimes be more economical to extend the duration of the stopping period rather than to increase the frequency.

Lower we notes for holidays in Wroclaw City are determined by the relatively low frequency of running (trams every 30 minutes, bus lines in diluted mode, part of lines not running). Timetable designers in such situations use the vehicle changes between the communication lines to increase the value of the performance indicator.

Operational research on course arrivals in Wroclaw it was performed. For the analysed period of time it was found, the arrival deviations from scheduled time can described by normal distributions N (3.6, 8.2) - for working days, N (2.4, 5.9) – for weekends and holydays. The sample size was more than 300 arrivals per type of day. The Chi squared goodness of fit test was performed. At significance level 0.05, there was no reason to reject the goodness of fit hypothesis. For the matched distributions, the third quartiles of arrival deviation were calculated. Respectively 9.0 and 6.5 were obtained. Using the quartile values, the stopping times on the loops were recalculated. The resulting crew efficiency indicator has also been recalculated. Time was reduced for stops in the loop longer than 15 minutes to 15 minutes due to the Laws (Law of 16 December 2010) and (Law of 16 April 2004). Other times were shortened to 4 minutes in order to perform service duties (for example, completing the road card, change direction boards, change the cabin in two-way vehicles) on the loop. Higher values
of the coefficient were obtained. However, this is not a way of increasing it. This means that the timetable is impractical. In Wroclaw, a lot of delays in public transport are caused by traffic jams in peak hours.

References

DIRECTIONS OF DEVELOPMENT OF EASTERN POLAND’S TRANSPORT INFRASTRUCTURE BY THE EXAMPLE OF THE LUBLIN PROVINCE

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**Keywords:** logistical centres, transport cooperation, European integration, Pan-European Transport Corridor No. 2, transport infrastructure, Via Carpathia

The paper refers to present the results of research carried out at the Motor Transport Institute in Warsaw on the direction of transport infrastructure development in the Eastern Poland and the EU, in the Lublin province, in the aspect of management and organization. The analysis carried out led to the forecasts how this development will affect the transport system of the region and the country. The article also presents the results of research on the economic calculation of postulated changes and transport investments being carried out in the Lublin province. Based on the economic calculation and the analysis carried out, the authors prepared appropriate conclusions and recommendations. We claim that competitiveness and development of the Lublin province will be greater with the development of modern road infrastructure, in the form of the A2 motorway along the section Siedlce – border of Poland in Kukuryki, as well as other expressways (S17, S19 or S12). The economic effect of these road investments will soon return and is associated with serving heavy freight traffic in transit through Poland.
POWER PLANT OPTIMAL OPERATION TIME APPROACH
IN BEST ENERGY MIXTURE MODEL WITH SIMULATION
ANALYSIS

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Keywords: best energy mix, energy simulation, renewable sources, combined bio-winds system

In this paper we proposed a new best energy mixture model and power plant optimal operation time approach. We choose all available energy sources for the region of our interest. Every energy source can be expressed in terms of cost of electricity (COE), and for every energy source we calculate cost of electricity generation COEG(t) to define the boundaries of the corresponding power sources usage amounts. Based on optimal operation times per each energy source we determine the overall capacity of power stations. This is done by means of energy consumption curve for the region of interest.

We perform the model validation by simulation the power generation. Simulation can be done by using existing historical values of resources availability, such as wind speed by hour, power consumption by hour, and so on. Or otherwise it can use the generated time series values based on statistics or estimates. As a result, we get a detailed picture of the generated amounts per every power source. This result shows that all demand is supplied and we can calculate precise values of generated energy by time.

This approach is explained based on Latvia case example where we use existing gas power station with combination of introduced combined bio-wind energy system. The goal is to replace imported fossil fuels for electricity generation with locally produced renewable sources of energy, to secure and increase independence of the country and to reduce CO2 emissions. The introduced best energy mix is based on two renewable sources: biomass and wind power stations. To make use of both advantages we combine these two types of power stations into one hybrid power system that gives a stable power output to supply country’s energy needs.

Acknowledgements

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15
DECISION-MAKING PROCESS FOR CHOOSING TECHNOLOGY OF DIESEL BUS CONVERSION INTO ELECTRIC BUS

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**Keywords:** Low-emission, Electric Bus, Converted Diesel Bus, Economic Analysis, Total Cost of Ownership, Energy consumption

Following the European Commission’s 2016 Strategy for Low Emission Mobility (European Strategy for Low-Emission Mobility, 2016) many local public transport authorities and operators are in need of replacing ageing bus fleet with cleaner and more sustainable vehicles in order to meet standards, increase efficiency and reduce transport related emissions. There is a wide choice of cleaner fuel and engine technologies for urban bus operators in the market including electric buses but at the same time new vehicles beyond lower emission Euro VI diesel buses are still a challenge for public transport operators due to high acquisition costs of a new vehicle and lack of charging infrastructure. The alternative proposed is to convert used diesel city bus into electric bus which would significantly reduce the harmful impact of the used diesel bus on the environment and improve performance of the vehicle.

Decision-making process for choosing technology of the bus conversion requires thorough assessment of possible solutions from technical, operational, logistical and economical point of view under the given conditions and constraints.

Within the framework of this research, mathematical models are developed for assessing the efficiency of an electric vehicle on the basis of various criteria which affect life cycle costs as well. The models include the definition of functional dependencies and dynamic performance equations of a diesel bus and a converted electric bus. The models are implemented in the specially developed simulation environment. Motion of the diesel and electric bus has been simulated for different routes, road profiles, loads with the goal to forecast and to evaluate energy consumption equivalent to daily service based on bus operating profiles in mid-size city in Latvia. The results of these models help to choose the most suitable parameters of the traction motor’s torque and power under the given conditions and determine the most suitable battery type and capacity for the selected bus route. Total Cost of Ownership (TCO) model is utilized in the decision-making process to determine economic viability of technological solution to convert a diesel bus conversion into an electric bus. In addition, the assessment of charging options and availability of grid connection is also considered.

Acknowledgements

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Session 2

Statistics and Modelling in Transport Applications
EXPLORING WOMEN TRAVEL BEHAVIOUR IN THE REGION OF ŽILINA FROM LARGE SCALE MOBILITY SURVEY

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Keywords: Gender sensitive design, mobility planning, transport policy, accessibility, mode choice, active mode

Women and men often do not experience equal mobility opportunities in their societies. Increasingly gender is being recognized to play a significant role in transport planning, particularly for addressing individual mobility needs in urban and rural areas. Previous studies have shown that transport policy and mobility planning are better suited to men’s activities and mobility needs, while women experience the transport system differently than men in terms of accessibility, safety and security. These findings reveal differences in needs and requirements to the transport system and choice of transport mode between men and women. To create a more balanced transport system that increases everyone’s mobility and accessibility to all transport modes, it is crucial to distinguish between individuals’ travel needs and wishes, which are also closely linked to life circumstances influenced by gender, life stages and socio-economic situation.

To gain an in-depth understanding of women travel patterns in their daily activities, this paper investigates the factors that influence women’s decisions between activity participation and choice of transport mode through analysis of mobility behaviour data gathered from 6000 households by Žilina self-governing region between 2013 and 2016.

The results of this analysis provide valuable insights about the possible causal relation among socio-demographics, activity participation characteristics and daily travel mode choice of female and male travellers in the studied cities, which could be incorporated into more gender sensitive designs in mobility planning and travel demand modelling. Furthermore, the outcomes of this study can help decision makers, local and regional authorities and transport companies by raising awareness and providing support for 1) forming sustainable policies to overcome community mobility and accessibility challenges and 2) bringing more gender equality in the region of Žilina by changing traditional transport functionalities and providing more equitable provision of transport systems, particularly in public transport and active modes (non-motorised transport).
ASSESSMENT OF INVENTORY INDICATORS FOR NOMENCLATURE GROUPS WITH RARE DEMAND

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Keywords: supply chains, inventory classification, indicators calculation, forecasting, Poisson distribution

The main goal of inventories is reliable and efficient functioning of enterprises, because non-efficient inventory management leads to two problems: creation of non-liquid assets and/or deficit. The first one brings stagnation to financial assets of the enterprise; the second one brings penalties, lost profit and loss of customers.

In the article there is given literature overview and analysis of research studies devoted to inventory management (Axsiäter, 2006; Ballou, 1999; Bowersox et al., 2007; Chopra and Meindl, 2013; Coyle et al., 2003);
identifying shortcomings of existing approaches;
presenting developed αβγδ–classification of inventory consumption processes, where γ–processes reflects rare demand;
designing methodological approach and algorithm for forecasting assessments of current and safety stocks for rare demand and restricted choice diapason of data;
proposing methodology of calculating inventory indicators in the way of combined assessments on the basis of statistic (Poisson distribution) and dynamic (different forecasting methods) approaches.

Special part is devoted to assessment methods of inventory indicators for supply department of the enterprise, conducting centralized purchasing for several subsidiary departments (distributed supply chain) in order to receive wholesale discounts.

The given examples of calculations and results of developed methods approbation in different companies (trading, transportation ones, etc.) have shown that the designed approach allows to increase the assessment accuracy of nomenclature indicators with rare demand. That will finally increase the efficiency of supply chains functioning.

References
MULTI-AGENT APPROACH TO OPTIMIZATION OF TARIFFS FOR THE AIR NAVIGATION SERVICE

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Keywords: air navigation tariffs, multi-agent, graph search

In this paper, the problem of statement of tariffs for the air navigation service is considered. These tariffs, together with fuel costs, contribute a significant part to the total expenses of airline companies for aviation operations. Too low tariffs yield foregone earnings of air traffic control institutions as too high tariffs can invoke loss of transit flights if the air carriers choose alternate routes avoiding high tariffs zones.

The air navigation tariffs are subjects of state authority statements and should as reimburse expenses of the air navigation service operation as get a spatial rent because of the geographical position. So, a reasonable motivation exists to establish the maximal level of tariffs unless the transit air traffic participants prefer to bypass our air traffic zone. Having the statistics of operation on previous periods of time we can easily calculate different scenarios for varying air traffic tariffs and predict the carriers’ behaviour from the point of view of our air control institution. However, air control institutions in other countries could change their tariffs as well, so our forecast will be wrong and we get not expected earnings. To solve this problem we need to model the behaviour of many aviation authorities where each one eager to maximize the spatial rent.

The formal task statement is to be outlined as follows. Let say we have a finite in directed graph \( G = (V, E, Z) \), where \( V \) – set of nodes, \( E \) – set of edges, \( Z \) – air traffic zones. Edge \( e_{ij} = (f_{ij}, a_{ij}) \) links nodes \( V_i \) and \( V_j \), where \( f_{ij} \) – fuel cost, \( S \), \( a_{ij} \) – air traffic service cost for the flight from \( V_i \) to \( V_j \) or from \( V_j \) to \( V_i \). Air traffic service cost \( a_{ij} = t_{ij}d_{ij} \), where \( t_{ij} \) – air traffic tariff, \$/km, \( d_{ij} \) – distance between \( V_i \) and \( V_j \), km. Each \( t_{ij} \in Z_r, r \) – air traffic operator. Each air carrier \( k \) fulfils a set of flights \( \{F_k\} = \{V_i, V_j\} \). For the simplicity, we mean \( f_{ij} \) and \( t_{ij} \) are equal for all aircrafts. Each \( k \) flight builds a chain of several edges \( s_k = \{e_{ix}, \ldots , e_{yj}\} \) so the operation cost of \( k \) flight

\[
C_k = \sum_{x,y \in s_k} (f_{xy} + a_{xy}).
\]

Each air carrier has a goal to minimize sum of operation costs

\[
S_k = \min_k \sum n_k C_k,
\]

where \( n_k \) – number of flights during the period of time. Each \( r \) air traffic operator aims to maximize the income for their service

\[
I_r = \max_{i,j \in Z_r} \sum n_{rij}a_{ij},
\]

where \( n_{rij} \) – number of flights through the edge \( e_{ij} \).
These two goals are contradictory, so the optimal solution is a subject of compromises reached between air traffic participants. Hence, if one tries to increase the tariffs then not only air companies would avoid this air traffic zone, but other air traffic operators could change their tariffs. An approved solution for such complex tasks is a multi-agent approach that widely used at air traffic control modelling (Agogino and Tumer, 2010; Lancelot et al., 2015).

The proposed method is based on search on the graph task where graph nodes are the borders of the air traffic zones and the edges are air routes as shown above. Each zone is an agent aiming to maximize its income as other agents are air companies building their routes with minimal expenses. The behaviour of each agent could reflect not only economical aspects of air transport, but legislation details related to tariffs policy.

References
SPATIOTEMPORAL FEATURE SELECTION FOR URBAN TRAFFIC FLOW FORECASTING

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Keywords: spatiotemporal models, feature selection, support vector regression, urban traffic modelling

Short-term traffic forecasting is an emerging problem in transportation engineering that attracts significant academic attention over past decades. Recently, a methodological focus of researches shifted to spatiotemporal models that utilise both spatial and temporal relationships (Ermagun and Levinson, 2018). Given a large number of available urban traffic data sources, an appropriate variable selection becomes an integral part of modern forecasting methodologies. In this study, we present an empirical analysis of different approaches to spatiotemporal variable selection for support vector regression and their stability in case of large urban networks.

We employ the classical soft-margin support vector regression model (Drucker et al., 1997):

\[
\begin{align*}
\text{minimize} & \quad \frac{1}{2} w^T w + C \sum_{i=1}^{n} (\xi_i + \xi_i^*) \\
\text{subject to} & \quad y_i - w^T x_i - b \leq \varepsilon + \xi_i, \\
& \quad w^T x_i + b - y_i \leq \varepsilon + \xi_i^*, \\
& \quad \xi_i, \xi_i^* \geq 0.
\end{align*}
\]

where \(y_i\) is a dependent variable (traffic flow at a road segment), \(x_i\) is a set of spatiotemporal variables (features), \(w\) is a vector of unknown coefficients, \(\varepsilon\) and \(C\) are tuned parameters \(\xi_i\) and \(\xi_i^*\) are soft-margin terms. The support vector regression was selected as a predictor due to its good balance of the resulting model transparency (inherited from statistical models) and flexibility (inherited from neural networks).

The problem of variable selection is of great importance in specifying support vector regression models, because the potential number of explanatory variables is generally large, especially when simultaneously taking into account temporal and spatial information of a city-wide road network, and naturally lead to problems of high dimensionality and overfitting. Several recent studies (Chen et al., 2017; Xu et al., 2016; Zheng et al., 2018) mentioned this problem as a potentially important research direction.

In this study, we consider different approaches to selection of explanatory variables \(x_i\), such as predefined road network-based predictors (exogenous filter approach) and evolutionary identified predictors (wrapper approach). The main focus of this research is a stability (in terms of overfitting prevention) of selected approaches given an expanding size of analysed road network segment.

Acknowledgements

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22
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APPLICATION OF DIRECT PARTIAL BOOLEAN DERIVATIVES AND BINARY DECISION DIAGRAMS IN IDENTIFICATION OF MINIMAL CUT VECTORS

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Keywords: decision diagram, direct partial Boolean derivative, minimal cut set, minimal cut vector, structure function

Minimal Cut Vectors (MCVs) or their equivalents known as minimal cut sets play a key role in reliability analysis. They can be used to estimate system availability, evaluate importance of the system components (e.g. Fussell-Vesely’s importance), plan system maintenance, etc. (Rausand and Høyland, 2004). However, one of the problems behind them is their efficient identification. Most of the existing algorithms have been proposed for their finding in fault trees (Limnios, 2007), but only few can be applied to other forms of system representation. Kvassay et al. (2016) presented one that is based on logic differential calculus and the can be applied if the system structure function is known.

Logic differential calculus is a tool that has been developed originally for investigation of Boolean functions. Its central term is Boolean derivative. Several types of Boolean derivatives exist. One of them is Direct Partial Boolean Derivative (DPBD), which allows finding situations in which a given change of a Boolean variable results in a considered change of the investigated Boolean function. Zaitseva and Levashenko (2013) have proposed to use this instrument in reliability analysis to identify situations in which a given change of component activity results in failure/repair of the analysed system. This idea is based on the fact that the system structure function, which defines the relationship between activity of the system components and the system functioning, can be viewed as a Boolean function. However, the main problem behind the analysis based on the structure function and DPBDs is their efficient representation for systems consisting of many components. This can penalize the algorithm proposed by Kvassay et al. (2016). One of the possible solutions to this problem can be application of Binary Decision Diagrams (BDDs).

BDDs have been developed for efficient representation of and manipulation with Boolean functions of high dimensions (Bryant, 1986). Since DPBDs are Boolean functions and the structure function can also be viewed as a Boolean function, BDDs can be used in reliability analysis to represent both of them. Several algorithms for finding DPBDs based on the structure function represented by BDDs have been proposed by Zaitseva et al. (2015). The result of these algorithms is a BDD representing the considered DPBD. However, the problem of identification of the MCVs using the DPBDs expressed in the form of BDDs has not been considered by Kvassay et al. (2016).

In this paper, we will consider a task of finding the MCVs using DPBDs and BDDs. We will present a new method for computation of MCVs. This method assumes that the DPBDs analysing consequences of repairs of the system components are expressed in the form of BDDs. The method is then based on transforming these DPBDs (and the corresponding BDDs) into the so-called expanded forms and computing a special type of intersection between all expanded derivatives.

References
EXPLORING THE POTENTIAL OF SOCIAL MEDIA CONTENT FOR DETECTING TRANSPORT-RELATED ACTIVITIES

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Keywords: text mining, Twitter, big data, classification models, location-based data

The explosive growth of social media use and the amount of the publicly shared information has resulted in huge volumes of available and active data. The wide spread of social media encourages the users to share more often their activities as well as their location, leading to an exponential increase of the data volume day by day. This user-generated content on social media platforms rendering them powerful tools, suitable for transport related data collection. In this paper data from Twitter are used to explore their potential for transport purposes.

Social media is acknowledged as a valuable source of information in recent literature (Kuflik et al., 2017; Steiger et al., 2016), but utility of obtained information is highly dependent on intensity of social media activities in the specified area. The main objective is to investigate the reliability of the transport related content retrieved from tweets and the transferability of findings to smaller cities and other languages.

The research data set includes thousands of tweets collected for three cities: Minneapolis-Saint Paul twin cities (USA), Riga (Latvia), and Volos (Greece) in May-June 2018. Selection of the research areas are related to substantially different environments in terms of population, language and transport infrastructure.

We use an extended information about each tweet – text, user account details, datetime, number of retweets/addition to favourite lists, and geo-reference (if available) – for its classification.

The main methodological steps of the research are:

• Pre-processing of collected data – sample clean-up (exclusion of automated notifications and empty tweets) and normalisation of tweet texts (word stemming, removal of punctuation and meaningless words).
• Identification of most frequent domain classes of messages: traffic-related, public transport-related, activity-related, etc.
• Preparation of a training sample for classification, which include tweets labelled by experts as related to one of identified classes.
• Training the classifier algorithm (naïve Bayes) and its application to the complete research sample.
• Exploring the results of classification in terms of classification precision and specific attributes of discovered classes (class size, availability of geo-reference information, etc.).

Based on the obtained results, we made conclusions about efficiency of Twitter as a social media source of transport-related information in different urban environments.
Acknowledgements

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References


SIMULATION MODEL OF CHECK-IN MANAGEMENT REGARDING THE IATA LEVEL OF SERVICE STANDARDS

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Keywords: airport, check-in, simulation model

The performance of the systems is currently very often related to information concerning the passengers’ level of service. Assuming some time ranges, in which the passenger should be handled in order to minimize the delay, it is also possible to control the system in order to ensure the highest possible comfort for the passenger. This article presents a practical simulation model that enables the choice of resources for the execution of the check-in process at the airport terminal in order to ensure an appropriate level of service. We present a quantitative and qualitative approach that enables the classification of adjustment of the schedule to the optimal class of the level of service, and through quantitative indicators, to subsequently present the level of overestimation or underestimation of the system.

Based on the conducted analyses in the actual system, it has been observed that the reports stream varies considerably depending on the nature of transport that is carried out. The probability density functions (PDF) for the reports of passengers to the system have been indicated on this basis. It is possible to assign flight numbers to low-cost, traditional, and charter groups.

The simulation model functions on the basis of a basic queuing model in which any number (assumed by the user) of service channels occurs. Each desk is equipped with its own queue, and the passengers choose the entry to the queue from a set of check-in desks dedicated to their flight number according to the lowest number of waiting passengers. The passengers are checked-in according to the FIFO (First In First Out) strategy.

The simulation experiment is carried out many times on the basis of the Monte-Carlo method that enables to obtain the value of the expected output data. It has been assumed in the simulation model that it is important to determinate whether the assumed schedule allows for obtaining the C category in the aspect of the level of service according to the IATA (2014) standards. It has been assumed on this basis that the system may be in three states during the execution of the service process. The state in which the system finds itself is determined on the basis of the actual time \( t_q \) [min] of waiting of the passengers in queue according to (1).

\[
S = \begin{cases} 
S_{\text{overestimated}} & \text{for } t_q < 10 \\
S_{\text{optimal}} & \text{for } t_q \in \{10, 20\} \\
S_{\text{suboptimal}} & \text{for } t_q > 20 
\end{cases}
\]  

(1)

On the basis of formula (1), it is possible to elaborate the output data in the form of:

- percentage of occurrence of particular states,
- occurrence of particular states in the function of time (with an indication of the amount of assigned resources, the time of process execution).

The model enables to carry out the analysis on three different scales:

- macroscopic – indicators presented for the entire stream of handled passengers,
- mesoscopic – indicators presented with a division of the nature of the transportation or of the chosen carrier,
- microscopic – indicators presented with a division according to the flight number.
However, before accepting simulation model as correct, it was necessary to carry out a verification of the simulation model. Studies on the actual system have been conducted for the chosen day from Wroclaw Airport schedule. The distribution functions of waiting times in the passenger queue system within the whole day have been compared. A Kolmogorov-Smirnov test has been conducted at the significance level of 0.05. The obtained statistic value was lower than the critical value and, therefore, it could be concluded that the model generates correct results.

References
INVESTIGATION OF CONTEMPORARY NEUROEVOLUTION METHODS

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Keywords: neural network architecture regularization, L-systems, NEAT, HyperNEAT, AGE, ADEANN, schema of encoding, genetic algorithm

Neural networks (NN) are used today for the different tasks in the field of data science and artificial intelligence (AI). It’s one of the most common machine learning tools that is used for the smart and intelligent systems development. NN demonstrated the universality, flexibility and high efficiency in the field of classification, prediction and approximation, as well as an excellent ability to recognize the people, objects, text and numbers during the images and video processing. All these tasks are an integral part of any contemporary intelligent transportation system and might serve the needs in identification of suspicious behaviour or events on the roads, traffic’s monitoring, prediction and control etc.

However, despite such a wide usage of them and their possibilities, still exists an open question regarding the NN regularization (the optimal NN’s architecture and weights selection for the specific task solving). Several approaches of NN regularization are known now:

• manual approach on the base of empirical experiments,
• by means of methods based on iterative architecture complexity’s reduction or increasing which are characterised by high computational complexity,
• by means of genetic algorithms (GA).

The last one seems to be one the most promising because GA belongs to the group of heuristic optimisations methods of (De Campos et al., 2016). They are developing very fast today and provide an opportunity of NN regularization. The combination of NN and GA gave rise of the new term “Neuroevolution”.

The most popular neuroevolution method today is NEAT (neuroevolution of augmenting topologies, Stanley and Miikkulainen, 2002) which is used for NN architecture encoding and optimization. But it has several drawbacks. One of the most important of them is that NEAT generates networks with an excessive number of neurons, which subsequently reduces the speed of applying of such neural networks (Baldominos, 2018; Silva et al., 2017; Wang et al., 2016). The other one is Hyper NEAT approach (Hypercube-based NEAT, Stanley, 2007) which is very popular in the field of AI tasks. It can generate optimal networks with many input parameters, but one of the most important drawbacks is its high computation complexity. However, several new NN evolution approaches are mentioned today including such as AGE and ADEANN.

The AGE (Analog Genetic Encoding, Dürr et al., 2006) uses a sophisticated approach of NN encoding in chromosomes which can be used in a standard GA framework and provides an opportunity to create the NN with different types of architecture. It has some disadvantages as well but still is very popular because of its ability to provide a complex and still optimal NN for the different kind of tasks.

The ADEANN (Artificial development and evolution of artificial neural networks, De Campos et al., 2016) is based on a novel approach of NN encoding needed to work with GA. The authors suggested an encoding approach based on L-system (Lindenmayer system) and argued that it excels the NEAT approach and can produce the recurrent NN.

The description of these two innovative approaches sounds very promising for the data scientists’ society but nowhere was mentioned the results of these approaches comparison with
This paper reveals the results of AGE and ADEANN comparative analysis with two traditional approaches (NEAT and Hyper NEAT) and shows the opportunities and disadvantages of their application for NN regularization. The obtained results may help to understand the advantages of novel approaches application for NN regularization and provides some recommendations in which cases these approaches maybe not so effective against the traditional one.

References

REDUCTION OF DIMENSIONALITY OF FEATURE VECTORS IN SUBJECT CLASSIFICATION OF TEXT DOCUMENTS

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Keywords: text mining, Polish, subject classification, dimensionality reduction, PCA, random projection, bag of words, fastText

Subject classification of text documents is a task of automatic assigning a given document into one of defined groups. It is based on a usage of natural language processing (NLP) methods and algorithms of machine learning. The documents are represented by high-dimensional feature vectors which are then used for training classifiers such as SVM (Hastie et al., 2009) or multilayer perceptron (Hastie et al., 2009) given a collection of documents with known categories (class labels).

Within a paper we investigate the influence of dimensionality reduction of feature vector on the results of subject classification of text documents in Polish (Walkowiak et al., 2018a; Walkowiak et al., 2018b; Walkowiak and Malak, 2018). Two, state of the art methods of text representation are used, i.e. the bag of words (Harris, 1954) consisting of the most frequent 1000 lemmatized nouns (Walkowiak and Malak, 2018) and the emerging fastText (Joulin et al., 2017) based on the word embedding technique (Mikolov et al., 2013).

To test the influence of dimensionality reduction on classification results we have used two corpora. The first corpus (Press) (Walkowiak and Malak, 2018) consists of Polish press news. The texts were assigned by press agency to five subject categories. All the subject groups are very well separable from each other and contains reasonably large number of members. The second corpus (Wiki) (Młynarczyk and Piasecki, 2015a; Młynarczyk and Piasecki, 2015b) consists of articles extracted from the Polish Wikipedia. It consists of 34 subject categories. We have randomly divided each corpus into training and testing data set in two different proportions.

We compare two methods of dimensionality reduction: principal components analysis (PCA) and random projections. Given a data set $X_{n \times d}$ composed of $n$ observations in $d$-dimensional feature space (1000 for BoW and 100 for fastText), both methods project the observations onto $k$-dimensional subspace ($k<d$). The methods differ in how the projection matrix $R_{d \times k}$ is constructed. In the PCA method, columns of the projection matrix are taken as eigenvectors of the covariance matrix of the features (or of the columns of the original matrix $X$), where the eigenvectors are ordered by descending value of the corresponding eigenvalues. The resulting $k$-dimensional subspace is orthogonal, with the most variance in data captured along the first axis (principal dimension), the second most along the second axis, etc. The drawback of this method is high computational cost.

Random projections method constructs the projection matrix much simpler. The methods are motivated the Johnson-Lindenstrauss lemma (Johnson and Lindenstrauss, 1984) which states that a dataset of $n$ observations can be mapped onto $k \sim O \left( \frac{\log n}{\epsilon^2} \right)$ dimensional subspace, with distortion in Euclidean distance between the observations not bigger than $(1\pm \epsilon)$. Interestingly, the minimum required dimensionality $k$ depends (logarithmically) on the number of observations $n$, but does not depend on the original dimensionality $d$. As shown, e.g. in (Dasgupta and Gupta, 1999), such mapping can be constructed by randomly selecting the subset of original dimensions, which motivates the commonly used procedure to construct the projection matrix $R_{d \times k}$ as a random matrix from the Gaussian distribution.
In performed experiments we applied PCA and random projection with different projection subspace for all corpora and both analysed methods of text representations. Achieved reduced feature matrix were used to train multilayer perceptron (MLP).

Results show that PCA gives better accuracy than random projections in all analysed cases. In case of fastText, a significant reduction of up to 10 times is possible without loss of quality regardless the quality of corpus. To analyse this phenomena, we have performed a set of experiments in which we train fastText with different values of word embedding dimensionality (from 2 to recommended 100). Results show that even the dimension 3-10 (depending on the quality of data) allows to achieve very good accuracy.

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References

COMBINATORY METHOD OF OPTIMIZATION OF REGIONAL BASING OF MOBILE UNITS OF COMMERICAL UNMANNED AIRCRAFT VEHICLES

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Keywords: mobile unit, unmanned aircraft vehicle, basing task, combinatory method, optimization

The problem of optimizing the number and geographical referencing of mobile units (MU) of unmanned aircraft vehicles which are included in a commercial company and provide aerial observation and/or aerial mapping services to the relevant customers and facilities on the territory of the region assigned to them (MU). The efficiency criteria and initial conditions are determined. The optimization task is assigned as a Boolean programming task. When choosing the initial conditions, the potentially possible locations of the MU are analysed taking into account the geography of the region, the specifics of the weather conditions and of the facilities for the air service delivery. The combinatory method is proposed for solving the task. Differences between the suggested method of solution to the assigned task and the method of linear programming which imposes restrictions on the quantity of customers fixed for each base are demonstrated. The method is validated with the particular example – optimization of the number of bases, their locations and attaching customers to them for a Costa Rican company.
DATA PREPARATION FRAMEWORK DEVELOPMENT FOR MARKOV-MODULATED LINEAR REGRESSION ANALYSIS

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Keywords: Data Mining, Public Transport Passenger Flow, Regression, Data Preparation and Exploring

Modern data collection and analysis methods enhance reasonable and effective data-driven decision making in transport planning and have significantly expanded the scope of potential data applications. But if the goal is to use data in transport models for evaluating and predicting, the quality of data becomes crucial.

This research is focused on data pre-processing issues such as data understanding, data exploring, and data transformation as an important part in of CRISP-DM (Larose D. and Larose Ch., 2014) rather than transformation models themselves. Thorough consideration is given to the following phases: Data Preparation and Data Understanding are critical to fit the models to data; transform data into knowledge. These phases involve many different tasks and many of the data preparation activities are routine, tedious, and time consuming. It has been estimated in (Xu et al., 2013) that data preparation accounts for 60 percent to 80 percent of the time spent on a data mining project. Data processing techniques, when applied before mining, can substantially improve the overall quality of the predictive models.

Authors suggest to use Markov-modulated linear regression for public transport passenger flow prediction in (Spiridovska and Yatskiv, 2018) or other transport planning tasks (Spiridovska, 2018). This kind of regression model suggests that the model parameters vary randomly in accordance with the external environment.

With this point in mind in the present study the framework for data exploring and preparing, considering the limitations and assumptions of formulated regression model was developed to improve the precision of the prediction models and realization time. R software in conjunction with a set of libraries is used for steps automatization.

The developed framework is applied on a data set from two sources: Riga Urban Public Transport Operator archive data system and the Latvian Environment, Geology and Meteorology Centre database. The first of the mentioned systems archives entire trip data captured by e-talon units installed on tram serving a 20 km urban tram route on daily basis. Half-year (2017) data is explored along with in-depth analysis.

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NATURAL LANGUAGE PROCESSING KNOWLEDGE NETWORK APPROACH FOR INTERACTIVE HIGHLIGHTING AND SUMMARY

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Keywords: information retrieval, knowledge network, text mining, summary generation

This paper describes a new method of data retrieval from free text documents for interactive highlighting and summary. Proposed approach creates the document summary and highlights most important keywords in the text. To highlight important or meaningful keywords in the document, we use keywords voting approach. This approach identifies which keywords have to be highlighted in the text based on votes for every keyword, which reached the summary of the document.

The approach starts with the top level concepts which have the highest number of points – those which were filtered out to be shown in the summary. The points of these concepts become votes, which they will share between their children concepts to contribute to underlying keywords highlighting.

To achieve this result, we process the document natural language text and build a knowledge network as an internal representation of the text. This knowledge network is a graph with concepts, relations between them, and points as a metric of relevance. The approach performs ambiguity resolution, selects most relevant concepts to display in the summary, and votes for keywords highlighting in the text by means of points in the knowledge network. Besides the direct representation of identified information in the summary, this approach proposes a way to provide extended summary by using additional knowledge about relations. The described approach helps to speed up analysis and decision making processes by means of providing aggregated summary for a document and highlighting most meaningful parts of the document’s text.

Experiment results demonstrate that interactive summary generation and keywords highlighting can be successfully performed by the proposed approach to achieve meaningful and highly relevant information.
BALTIC SEA REGION STATES IN THE LOGISTICS SERVICES’ MARKET: KEY SUCCESS FACTORS

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Keywords: Logistics Performance Index, Gross Domestic Product, foreign trade turnover, transport barriers

Transport barriers play an important role for the countries and region’s economies and international trade in particular. Due to escalating geopolitical situation, economic sanctions against Russia and counter sanctions, some of traditional transport routes were disrupted. In some cases, new supply chains have been arranged. At the same time, transport services play an important role in GDP structure of developed countries. In spite of political problems, the EU remains one of the main trade partners of Russian Federation links with European.

Therefore, assessment of logistics efficiency and performance of a particular country is an important issue. The research is aimed at finding correlation between macroeconomic indicators and LPI and factors influencing variation of Logistics Performance Index at Baltic Sea Region states.

Logistics Performance Index (LPI) was developed by the specialists of the World Bank for analysis of national logistics system’s efficiency (Arvis et al., 2007a, 2010b, 2012c, 2014d, 2016d). The state of knowledge helped us to depict scientific experience in field of importance transport and logistics in national economy.

The paper is focused on Baltic Sea Region (BSR) states: Estonia, Latvia, Lithuania, Finland, Sweden, Denmark and Poland. We consider Russian position in LPI ranks in comparison with the BSR countries. For quantitative analysis, we used statistical and econometrical methods. Our calculations were carried out in Gretl. Based on World Bank and UNCTAD data we find deep positive correlation between GDP and Logistics Performance Index. On other hand we have low correlation between countries trade turnover and LPI. Scientific interpretation of these phenomena is difficult because in Logistics Performance Index methodology the interviewers use such questions to respondents as following: what are the most important trade partners in export and import for their countries?

Baltic States improves their ranks in LPI steadily (Skorobogatova and Kuzmina-Merlino, 2017) as well as Poland. Scandinavian countries are rather unstable in the field of logistics efficiency. Meanwhile Sweden showed the best result in 2016 (the 3rd place in ranking) between all analyzed countries with the highest score – 4,2. The same 3rd place had Finland in 2012.

As for Russia, our country had showed the best result in 2014, but now it returned to the starting position – the 99th rank. The main reason are inadequate and inefficient reforms in the sphere of transport and logistics, non-transparent customs and tax legislation, corruption and some other problems. Russia falls behind the leader of ranking (Germany) in all positions.

References
Session 3

Intelligent Transport Systems
USE CASES AND INTRODUCTORY ANALYSIS OF THE DATASET COLLECTED WITHIN THE LARGE NETWORK OF PUBLIC CHARGING STATIONS

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Keywords: data analysis, electric mobility, energy forecasting, vehicle charging

Currently, we can observe large global initiatives aiming at reduction of the greenhouse gas effects, mainly focusing on smaller production of CO₂ emissions in transportation and energy sectors. About 20% CO₂ is produced by transport and therefore EU countries have been incentivising use of electric vehicles and building of renewable energy sources. In the past years, this led to an increase in the use of electric vehicles, social changes and it created needs for technological changes in the current transportation and energy systems, for example, substantial investments have been used for building new charging infrastructure and doing required improvements in the electrical grid. (Sandén and Wallgren, 2017) On one side, this creates opportunities for new businesses, on the other side, it is challenging for system operators to make effective decisions in a such dynamically changing environment. In order to provide effective decision support, we are exploring possibilities for exploiting available dataset and present results of preliminary data analyses to uncover basic characteristics of such complex system.

Our dataset contains over 32 million meter readings from charging of plug-in electric vehicles on more than 1700 public and private charging stations, located in the Netherlands. First, we analyse possible use cases of the dataset based on the existing literature, by evaluating discussions with experts from companies working in the electro-mobility field and by considering results of preliminary data analysis. Using this information, we identified three main application areas: forecasting of demanded energy, identification of customer segments and characterization of suitable locations for charging stations, which we aim to investigate further. Second, as an example of a use case, we further analyse PEV charging transactions in the region of Utrecht, where the electromobility is strongly developed. To gain insights, which information is relevant for doing precise long and short-term energy forecasts, we evaluate which predictors and in which form are significant in the forecasting, when using regression models (Dannecker, 2015). Based on the obtained results, we derive conclusions and useful recommendations for the data analysis in the electromobility field.

Acknowledgements

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References

INFLUENCE OF CONSTRUCTIVE MATERIALS OF ROAD COVER ON MAGNETIC FIELD DISPERSION OF WIRELESS POWER TRANSMISSION SYSTEMS

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Keywords: wireless power transmission; magnetic field; road cover; constructive materials

Currently, the technologies wireless power transmission for charging the electric vehicle accumulators are given sufficient attention (Covic and Boys, 2013; Li and Mi, 2015). Charging the accumulators on the move seems very perspective which is confirmed by the standards of the leading world countries (Pereirinha and Trovão, 2013).

To improve the efficiency of wireless power transmission systems using resonantly inductive energy transfer technology (Grajski \textit{et al.}, 2012), many studies and design developments have been performed, for example, using different coil designs, applying different amplification and conversion schemes on the transmitting and receiving side, using a variety of schemes for frequency and load regulation (Shin, 2014; Imura \textit{et al.}, 2009; Hui \textit{et al.}, 2014).

For electric vehicle dynamic charge in motion the transmitting module of the system must be built into the road cover to ensure the safety of traffic, as a high-speed highway cover must be smooth and all components of wireless charge system must be hidden under it. Most studies of energy transfer efficiency were performed when there was an air gap between the transmitting and receiving coils of wireless power transmission system and only occasionally asphalt or concrete without taking into account features existing road cover. The aim of the given research is to determine influence of different construction materials used in road cover on the parameters (efficiency) of electric vehicle wireless charge system.

In Latvia, the types of road cover are regulated by documents of State Joint Stock Company Latvian State Roads (VAS “Latvijas Valsts ceļi”, 2010). In accordance with this document, 10 samples of road covers were used for carrying out our investigations. These samples fully corresponded to all types of motor roads in Latvia in terms of structure and materials of the upper layers of road covers. The horizontal dimensions of the samples were 1200 mm and 800 mm, and the thickness of the samples corresponded to the road type.

To conduct a research test bench was erected consisting of an electric vehicle, a system of electric vehicle wireless charge with power 3KW, a trestle of non-magnetic material, a system of coils orientation and an automatic registrar of magnetic field with mechanic dispersion. During the experiment between-an electric vehicle supplied with the receiver of wireless charge system and a transmitter were placed samples of different materials and their combinations after that the system was transferred into working position and were taken the field measurements. The measurements were made using each road cover specimen for three conditions: a dry sample, a wet sample, and a sample in a saline solution.

Analysis of research results leads to the following conclusions:

- most materials, not containing metal parts, in dry condition did not substantially influence the operation of wireless power transmission;
- the property of these materials may change to a great extent with plunging them into the water;
- the water containing defrosting agent as sand layer with thickness 30MM, saturated with 1% NaCl solution absorb 20% of magnetic stream;
- the usage of metal armature and net over the coil receiver leads to the working incapacity of the system and under the coil it is possible to use it at the depth over 100 mm;
- the composite armature does not affect so much the work of the system.

References
SPEED MANAGEMENT IN ZONES OF CROSSWALKS

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Keywords: speed management, traffic organization, measures of speed control

Calming traffic is one of the main approaches to ensuring traffic safety in city streets and it is based on the concept of speed containment (Nilsson, 1982). The aim of this approach is to minimize passing transit flows through the streets of district importance, to ensure the pedestrians and cyclists safety, as well as the impact on the behaviour of drivers in urban conditions. City streets should be designed taking into account the restriction of "extra" speed, as well as in accordance with the category and purpose. It is necessary to take into account the functionality of the street, the uniformity of the traffic flow, the appropriateness of the imposed limitations, the predictability of the technical means used to organize traffic.

The main criteria for the use of such approach, as a calming traffic, can be: accident rate, speed, through traffic, specific traffic conditions (Taylor et al., 2002).

The article presents practical results of traffic conditions studies in the pedestrian crossings areas equipped with humps (Kapsky, et al., 2015). Considered alternative measures of physical and psychological effects on the traffic participants in the context of the traffic calming approach.

Acknowledgements

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THE PERFORMANCE WALL OF LARGE PARALLEL COMPUTING SYSTEMS

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Keywords: parallel computing, efficiency, performance, limitations, supercomputer, brain simulator

Since the beginning of using parallelized computing units it is known that the actual performance is less than the possible nominal performance: part of the computing performance remains “dark”. It is also known that the amount of dark performance strongly depends on the number of parallelly working processing units, so its role must be crucial for supercomputers, where in the coming exa-scale models millions of processors are utilized, as well as for the exa-scale applications they are running, like brain simulation and Earth simulation. Although the effects affecting parallel performance are known from the beginning, their relative weights have been considerably changed with the development of the field and strongly depend on the type of application. The careful reconsideration discovers that in contrast with the general belief, supercomputer performance has an upper limit, and reaching that limit explains some strange and mysterious events, like cancelling projects immediately before their target date or that the special-purpose brain simulator cannot outperform the many-thread simulator running on a general-purpose supercomputer.
Session 4

Telematics
AVAILABILITY OF APPLICATIONS IN CONTAINER-BASED CLOUD PAAS ARCHITECTURE

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Keywords: Fog computing, cloud computing, edge computing, availability, reliability

Fog computing is a paradigm that extends cloud computing and services to the edge of the network. Similar to cloud, Fog provides data, compute, storage, and application services to end-users. Main aim of Fog computing is to reduce the burden on cloud by gathering workloads, services, applications and huge data to near network edge.

Fog computing based systems are becoming an important class of Internet of Things (IoT) and Cyber-physical systems (CPS). Technological advances in sensing devices, real-time computation and the development of intelligent systems, have instigated the need to improve the performance of IoT and CPS in terms of security, accuracy, efficiency, reliability, and fault tolerance. For many applications in such systems, reliability issues of their operation become especially important.

The paper suggests an approach to the analysis of application reliability in complex networks based on cloud technologies with Fog computing as an extension of the traditional cloud-based computing model where implementations of the architecture can reside in multiple layers of a network’s topology. A Markov model is proposed to calculate the availability of applications in a system with the specified architecture.

Expressions are obtained for the calculation of availability of end applications in the lower-level nodes of the network of the indicated topology.
INCREASING THE EFFICIENCY OF THE WIRELESS CHARGING SYSTEM FOR MOBILE DEVICES THAT SUPPORT QI STANDARD

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Keywords: Wireless charging, WPT, Qi, A4WP

Wireless charging or wireless power transfer (WPT), is the technology that enables a power source to transmit electromagnetic energy to an electrical load across an air gap. Nowadays, wireless charging is rapidly evolving from theories toward standard features on commercial products, especially mobile phones (Xiao et al., 2015).

The main purpose of the described project is to develop a prototype charger, which should have the following features:

▪ Compatibility with the main standards (more popular are Qi and A4WP);
▪ Effective charging at distances of several tens of centimetres (at least 10 cm) including through non-metallic surfaces;
▪ Constructive possibility to embed the device in various furniture surfaces;
▪ Some permissible level of electromagnetic compatibility (EMC).

Comparing the Qi and A4WP standards, we conclude that the undoubted advantage of the A4WP standard over Qi is the distance between the transmitter and receiver. However, the management processes for connecting and charging are much more complicated in A4WP and is not yet widely used for mobile phones.

Analysis of effectiveness lead to the conclusion that the most significant characteristics for the project are: efficiency in transmitted power (a typical solution for Qi WPT system has an efficiency of about 58%); power transmission distance (company Texas Instruments indicates that the power transfer efficiency between the coils is about 89% for a distance up to 3.7 mm); EMC efficiency (for WPT has not included in limits for public exposure but due to some recommendations magnetic field inductance B need to be less then 27μT). Those figures are targets for a feasibility study of the described project.

We have summarized data from the main publications on the models and methods for calculating the characteristics of WPT but all models work only in the linear case. From the point of view of the considered models, the solutions in the prototype should be recognized as sufficiently effective and simple. The distance for Qi devices for a two-stage project charging system reaches up to 200mm.

Contour models were used to calculate the magnetic field parameters. Methods for calculating of magnetic fields in the surrounding space were based on the solution of Maxwell’s equations. On the series of numerical calculations, it was shown that the applied methods far from the coil (r / R> 1), provide sufficient accuracy. At distances closer to the contour (r / R <1, R-radius of contour), deviations from analytical calculations can be observed. The models and calculations were applied for comparison with the data of field experiments.

Magnetic field measurements were obtained from the prototype at distances of 0 - 200mm from its working surface (perpendicular to the plane of the transmitting and receiving contour). We compare figures with the IEEE standard, which is more liberal than the ICNIRP standard. It was found that condition is not satisfied in full (for all values r / R) range. At a distance about
50mm from the plane of the contour, the magnetic field strength is within the requirements, and it rapidly decreases with further distance from the contour plane.

References
A SYSTEM OF DATA PROCESSING AS TWO-PHASE QUEUEING SYSTEM

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Keywords: Poisson flow, queueing system, complex message, elementary message

Modern telecommunication and data processing systems perform the processing of calls or data packages in several stages. These processes are simulated and investigated by using tandem queues or networks. The following case of two stages is considered in the paper. There exist $N$ independent Poisson flows of elementary messages. The intensity of the $i$-th flow equals $\lambda_i > 0$. Based on the incoming elementary messages, a complex message is formed according to the following rules. 1) A complex message does not contain more than $h_i \geq 1$ elementary messages of the $i$-th flow. 2) The generation of a complex message ends if the number of elementary messages in some flow reaches the maximal value. The complex message that has been generated is sent to a one-line queueing system. Such a system has not been previously discussed in the literature. Different indices of the described process are calculated, such as the distribution of elementary message generation time, the distribution of the queue length for complex messages, etc. The obtained results conform to airport control systems.
3D-RECONSTRUCTION OF HUMAN'S FACE IN PERSON’S IDENTIFICATION PROBLEM FROM VIDEO STREAM DATA

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Keywords: Computer vision, face recognition, optical flow, epipolar geometry, stereo correspondence, 3D-reconstruction

The problem of a human’s face recognition on base of photo or video images obtained under different angles of vision is considered. To solve such a problem, it can be used the reconstruction of a three-dimensional (3D) face model constructed in automatic mode using the ‘Shape from Stereo’ (SFS) approach.

The problem of automatic identification of a person by his image is very actual at present in computer vision systems used to provide access control, airport security, public buildings, critical infrastructure facilities, etc. (Biswas et al., 2013). Two models are used when identify a person's face:

- reference model contains the face where the association with certain person is already known (the passport photo of this person can be considered);
- the model contains the photo where a human’s face can be detected, and its parameters can be compared with the parameters of face in sample model when performing identification.

Usually the ordinary photos are used as the models, but the following problem arises in this case: the photo used as the sample for identifying a human face on photo, is sensitive to the existent head’s position in space of this photo. Sometimes there are cases when the human’s face cannot be automatically identified in the photo, because the face on the photo is rotated at some angles, where it is impossible to compare it with the reference photo.

The problem can be solved with the use of a three-dimensional (3D) model of human’s head surface (Rani and Sharma, 2013). When researching methods that implement various subtasks of this approach, its shortcomings were found, and a variant of its improvement was proposed, using the video stream instead of a pair of photographs. Comparison of the found stereo pairs is made using the usual SFS approach, as well as for its improved version.

A method for evaluating the quality of the obtained models is proposed, based on a comparison of the synthesized plane images of a person with the original photographs by the criterion of least squares of errors.

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References

SIGNIFICANT SIMULATION PARAMETERS FOR RESTART/LRE METHOD IN TELETRAFFIC SYSTEMS OF SDN

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Keywords: RESTART, LRE, Rare Event, SDN networks, Teletraffic Models

The last years the telecommunication sector constantly evolve. Estimating parameters as the probability of a rare event has applications in reliability, telecommunications, insurance, and several other areas. The rare events such as blocking, overflows and losses in new generation networks, especially in systems with very low probability, are one of the major estimation problems for ordinary simulation methods (Iversen, 2015). Speed-up simulation is the most convenient method for estimation of rare events (Bucklew, 2004; Cerou and Guyader, 2000). The main purpose of the research is to determine and compare the significant parameters for speed-up simulation of SDN (Software Defined Networking) (Nguyen et al., 2014). The simulations opportunities represent a chance to reduce the digital divide and to ensure SDN with minimum cost of time and financials. The simulation of teletraffic models allows the modelling of resource management issues, admission of system users with different parameters.

For complicated models, this could be calculated done in principle by the Monte Carlo simulation, but when the event of interest is rare (Bucklew, 2004), straightforward simulation would in most cases require an excessive number of runs for the rare event to happen frequently enough so that the estimator is meaningful. RESTART (Repetitive Simulation Trials After Reaching Thresholds) is an accelerated simulation method, which belongs to the importance splitting methods, used to speed-up the rare event simulation. Combination of RESTART and LRE (Limited Relative Error) (Garvels and Kroese, 1998; Garvels, 2000). The LRE measures the complementary distribution function of the queue occupancy and performs the Run Time Control (RTC) of the simulation. The LRE performs the Run Time Control with two conditions: the Large Sample Conditions and the Relative Error Condition.

Simulations represent a good opportunity to reduce the digital divide and to ensure the new trend of SDN networks. The implementation of simulation program is made with .NET. .NET Framework introduces a Common Type System (CTS) that defines all possible data types and programming constructs and how they may or may not interact with each other. Because of this feature, .NET Framework supports the exchange of types and object instances between libraries and applications written using any conforming .NET language.

The program product .NET is used because a large amount of generated data has to be processed efficiently. Standard simulators generate a pseudo random stream of information. The generated information that is needed for this study should be modelled by changing the specified parameters so that the RESTART method is applied. The teletraffic models with SSM, geometrical and Pareto arrival distributions, which are versatile, possessing a pseudo-memoryless property which makes the solution of many GE-type queuing systems and networks analytically tractable (Radev, 2012).

The new generation networking is interested in the modelling and performance evaluation of single communication links, but in the modelling of more devices in the whole network (Ivanova, 2013). Typically, the performance of the whole network containing many links working in parallel and interfering with each other is of primary interest.

This type of simulation allows the modelling of resource management issues, admission of system users with different priority, interaction and network loading by several types of traffic sources, etc. The aim of such modelling is network capacity evaluation and probabilities of failure (Iversen, 2015).
First simulations are made with M/M/1/N queuing systems with the .Net tools, because it was necessary to compare analytical and simulation results, to prove and validate the new results (Mitkov, 2010). The algorithm and results are described before (Ivanova, 2013).

After validation of results, the next step of determine significant parameters is calculating of correlational matrix for the teletraffic systems with general non-Markovian distribution of arrival rate.

Correlational matrix for system G/M/1/N is calculated, after the important proof that the parameters \( L, n \) and \( RE \) are without linear dependence.

The next step of validation of significant parameters of the RESTART/LRE algorithm for such a system is multifunctional regression analysis. The analysis defines which parameters will have significant influence of final results.

The simulation of the SSM/M/1/N, Erlang/M/1/N and G/M/1/N queuing systems is made for different number of observations \( n \). The increasing of arrival rate leads to insignificant increasing of blocking events. We choose arrival and service rate, to receive appropriate result. First simulations were made with different disciplines of service. The amount of rare events in system with disciplines of service: LIFO and FIFO are with insignificant difference.

In this paper we have reviewed, presented, validated and discussed the scenarios for teletraffic models for software defined networks. Secondly, this paper presents an implementation of teletraffic models developed in .NET for estimation of blocking events.

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References

FEASIBILITY STUDY OF MODERN INTELLIGENT METHODS APPLICATION FOR DIGITAL FORENSICS

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Keywords: Digital forensics, Big Data, Intelligent methods

Nowadays cyber weapon, a piece of computer software or hardware used to commit cyber warfare, are widely developed and utilised to cause physical damage through computers. Different types of attacks could shut down a society’s critical infrastructure, potentially causing significant harm to people.

Implications and scopes of cybercrimes have rapidly expanded during last decades and thus greater research attention is focused on apprehending and prosecuting of offenders. New technologies and legislation could be developed to facilitate the investigation of digital criminal activities. Investigating human misuse of computers creates new puzzles and technical challenges, particularly when offenders attempt to conceal incriminating evidence and their activities on computer systems and networks. One of the main problems of digital forensics is related to the fact that a huge volume of data needs to be analysed for evidence of crime.

The primary aim of this work is to improve this challenging forensic process through application of intelligent methods for analysis of digital evidences. The desired outcome of this work is to encourage advancing these methods in a forensic science discipline.

Methods of digital forensic analysis are classified by the application area as Endpoint Forensics, Network Forensics, Mobile Forensics, IoT Forensics, Email and Social Media Forensics (Muniz and Lakhani, 2018). Procedures of all mentioned areas include capturing data, data storage, and data analysis and thus meet well-known Big data challenges – volume, velocity, variety and others.

This work is a feasibility study of methods of Information security and Big Data analyses for solving digital forensic problems, in particular on timeline reconstruction. Timeline reconstruction is focused on identification of a limited number of investigator-friendly high-level events on the base millions of low-level events (networks packets, registry updates, file modifications, etc.). There is a wide range of software tools that allow extraction of low-level events from various sources of raw data (Zeitline, log2timeline and others), but composing of high-level events is an open scientific direction. Since Abbott et al. (2006) proposed automated recognition of event scenarios for digital forensics, several methodological approaches were utilized for high-level event reconstruction – finite state machines, rule-based, neural and Bayesian networks.

References
Using Impact-Oscillatory Loading and Nanotechnologies for Improving Mechanical Properties of Two-Phase Titanium Alloy VT23

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Keywords: aerospace engineering, fracture, deformation, impact-oscillatory loading

Based on numerous experimental studies, the optimal modes of impact-oscillatory loading have been substantiated for sheet two-phase high-strength titanium alloys used in aerospace engineering. These optimal modes of impact-oscillatory loading provide the maximum increase in their plastic deformation, compared to the initial state. The result of structural transformations of materials under impact-oscillatory loading is the appearance of microextrusions on the specimen surface in the form of a lattice of “ridges” (“mountains”) due to the formation of less dense dissipative structures. The obtained effect is used to develop an effective method for strengthening and nanostructuring the surface of materials and obtaining the uniformly controlled nanoscale structure of a surface layer with the enhanced mechanical strength. The technology of this method is as follows. Prior to the application of the impulse loading, the surface of specimens from the test materials is wetted with a colloidal solution of metal nanoparticles, or nanoparticles of solid alloys, or nanoparticles of metal carbides, or nanoparticles of metal nitrides, or the colloidal solution of solid nonmetallic nanoparticles, after which nanoparticles from the solution are precipitated on the material surface by drying. As a result of the preliminary wetting by a given colloidal solution in the dynamic unbalanced process caused by impact-oscillatory loading, the nanoparticles of the metal that are on the surface of the test material are “embossed” into the surface, which causes significant structural changes in the surface layer with the formation of a controlled surface nanostructured layer. The controlled structure of the material surface is obtained by using in a colloidal solution of metal nanoparticles of the appropriate size and the solution of the appropriate concentration.

The technique for improving the mechanical properties of titanium alloys by means of impulse introduction of energy and nanotechnologies was tested on the titanium alloy VT23. For the VT23 alloy, the optimum effect of the intense impulse introduction of energy on the maximum increase in the initial plastic deformation was noted when the value of deformation shifts $\epsilon_{imp}$ was about 3...3.5% in the process of the impulse introduction of energy. In this case, an increase in the plastic deformation of the alloy was obtained, as compared to the initial state, by 30–35%. Using this optimal effect of the intense impulse introduction of energy into the titanium alloy VT23, which was achieved due to the above described technique, the strengthening of the surface layers of the VT23 alloy was performed additionally.

The tests were performed using colloidal solutions of tungsten nanoparticles, tungsten carbide, special polymer material, and carbon. After the application of additional impulse loads, the specimens were completely unloaded, wiped with alcohol, and the hardness of the surface layer in the working area and on the specimen heads was measured by the Vickers method on the NPO-10 hardness meter at a working load of 10 kg.
The analysis of the data shows that using the colloidal solution of tungsten, one can increase the microhardness of the surface layer of the titanium alloy VT23 by 8.5 .. 9%, the colloidal solution of W-C – by 18.5–19.0%, the colloidal solution of the special polymeric material – by 8.0–9.0%, and the colloidal carbon solution – by up to 8.5%.

New technological methods for the modification of the mechanical properties of titanium alloys of high-tech transport systems with the use of impact-oscillatory loading and nanotechnologies are proposed. These methods are highly effective for increasing plastic deformation and strengthening the surface layers of materials for air transport.
EMPLOYMENT OF SIC MOSFETs AND GAN – TRANSISTORS FOR OF WIRELESS POWER TRANSMISSION SYSTEMS

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Keywords: wireless power transmission; power inverter; cooling; inverter efficiency

The development and improvement of electric vehicles (EVs) and hybrid electric vehicles (HEVs) is a modern trend of the auto industry. EVs have such advantages as reducing fossil fuel consumption and emissions from the tailpipe. The problems of using EV are manifested in a short range of driving and long time of accumulators charging.

These problems can be solved by dynamically charging EVs accumulators in motion using wireless energy transfer (WPT) systems, in which resonantly inductive energy transfer technology is realized (Shin, 2014; Imura et al., 2009). In this case, such WPT systems should be characterized by a high energy transfer coefficient. The effectiveness of the WPT system depends on the design features and technical characteristics of the functional elements of the system, among which the transmitting side power inverters are the most important devices (Covic and Boys, 2013; Li and Mi, 2015).

The WPT systems inverters must have a high conversion efficiency provided that their operating frequency is increased, their sizes is reduced and they have high reliability, since the WPT systems transmitting modules are built in the road cover. The characteristics of power semiconductor devices used to create inverters determine mainly by characteristics of power electronic inverters.

Field-effect transistors based on silicon carbide (SiC) and gallium nitride (GaN) are characterized small mass, small dimensions, greater efficiency, increased operating frequency and improved reliability (Biela et al., 2011; Everts et al., 2018) compared to silicon MOSFETs, which are usually used to create power inverters of WPT systems. Small dimensions of these power semiconductor devices allow use the modular principle of designing power electronic inverters. In this case of power inverters, the modular construction requires the use of cooling systems of the entire power module, rather than individual power transistors.

The purpose of our research is the development modules of power inverters on SiC MOSFETs and GaN – transistors for WPT system and determination of their frequency properties cooling conditions. SiC MOSFETs of a new family - C3M0065090J (C3M0065090J, 2012) and eGaN transistors EPC2034 (EPC2034, 2013) were chosen to create modules of power inverters. To ensure high reliability ultrasonic welding methods have been used to create these modules.

The test bench has been designed to research the parameters of the created modules of power inverters. The test bench also provides direct liquid cooling, liquid-air cooling and two-circuit liquid cooling of the designed modules of power inverters (Boukhanouf and Haddad, 2010; Valenzuela et al., 2005). Frequency dependences of output power and efficiency of electronic power modules were determined using each of the three cooling technologies.

Analysis of research results leads to the following conclusions:

▪ direct liquid cooling proved to be more efficient than the other two cooling methods;
▪ when using a module made on eGaN transistors EPC2034, the efficiency is greater than 90% if the operating frequency is in the range from 100 kHz to 300 kHz;
when using a module on transistors C3M0065090J, the efficiency decreased to 75% in the same frequency range.

References
OFF-THE-SHELF CONVOLUTIONAL NEURAL NETWORKS
LOW-LIGHT OBJECT DETECTION COMPARISON

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Keywords: object recognition, low-light imagery, Poisson noise, Bernoulli trial, off-the-shelf convolutional neural networks, testing procedure

The article describes the test settings, which mimic the actual scenario in which, a company (be it a start-up, or an established enterprise) want to verify to what extent the open source off-the-shelf neural network-based (usually of convolutional type, CNNs) object detection tools are applicable in applications involving:

• Surveillance, or
• Autonomous vehicles (drones and/or cars).

The common issue in these applications is a lack of sufficient scene illumination, as it is assumed that they need to reliably work from "dusk to dawn" as well. This results in a low signal-to-noise ratio, SNR. In turn, the available CNN-based tools are trained with the help of well-lighted scenes and objects, that is, in conditions where SNR is high. The recent tragic accident in Arizona, where allegedly (according to the recent findings of the National Transportation Safety Board, NTSB, which investigates the accident)¹ the "hardware" detected the trespasser, but the "software" falsely ignored her presence, testifies to such a need.

The experiment setup described and used in this report exploits the following observation: The close to realistic low-light versions of well-lighted scene images can be obtained using Poisson distribution with the rates parameters for each pixel equal to template image pixel values (cf. e.g. the references below).

The presented, preliminary findings suggest that the off-the-shelf CNNs are applicable in general in surveillance/autonomous vehicle applications. Moreover, the simple convolution- and wavelet-based smoothing algorithms increases the probability of proper classification.

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¹ See the report: https://ntsb.gov/news/press-releases/Pages/NR20180524.aspx
PERFORMANCE EVALUATION OF EVENT-DRIVEN SOFTWARE APPLIED IN MONITORING SYSTEMS

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Keywords: event processing, monitoring system, web application, performance analysis

Operation of various contemporary real-time information systems is often based on Detect-Decide-Respond scheme; with a coming stream of events, functionality of the system can be defined as a detection of some specific temporal and semantic patterns within them, followed by an evaluation of their various characteristics and generation of appropriate reactions as the result of their classification. In these cases, it can be advantageous to base construction of the whole information system on the event-driven processing paradigm. The performance (Miller, 2013) of such a system is an important aspect in monitoring applications. It can be assessed in three aspects: their capability to provide responses in the desired timespan, the capability to respond correctly (without errors), and the ability to handle large, cumulated workloads (Caban and Walkowiak, 2015). In this paper we examined the performance of software implementing the event processing (namely the Proactive Technology Online – PROTON (IBM Research Lab, 2018)) deployed as a web server.

The general structure of a typical Complex Event Processing (CEP) system is a network of some basic components which communicate with themselves by sending event messages (Opher and Niblett, 2011). The primary source of raw events (i.e. the basic events which enter the system) are external event producers while the essential part of the processing is done within an Event Processing Network (EPN) which is a composition of Event Processing Agents (EPAs). Each agent is capable of reading events on its inputs, analysing them according to some specific processing scheme and generating derived events on its outputs. The derived events can be forwarded to other agents within the network for further processing or can be sent to event consumers as the result of system operation.

The case study in this paper analysed a stream of two raw events: A and B where the expected correct behaviour is when each occurrence of the A event was followed by the B within some constant time-out window T_{AB}. In such a stream we wanted to detect and report two alerts: absentB – an event generated at the end of the time-out period after A if no occurrence of B has been registered and detachedB – an event signalling reception of B which was not properly preceded by an occurrence of A. An additional requirement was to consider an ObjectID attribute stored in each A or B event which would identify a user or object generating it – the events could refer to multiple objects and the system had to be able to distinguish them and to monitor their behaviour individually and independently.

For detection of these alerts we defined two EPNs which – for the performance evaluation – were implemented on the PROTON platform and tested as a RESTful web application (Complex Event Processing Open RESTful API Specification, 2018) on the Tomcat server. Two test scenarios were used. The first scenario (A) modelled a security breaking situation, i.e. the EPN received only events of type A with each event coming with different ObjectID attribute. In the second scenario (B) the correct situation was modelled, i.e. the
generated stream included pairs of events: event A followed by event B after 0.5 sec ($T_{AB} = 2$ sec), both with the same ObjectID value. Additionally, another configuration was verified which corresponded to a common practical situation when the system receives the events from some kind of a central broker and all events come from the same IP address. The numerical results included in the paper – the average system response time as a function of the increasing load (the stream of incoming events) – identified some differences in performance between configurations with and without the central broker but first of all they demonstrated substantial limitations in the performance of the implemented systems which were related to inefficiencies of massive multi-threaded processing in the Java environment.

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CHECKERS PLAYER NEXT MOVE AIDED SYSTEM

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Keywords: checkers, Negamax, SARSA, softcomputing, agent system

Main aim of the paper was to create checkers player move aided system. For this purpose, two different approaches were used. First one was well known searching algorithm - Negamax and second one was Reinforcement Learning algorithm - SARSA. For the purpose of making experiments on algorithms’ performance special environment was created. It was checkers program which main goal was to give its user possibility of launching the game between two different agents. One of its constraints was also to make creating and adding new agent easy for the future use in other research.

The game of checkers is one of the most valued board games in the world. There is no one person who did not heard about this game. For centuries it was played by kings, learned and ordinary people. Big fans of the game were for example Charles Darwin, Lev Tolstoi, Benjamin Franklin, Napoleon Bonaparte and Frederic Chopin. It is even a subject of poem named 'Checkers' by Adam Mickiewicz. It is hard to be surprised with those facts because simplicity of rules and creation of checkers that comes in pair with complexity of the game itself makes it enjoyable entertainment and brain training for the ones that look for something more demanding. Roots of checkers date back to ancient times and they are not losing popularity until these days.

Variant of checkers that was used during the research presented in this paper is already mentioned American Checkers called also Straight Checkers or English Draughts. The game is played on 8x8 checkerboard. Both players have 12 pieces. In starting position all pieces are put in three first lines on both sides of the checkerboard. Black moves first and then players alternates their moves.

The main idea was to create the system that implements a game of American Checkers according to the rules that were introduced in the previous chapter. This system have had to give a user possibility of making different kinds of agents playing against each other in order to collect statistics about the game. The word 'agent' does not have a standardized definition. The word should be understood as an entity that is acting in the environment and is characterized by three main features: communication - it is communicating with the environment in some way, perception - it monitors the changes that happens in the environment, autonomy - it is able to make autonomous decisions about future actions taken in order to achieve its goal (to win the game).

Two agents of different types (or two instances of the same type with different parameters) can be chosen to play with each other. Whole program is prepared in the way that provides possibility of adding new algorithms and ideas for agent’s ‘brain’. In order to do this new class of agent has to be created. Such class gets all needed information about actual state of environment and returns chosen action. During the research five kinds of such agents were created: Human Agent, Random Agent, Negamax Agent, SARSA Agent and SARSA(λ) Agent. Every one of them was based on individual algorithm and can get slightly different input but all of them provides the same output - an action to be taken.

During the research different systems for making decisions about moves taken in the game of checkers were implemented. Agent based on searching algorithm with good evaluation function got to the level a bit below an amateur player. Main issue of such algorithm was huge
computational complexity of the task. Using typical personal computer, it is not likely to bring much better results than the ones that were presented in previous chapter. Second tested SARSA and SARSA(\(\lambda\)) reinforcement learning agents that were implemented also did not brought satisfactory results. After seemingly successful process of learning during which they showed ability of beating other no-human agents they still were almost useless during the game with human. Occurrence of so many combinations even after trial of their reduction still resulted in situations in which SARSA agent acted randomly most of the time leading it to lost in the game. Even if reinforcement learning used for this complex problem did not brought revolutionary results it proved to be very interesting and promising method. The agent could learn in foreign environment during the process of unsupervised learning. That could make it useful for solving different problems. Also using possible skill for generalization of such agent is very promising.

After the research presented in this paper a lot of ideas for future development were invented. Possible way to be taken depends on a lot of elements like which part of the research was the most interesting or what goals will be set to achieve. Actually, research showed that it should stop being called SARSA and using only this reinforcement learning technique for the task of solving checkers because it occurred to be not enough. Some different approaches can be used together with SARSA algorithm.

A good idea would be to test mixing Negamax with SARSA. Thanks to this agent could learn new moves and know exactly how to behave most efficiently in particular situations using SARSA and deal with unknown situations using searching algorithm. Also, some new techniques could be added. Some heuristic for searching also could be implemented and tested. Quality of research would also be improved by using more sufficient equipment. All just presented ideas are focused on developing agent for this particular game, but it does not have to be the clue of further research. Instead developing of great checkers player main interest could be focused on reinforcement learning technique. Experiments showed that it could be interesting field for more thorough studying. Playing checkers does not have to be the main problem taken into consideration. Something less computationally demanding like for example not very advanced case of path finding could be use instead. Using other problem could help in finding the most promising method of reinforcement learning and setting the best performing parameters. After that this technique could be checked again in trial of solving checkers. In this way also generalization feature of this method would be verified.
REQUIRED DEPTH OF ELECTRICITY PRICE FORECASTING IN THE PROBLEM OF OPTIMUM PLANNING OF MANUFACTURING PROCESS BASED ON ENERGY STORAGE SYSTEM (ESS)

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Keywords: Energy storage system, battery, electricity consumption control, time series forecasting, artificial neural network

The issue of appropriated range of electricity market price forecasting in the problem of enterprise’s electricity consumption expenses optimisation is considered. Various kinds of battery energy storage systems (BESS) for small enterprises, as well as control algorithms for energy consumption expenditures cost reduction, are considered. The estimation of accuracy of hourly electricity price time series forecasting with the artificial neural networks (ANN) algorithm is made with step-by-step increasing depth of the forecast. It is shown that for the optimal control of electricity consumption forecast makes sense no more than for about of few hours (or tens hours) ahead only in dependence on forecast errors.

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Session 5

Smart Solutions for Supply Chain Management
OPERATIONAL SIMULATION-BASED DECISION SUPPORT IN INTRALOGISTICS USING SHORT-TERM FORECASTS

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Keywords: intralogistics, real-time simulation, modelling, optimization, forecasts, operational decisions

Today’s decision-makers have to analyse rapidly complex problems in the intralogistics to make the right decision. There are not many tools to help in this process but there are many data. A concept to use this data in an easy way to optimize the own decision based on forecasts would deliver a great benefit for the decision-makers.

In the planning of processes in the intralogistics, the use of material flow simulation models is quite common. The benefit of such simulation models does not end in the planning process. There is a way to extend it to an operational use. Modern simulation approaches and the current rapid hardware enable simulation runs in an extremely short time. Many simulation software already offers numerous integrated optimization tools: Beside classical optimization algorithms, this can also be artificial neural networks and genetic algorithms.

The simulation model can provide with real-time data valid short-term forecasts. The integrated optimization tools can afterwards directly use the data for changing of various control parameters to optimize the target parameters. Renewed simulation runs enable the validation of this optimization. The decision-maker can then use the highly accurate results for the decision in his specific situation. The idea of real-time simulation is not new and emerged from the idea of control manufacturing systems dynamically (McConell and Medeiros, 1992). Since the 90s researchers already applicable real-time simulation for example to “assign due dates on logistics-manufacturing networks” (Ruiz-Torres and Nakatani, 1998) or in combination with artificial neural networks to control flows in sewerage networks in real-time (Hunter et al., 1997). Despite the progress in this area, research continues to focus on other use cases and new concepts nowadays.

This paper shows a concept of a procedure model for the realization of such operational simulation-based decision support applied to the picking area of an industrial laundry. The operational use of the simulation model is part of the project “Laundry Order Consolidation System (LOCSys)”, which aims to improve the picking & storing processes in the clean area of an industrial laundry through automation.

There are not many applications of real-time simulation for industrial laundries. At least one approach describes the use of a real-time algorithm that optimizes the sequence in order to save resources with a predictive control (Peitz et al., 2016). A specific simulation-based approach is missing in this context.

Our concept consists of a combination of gathering real-time data, simulation and short-term forecasts to give decision support in the picking area and the warehouse. Figure 1 shows the key processes of an industrial laundry and gives an example of an early concept, where a digitized goods receipt provides data of the incoming laundry items and transfers it to the operational simulation model. The simulation creates various short-term forecasts and delivers a decision support for the SRU in LOCSys.
Acknowledgements

As part of the “Zentrales Innovationsprogramm Mittelstand” (ZIM), the Federal Ministry for Economic Affairs and Energy of Germany launched a research and development project to find an innovative solution for automating the picking area in industrial laundries. The project is called “LOCSys - Laundry Order Consolidation System”. Part of LOCSys is the use of an operational simulation model to provide short-term forecasts and support the decision-making of the automated picking system.

We are very thankful for the financial support of the ministry, which allows us to research for new picking solutions in the laundry industry.

References

CHOOSING THE LOCALISATION OF LOADING POINTS FOR THE CARGO BICYCLES SYSTEM IN THE KRAKÓW OLD TOWN

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Keywords: cargo bicycles, loading point, localisation problem, Python programming, computer simulations

Effective freight deliveries within cities is a highly problematic issue, which generates relatively high costs in comparing to costs of the entire delivery process. Neglect of this issue by transport companies and researchers cause that its practical aspect meets with numerous physical, administrative and organisational limitations. Furthermore, last mile deliveries are usually characterised by a large diversity of cargos in terms of natural susceptibility followed by low utilisation of transport capacity. In such situation, cargo distribution systems based on cargo bikes could be considered as the alternative to traditional deliveries by automobile transport.

In the developed mathematical model, we present consignees as vertices of the transport network, while the graph edges reflect the relevant sections of the road network connecting consumers of transport services. The basic characteristics of the vertices are their geographical coordinates and lists of edges. The necessary parameters of the edges are their weight and end vertices. Each request for transport services can be quantified on the grounds of numerical parameters, among which the most significant are: the size of the consignment, its dimensions, the time interval between requests, and the delivery distance. For a single request, the numerical parameters are deterministic characteristics, but for the ordered flow of requests, these parameters are random variables. For the simulation of the system of goods delivery by cargo bicycles, it is necessary to determine the delivery routes. Assuming that transport operators undertake activities related to shaping rational (or optimal) delivery routes, in the simulation model, we propose to implement the routing procedure based on the Clarke-Wright algorithm.

In order to implement simulation models of cargo bike delivery systems, the library of basic classes was developed. This library has been implemented in the Python language and is available as an open source: the developed code could be forked from the repository https://github.com/naumovvs/cargo-bikes-system.git.

The developed mathematical model was applied for choosing the loading point localisation for the system of cargo deliveries in the Krakow Old Town: demand parameters for transport of goods in the Old Town area were presented as random variables, the existing road network model was formed, and the system simulations for the alternative locations of a loading point were provided. The simulation results analysis allowed us to substantiate such a loading point location which is characterised by minimal value of the total transport work.

The proposed approach to modelling of goods deliveries by cargo bikes allows to consider the stochastic nature of the demand for freight transport and random parameters of the delivery process. The numerical parameters described in the mathematical model are the main characteristics, but the proposed model can be extended to be adapted to other issues.
THE ROLE OF REVERSE LOGISTICS IN THE TRANSITION TO A CIRCULAR ECONOMY

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Keywords: circular economy, reverse logistics, system of branded automotive service; spare parts logistics; decision support system

Globalization processes have led to the realization of the need to find ways of transition to a new model of the economy. Depletion of resources, climate change, negative impact on the environment – these are factors that raise the question of responsibility to future generations for the preservation of life on Earth. These are challenges of a planetary scale and they are causing companies to move from a traditional “take-make-dispose” model to a more circular strategy (Pakhomova et al., 2017), which has a restorative and closed character (Ellen MacArthur Foundation, 2013) and is based on minimizing the consumption of primary raw materials and reducing waste burial. The basis of the circular economy is formed by closed-loop supply chains, for which it is necessary to apply fundamentally new logistics approaches. One of such approaches is called reverse logistics (RL) and implies the movement of material flow from the consumption point to the original place of production (Niknejad and Petrovic, 2014). Circular planning must then be used to determine whether reclaimed products and resources should be transported back to a central hub facility or dealt with on a local level. To reach sufficient scale and build effective and efficient reverse logistics, companies need to consolidate their return flows by collaborating along the incumbent value chain, and adjacent or cascaded activities.

Modern trends in the automotive industry show that to ensure the competitiveness of the business it is necessary to have a developed logistic system. Such a system is the basis for interaction between production and service systems in the implementation of the principles of the circular economics and green technologies. If it concerns the organization of effective delivery of spare parts, firstly such tasks, as the choice of delivery mode, transportation mode, as well as the best route selection should be considered and solved.

One of the most promising areas for solving the above problems is the development of intelligent systems, that has become possible in the era of economics digitalization and the development of IT platforms, for example, automation of route selection (with different parameters), online tracking, client blocks (for integrated customers). The widespread of the Internet of Things and additive technologies can make significant changes both to production logistics and to the supply chain management.

Since transportation of automotive spare parts is a very complex process, involving many areas of technology, management, science, etc. that is also influenced by a lot of different factors, decisions are often made under conditions of incomplete information. In order to identify all the significant factors, the complete, relevant and adequate information, as well as the application of tools and methods of its processing and analysis is needed. Multicriteria analysis methods, OLAP-technologies, simulation, as well as the elements of situational management have to be used to make the final managerial decision. In addition, since any error in supply chain management can lead to financial, time and other losses, methods of risk
analysis and management have to be used. Managerial decisions in complex systems, must be comprehensive, consistent and scientifically based. Therefore, it is proposed to create a Decision Support System (DSS) consisting of modules, each of which will perform its function using all of the above methods.

The article presents an example of planning the supply of spare parts when organizing services in foreign markets. Planning is based on multidimensional analysis of failure and modelling data. For this purpose, an information system was developed. The application of new intelligent technologies and the digitization of processes will allow us to move to a model of a circular economy.

References

INCREASING THE ADEQUACY OF MANAGEMENT DECISION MAKING FOR CHOOSING INTERMEDIARIES IN SUPPLY CHAINS

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Keywords: reliability, analytic hierarchy process (AHP), supply chain, logistic intermediaries

The choice of logistics intermediaries, considered in almost all logistic publications, differs mainly by the depth of study and the presence of examples of calculations (Bowersox and Closs, 1996; Christopher, 2011; Saaty, 1990; Saaty, 2017; Taha, 2011; Wisner et al., 2012). In most articles, the choice of logistic intermediaries is made under conditions of certainty and is regarded as a one-criterion task or reducible to it a multi-criteria task. The algorithms and examples of calculations of integral (rating) estimates of logistic intermediaries are different from each other. The participation of experts in the evaluation procedures is not fully formalized and varies widely (criteria, alternatives, scores, weights, ratings), as well as specific indicators, which are often randomly quantified.

Analysis of various sources has shown that the analytic hierarchy process (AHP) covers more and more areas of human activity, where decisions are required in conditions of uncertainty or on the basis of so-called intangible (psychological, nonmaterial) resources (attributes). Despite the optimistic tone of the publications, in which the AHP was highly appreciated, a number of questions remain open.

It does not explain in any way why for quantitative (tangible) matrices, preference is given to assessing the consistency of C.I., rather than to the priority vector \( w \), which determines allows beyond the ranking, the allocation of resources that can be verified. One of the venues for the future research should be related to the generalization of expert assessments representing statistical aggregates of matrices of different dimensions and their comparison with artificial (generated) assessments. Obviously, in this case, in addition to the relation \( C.R. \leq 0.10 \), it will be possible to obtain probability estimates that will not only rank the criteria and alternatives, but also characterize the reliability (risk) of decisions made regarding the allocation of resources among logistic intermediaries.

References
THE ANALYSIS OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT ORGANIZATIONAL STRUCTURES ON RUSSIAN MARKET

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Keywords: Logistics, supply chain management, organizational structure, survey, questionnaire, research methodology

In the article the logistics management and SCM organizational structures research findings that were conducted by the NRU HSE International Centre of Training in Logistics in 2014-2016 are considered. The sample of companies operating on Russian market accounted about 400 organizations. The form for the respondents of online survey was created. Each participant estimated the logistics management organizational structure (logistic and/or SCM department) individually. The assessment was conducted from the perspective of the correspondence between the organizational structure and corporate and logistics strategies, key business processes, organizational structure management efficiency, functional employees allocation and so on in the different aspects of supply chains and logistics controlling.

The examples of typical logistics management structures of line and staff, matrix and project oriented structures are shown. Taking into consideration the importance of the SCM best practices and innovative technologies usage, the questions are highlighted in detail and a great variety of examples in SCM departments organizational planning are given.
THE POSSIBILITIES OF SUPPLYING PROCESSING LINES WITH THE MATERIAL

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Keywords: automated guided vehicle, supply, RFID, SVG, logistic processes

The paper deals with the possibility of introducing a self-service truck for the selected business.

The solution deals with material identification and identification of the transport systems (automated guided vehicle AGV) by RFID technology. Part of the solution is also identification of place which the decision logic will be applied. The main part of the solution is focused on the creation of algorithms and control logic in the RFID middleware AMP - Aton mobile platform with support of MySQL database system.

The main benefits of the solution will be to facilitate the material flow from the warehouse to the production lines, eliminate human errors and speed up the production process. Part of the solution was devoted to the route visualization through SVG graphics. The basic algorithms have been verified in our AIDC Lab.

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BLOCKCHAIN APPLICATION FOR SUPPLY CHAIN MANAGEMENT

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Keywords: Supply chain modelling, Blockchain, API, SCOR

The increased dynamics of digital supply chain integrations forcing companies to investigate the possibilities of emerging technologies, which enables to increase the interoperability and decrease the dependability on intermediate companies for mapping and integrating company specific data (Korpela et al., 2017). Existing solutions typically caused high integration costs, and target of current research is to offer an alternative solution for supply chain integration, based on block chain technology (Blasetti, 2016). Blockchains are a specific type of a distributed ledger and a way of ordering and verifying transactions into blocks with various protections against tampering and revision (Gromov and Lammi, 2017). If a blockchain is well-implemented, the resulting advantages include speed, privacy, reliability, and much lower costs. (Kabashkin, 2017).

To simplify the integration with existing Supply Chain authors have developed the novel Blockchain API, designed accordingly to the needs of predefined transport corridor. Authors research the impact of the new API to transport times with target to prove that the technology developed has made the significant effect on transit times. Authors have applied Value Added Chain (VAC) and Event Process Control (EPC) notations for supply chain modelling and simulation to validate the advantages of suggested solution during the Pilot1 project, which is a miniature example model of the approach applied to transport corridors. To measure the efficiency of new solution authors identified the measuring points and generated metrics framework based on SCOR standard based Key Performance Indicators. Qualitative analysis is used to measure: process efficiency, labour cost, time. Quantitative analysis of operational and waiting time’s measurement using valid statistical base.

Authors have tested the impact of the novel Blockchain API developed under the frame of SMART Log project, to transport and transit times. It is obvious, that whatever transport time reduction we will deliver, the ones benefiting from it are not the transport companies, but their customers, who are in manufacturing and retail. The target of current research project is to reduce the cycle time by 3% at least (full cycle: empty from depot - full export to terminal in a 20km long loop) when compared the situation before the developed methodology was used and after, and the testing methodology and comparison method will be described in the article.
References
The twentieth century enabled the explosion-like development of the „unlimited” moving of things. One of the preconditions of that development was the appearance of intelligent devices and systems in the field of logistics. The base of the approach called Industry 4.0 is digitization, that resulted in a paradigm change also in the activities related to logistic processes. The appearance of advanced cyber-physical systems, utilizing advances of information technology and new software methods highlight even more the role of logistics in forming the trends of indicators of competitiveness on the market. The different processes develop in direction of being networked, using real-time automation.

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Session 6

Sustainable Aviation and Maritime Transport
INTEGRATING AIR CARGO ROAD FEEDER SERVICES INTO GREEN TRANSPORT CORRIDORS

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Keywords: Road feeder services, air trucking, ACC3 regulations, Green Transport Corridor

Although European regional airports contribute considerably to regional accessibility of peripheral and remote regions as well as to socio-economic development, it might be stated that they face severe challenges nowadays. The number of loss making regional airports in Europe keeps increasing. The EU Commission has clearly stated that the public support and financial aids cannot be seen as a sustainable stimulation measure for efficient and durable airports’ operations any longer, i.e. the public support to regional and small airports in Europe will be cut. Nevertheless, regional airports can play the role as motors for regional development and growth.

On the other hand, the European Union introduced and promoted the Green Transport Corridor concept as a cornerstone for the development of integrated and sustainable transport solutions based on trans-nationality, multi-modality and a high involvement of public and private stakeholders, including the political level. Until now only little research has been done about the integration of regional airports into Green Transport Corridors and which role road feeder services for air cargo can play in this context.

This paper investigates potential role of air cargo and especially road feeder services for the integration of regional airports into Green Transport Corridors and as well as favourable conditions for sustainable regional development. The authors participated in several EU projects on sustainable transportation mainly in the Baltic Sea Region. Based on the empirical results of these projects, the research focuses on the different concept of Road Feeder Services or “air trucking services” for air cargo and their possible role for the integration of regional airports into Green Transport Corridors. Special attention is paid to the discussion of the tentative role of the air cargo security regulations in Europe (ACC3 regulations) as well as to sustainable frame conditions of integration air cargo into the concept of Green Transport Corridors. Since the action research of this study was executed in the Baltic Sea region, the presented results include specifics of this region.
CONDITION MONITORING OF HELICOPTER MAIN GEARBOX PLANETARY STAGE

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Keywords: vibration diagnostics, planetary gears, fault identification

Planetary gears are critical parts of power transmission in many heavy industrial and transport machines, for instance in helicopter. Any damage happened in operation may cause fatal consequences. As safety in aviation is most critical aspect, to increase it and to reduce operation costs the Health and Usage Monitoring Systems (HUMS) are used on helicopters starting since early 1990. As the main tool for mechanical units’ condition State-of-the-art vibration diagnostic techniques provide actual monitoring being the intellectual core of such HUMS. However, planetary stages of gearboxes remain the biggest problem because of its complicated vibration signature that contains multiple modulated signals. Authors overview different vibration techniques that over the last decades allow to make a breakthrough in planetary gearboxes diagnostics. Still, effective application of above techniques has met some limitations in operation, that are in-flight diagnostics of helicopter gearbox, optimal utilization of vibration signal and detection of any potential failures, including planet driver cracking etc.

Authors consider advanced spatial-time approach to vibration diagnostics of planetary gears. This approach considers each teeth pair interaction as separate impulse, simulates gear mesh spatial allocation and identifies each gear tooth mesh in time serial sequence. There is discussion of principles of spatial mesh model in application to planetary gears. Based on above model the algorithm of Spatial Time Domain Distribution (STDD) for vibration data development is briefly discussed. Application of STDD based algorithm to vibration of operating gearbox allows effective identification of gear failures. The paper also considers application cases of STDD technique for estimation of dynamic loads distribution between planets of specific main gearbox of medium heavy helicopter. Unevenness of planet loads distribution causes overcharge of some teeth and planets in planetary gears that may lead to planet carrier cracking. There are discussions of some cases illustrating application the STDD based technique. One case is main gear box testing on a test rig in industry and diagnostic parameters application for overhaul quality estimation. The second case is the diagnostic check on main gearbox on the tested helicopter.

Samples of STDD-based technique application are discussed for automatic condition monitoring of planetary gears. For instance, vibration data transformation using STDD technique provides normalized dynamic loads diagrams for planets of a gearbox. Values of STDD calculated dynamic load parameters are outlined by circles on rays of radar diagram, where each ray corresponds to according planet. Diagrams demonstrate two parameters of normalized dynamic loads distribution between planets that interact with both ring and sun gears.

Dynamic loads diagram may characterize various aspects of operating planetary gearbox. There is illustration of unevenness distribution between planets and the sample of ambient factors influence.
RESEARCH AND PRACTICAL APPLICATION OF VIBRATION TRANSFER FUNCTIONS IN DIAGNOSTICS OF JET ENGINE

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Keywords: vibration, transfer function, diagnostics, aviation engine

The paper considers different aspects of vibration paths properties of gas turbine engine non-rotating parts and its application for vibration diagnostics. Advance vibration diagnostic system of aviation jet engine uses wide set of diagnostic parameters based on wide frequency band vibration. Vibration models substantiating such system consider vibration as a function of two independent arguments: dynamic loads inside engine and stator’s response on interior excitation. Authors discuss the needs of practically applied diagnostic platform Vibropassport™ in transfer functions required for methodical and algorithmic parts of the platform. Frequency Response Functions (FRF) of separate engine units and engine in whole are considered as basic tools for transfer functions determination. Two main approaches to FRF measurement on actual engine are considered, including periodic actuation in low frequency band (shaker) and impact excitation by a hammer with a load cell. Authors discuss requirements for transfer features research and application in vibration diagnostics.

Some specialties of transfer features are considered for different types of excitation sources, like integral unit of an engine. The general view is given on experimental techniques for testing of integral aggregates and smaller excitation sources of an engine. There are samples of practical identification of compressor and turbine FRF in experimental research. Impulse excitation sources in engine are considered that form wide frequency band vibrations generated by such interactions like blade-vanes, gears and bearings. Experimental testing technique is described that is used for transfer function determination of impulse sources. Analysis of transfer features of concentrated and distributed multiple impulse sources is done as well as some samples of experimental testing and transfer coefficients determination. Main areas of transfer properties in application of engine vibration diagnostics are considered.

Authors discuss the role of transfer functions in aviation jet engine for vibration diagnostics on different stages of its development.

The paper includes conclusions regarding discussed matters and tasks for further works.
MEASUREMENTS OF THE PARAMETERS OF A BROADBAND SATELLITE DATA CHANNEL IN THE SAVSAT SHIP SYSTEM

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Keywords: Satellite channel, SEVSAT, broadband access, QoS measurement

The goal of the field measurements was to analyse the parameters of satellite data transmission channel, depending on various external affecting factors. The existing Ship Equip Very Small Aperture Terminal (SEVSAT) Satellite System (Inmarsat Group) was used as an object of research. At present time SEVSAT system is in use on board of ships for the organization of broadband (with high till some extent bandwidth) communication channel between the vessel and the coast via satellites in geostationary orbits.

Many important aspects of such potential systems are described in the fundamental publication (Kota et al., 2004) but till this time it is a lack of relevant experimental data about parameters of SEVSAT channels. The system providers give figures only for satellite channel bandwidth with a rather unreliable accuracy. Also, the impact of various external factors that have undoubtedly a significant influence on traffic of different types is not sufficiently studied.

To address this shortcoming, it was necessary to conduct series of experiments on real equipment with various combinations of ship position; sea state; weather conditions. For weather factor evaluation, the twelve-point Beaufort Scale adopted by the World Meteorological Organization for the approximation of the wind speed by its impact on ground objects or sea waves was used. For meteorological data, the zyGrib program was used. With this application for weather forecasts many parameters: sea waves high, wind force, pressure, temperature, humidity, precipitation, cloud cover, dew points, etc. can be downloaded.

In experiments, the parameters of data traffic were also changed. Data packets size and generated bitrate on transport level were variable. For traffic generation client-server program Iperf was used.

In the experiments the most important network characteristics for determining the quality of network services (QoS) were measured:

▪ channel bandwidth or maximal data rate, measured in bits/s;
▪ delay in packet delivery;
▪ variation in packet delivery delays (jitter);
▪ percentage of errors in packets.

Based on the results of the experiments the statistical analysis of the influence of various factors was performed. The quantitative importance of the influence of various factors on the parameters of the satellite channel was shown.

Estimations are given for choosing the most optimal packet length/bitrate ratio at which the maximum channel capacity will be achieved with the minimum allowable percentage of packet losses for broadband Internet access from the board of the ship and data transfer for voice communications via the Satellite channel.

References
ASSESSMENT OF MANAGEMENT OPPORTUNITY OF AIRCRAFT SPARE PARTS FOR MAINTENANCE

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Keywords: Spare parts, maintenance, aircraft, helicopter, warehouse

The development of civil aviation altogether increases the requirement to airworthiness, decreases cost of maintenance of aircraft.

Any technique requires maintenance after certain intervals of work for the maintaining of capable and serviceable condition. Also, aircrafts which consist of different system and components have specific intervals and forms of maintenance that must be perform timely to support its work. (Gupta et al., 2003)

In order to ensure method of technical operation by condition for fleet all the same components of aircraft need to realize constant control of reliability level, which in case reduce level of fact reliability that is lower standards registered by the manufacturer, and it conducts analysis of reason and carries out development of operations to improve reliability.

Particularity this strategy concludes in regular assessment the serviceableness of the aircraft for safe and economical operation. Further, we will limit ourselves to consideration of the particularity of operation of some components of aircraft systems that have high operational efficiency (interchangeability), whose failures do not affect the safety of flights and whose reliability allows to meet the requirements for regular flights and cost-effective maintenance.

In 2014, were analysed a number of airlines. As the research showed, the analysed airlines spent $ 14.4 billion on the maintenance of the aircraft. The narrow-bodied aircraft accounted for 50% of all costs, while the wide-bodied aircraft accounted for 36%; 10% of this amount was spent on maintenance of regional aircraft and 4% on maintenance and repair of turboprop aircraft. The average age of the aircraft in question is 9.4 years, and the average flying time is 3267 flying hours. According to the analysts of the working group, the average cost of MRO for aircraft was $ 1,077 per flight hour (Nurgaleev, 2015).

The efficiency of the organization's activities in the maintenance and repair of aircraft is impossible without the use of a database and methods for analysing the failure of aircraft components. Based on this analysis, the minimum required number of spare parts for the components of the aircraft is determined, which should be stored in the warehouses of the organization, which in turn will flexibly form a plan for the maintenance and repair of aircraft and their components. As a result, you can reduce the costs of the enterprise.

Accordingly, it becomes possible for the airline to order most of the spare parts only as necessary, since the technical condition monitoring systems will accurately predict such a need even before the occurrence of technical failures in order to reduce the costs of purchasing and storing components. Usually, 15% of the airline's operating costs are for maintenance and repairs. The use of advanced technologies can reduce these costs by up to 20% per aircraft. This was stated by the senior vice-president of the company Embraer and the operating director of the division of Embraer Commercial Aviation Luis Carlos Affonso (Esker, 2015).

In this paper, the technique of determining the minimum required number of spare parts is considered, which will allow excluding unreasonable idle aircraft for reasons related to the lack of necessary components in the performance of maintenance.
Also, it assesses the possibility of using optimization tools based on the law of normal distribution, as well as on the analysis of statistical data on the operating time of MI-8 helicopter equipment (aircraft repair plant data No 405) is also estimated. One of the problems with changing the maintenance program is the need to provide the required level of safety. Expected result of work:
- propose a new approach to solve the problems of the supplying of spare parts in the process of aircraft maintenance, taking into account the technological, material and information component of this process;
- to assess the possibility of applying methods of allocating labour resources for aircraft maintenance by the criterion of minimizing the total costs over time in case of localization of a functional system failure.

References
MULTI-LAYERED APPROACH TO THE UAV COLLISION AVOIDANCE SYSTEM

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Keywords: unmanned aerial vehicles, unregulated airspace, sensors, decision support, collision avoidance system

Unmanned aerial vehicle (UAV) technology is rapidly advancing, with multitude of commercial applications. However, beyond visual line of sight (BVLOS) flights remain off the table; in no small part due to lack of reliable collision avoidance mechanisms.

Although range requirements for such system were established (Lancovs, 2018), it became evident that there is a wide variety of obstacles threatening UAV navigation, and the problem cannot be solved by a single cooperative solution.

Instead, a system that accepts input from multiple sources, including self-diagnostics, and integrates them into a single “map” would be preferable. This “map” is then used by the autopilot for decision-making.

While some information sources include preloaded navigation data (terrain, buildings), others may be sensors used to identify both stationary and mobile obstacles. A three level approach has been commonly used for many years in such scenarios (Pohl and Van Genderen, 1998; Bhure and Kalyanasundaram, 2016), with transition from data level fusion to feature level, and then to decision level.

Since in this case decision-making is left to the autopilot and includes more factors than just the environment, it is necessary to provide a single source of decision support for the autopilot from multiple sources of data. Therefore, all the information must be presented spatially, ranging from moving and stationary obstacles, no-fly zones, to reachable areas based on remaining fuel and other self-diagnostic data.

Data level fusion is a problematic area even when dealing with homogenous sensors. In this case, a heterogeneous set may be employed, and each sensor has its own characteristics, defining its capabilities. Sensors have different reliability at different ranges and angles, and even weather conditions. Integrating data from such potentially unreliable sources needs to solve the following problems:

▪ False positives,
▪ False negatives,
▪ Duplicates.

A review of existing sensor fusion algorithms, such as proposed by Elmenreich, W. and Leidenfrost, R. (2008), is performed and the possibility of data level fusion in a heterogeneous sensor package for the purpose of detecting obstacles in a three-dimensional environment is explored.

A multi-layer approach is then presented, tailored specifically for a UAV collision avoidance decision making support, incorporating such algorithms at data level.

References

For the last few years, digital technologies and their progress have become increasingly important in various industrial and service sectors. Taking into account tangible value proposition, increasing cross-sectoral distribution and value-added potential of digital technologies, they are gaining more and more recognition also in the maritime industry sector and transportation. Large seaports, the so-called core ports of the TEN-T transport network in the context of the EU transport policy, such as Rotterdam or Turku are already using digital data-based technologies, e.g. Blockchain or Internet of Things (IoT) and continue to rely on sustainable development of these advanced technologies that promise security, process optimisation and sustainability. These technologies are evolving rapidly and merging into giant digital networks and platforms such as Internet of Things (IoT) or Industry 4.0. They connect and converge physical and digital worlds – machines, devices and people – over the Internet into a network. The main goal of such new digital technologies is to improve economic performance and energy consumption, to reduce consumption of resources and waste, and to better qualify the service portfolio.

In fact, seaports are subject to big transportation and logistics companies when it comes to developing insightful solutions and IoT applications. With large carriers like Maersk relying on Blockchain technology to optimise the flow of cargo and documents, it is important that other ports, including Small and Medium-Sized Ports (SMPs), take the opportunity to apply this technological solution in order to integrate into global supply chains. Otherwise they will stay outside. And that is especially crucial for big core ports as well as SMPs.

In the South Baltic Sea Region (SBSR), the distribution of blockchain and other IoT technologies in ports and their service portfolios is very limited, not shared and not integrated at cross-border level. Within the seed money Interreg project “Connect2SmallPorts”, the consortium of four partners conducted in 2017 interviews with more than 10 SMPs’ CEOs and 30 regional experts, including organisation of seven workshops and events to gather primary data to support demand-driven response. In line with empirical data, digitalisation and related problems, such as automation, decarbonisation and security, have been at the core of problems and challenges portrayed. Yet, while some ports in the region, e.g. seaports of Wismar, Karlskrona and Klaipeda clearly state the need for adoption of digitalisation strategy to increase or maintain competitiveness, Polish ports continue to focus on developing the main hard infrastructure without a clear vision and digitalisation strategy. Without smart development solutions for the region, future prospects of blue and sustainable growth remain jeopardised.

This research addresses the gap of marginalised research priorities on SMPs, in particular in the SBSR and within the rapidly evolving digitalisation networks and platforms. It builds on the fact that smaller, weaker or regionally bound but not clustered actors, such as small ports or regional SMEs in the SBSR could also benefit from evolving digital networks and the use of digital technologies for innovation, value creation and competitiveness alongside their larger players. From a practical point of view, specific challenges in the digitalisation of SMPs in the
region are addressed and dealt with. With the help of the cross-border cooperation platform Interreg South Baltic Programme 2014-2020 and the project “Connect2SmallPorts”, the researcher proposes a conceptual approach to facilitate digitalisation in SMPs.

It is clear that digitalisation is and will be the next wave of innovation. It therefore appears necessary to identify key strategies and tools also for SMPs as well as to prepare today in order to facilitate decision-making and policy implementation in terms of future investments into digitalisation and transportation industry sectors and policy priority areas.
IMPLEMENTATION OF A MULTIPLE REMOTE TOWER

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Keywords: logistics, aviation, transport, air control, remote tower

The number of passengers carried by air transport has been growing every year in the world during the last decade. The average annual growth rate of air passengers has been 8.4% since 2008. Such an increasing demand for air traffic services has posed plenty of challenges, such as larger airports or increased network congestion, to the management of air traffic. In Lithuania, the State Enterprises “Oro navigacija” and “Lithuanian Airports” are the companies facing those challenges directly, as they both operate in the industry of air traffic. “Oro navigacija” manages air traffic in all four Lithuanian international airports, while “Lithuanian Airports” runs those four airports.

“Lithuanian Airports” can be regarded as an example of a very successful Lithuanian company, which is currently beating market benchmarks due to an insightful strategic decision taken earlier. Last year, the growth rate of the number of passengers travelling via airports in Lithuania was 10%, in spite of the major reconstruction of the runway at the largest national airport in Vilnius. According to the CEO of “Lithuanian Airports”, one reason for the recent success of airports in Lithuania has been courage to start actively engaging with low cost airlines at the time when many European airports were still rather ignorant about them. He claims the decision of turning to low cost airlines were very timely, since today low cost airlines are already dominating in Europe, while traditional airlines have shifted towards longer-distance flights.

As a result, a question arises if “Oro navigacija” could follow success achieved by “Lithuanian Airports”. The successful example of “Lithuanian Airports” hints that insightful decisions can bring success to a company even in an extremely challenging business environment. So, is there any insightful strategic decision that could potentially result in the notable upgrade of the competitive advantage of air traffic management in Lithuania? Turns out that a multiple remote tower could be an answer. The preliminary cost benefit analysis indicates that it would be beneficial financially to establish a multiple remote tower for providing air traffic services to three national airports in Lithuania. This does not mean that Lithuania needs to immediately start with a multiple remote tower covering the management of air traffic over the whole country. However, the introduction of a single remote tower as early as possible would be a very insightful initial step.
Session 7

Reliability, Safety and Risk Management
SAFETY STATUS ON ROAD TRANSPORT SYSTEM IN THE EUROPEAN UNION

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Keywords: dangerous goods, threats assessment, managements, safety

The main paper problem is to discuss safety status on road transport system in the European Union and how to improve it, especially by reduction number of victims.

In theoretical part refers section 2, the following research methods were used: analysis, analogy, synthesis, induction and deduction. Characteristics of road transport infrastructure, counties of the most and smallest total length of motorways, and the statistics of road accidents, dead and wounded people in the European Union were presented. In 2017, the main number of victims of road accidents have occurred in rural area, the next in urban area and the last in motorways. The statistics of road traffic fatalities per 100 000 population depends on area of the world, the European roads remain the best in the world, the second - Americas, the third - Eastern Mediterranean, the fourth - South East Asia, the fifth - Western Pacific, and the last - Africa. Furthermore, the paper discussed the characterization of dangerous goods in the EU and the advantages and disadvantages of road transport. The statistics all over the world show that transport is the most frequently attacked area by terrorists, which is related to the fact that the objects and means of transport focus large number of travellers and are easily accessible to terrorists.

In practical part refers section 3, apart from mentioned theoretical, the empirical methods were applied: modelling and tests. Based the initiatives of the EU for road transport safety, some solutions of research projects in Poland were described, especially program of analysing data from digital tachograph and smart cards, functional structure of National Automatic Toll Collection System with proposition of OBU and also methodic and prototype of eCall system.

The paper resolved the main problem, the number of victims in the EU was significantly reduced from 54 900 in 2001 to 25 300 in 2017, by initiatives, legislative procedures and implemented Intelligent Transport Systems.
INNOVATIVE SOLUTION OF SECURITY SYSTEM AT INTERNATIONAL AIRPORT

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Keywords: threats, advanced technology, security system, international airport, CBRN

The paper refers to innovative solution of security system at international Airports, taking specifically into consideration current challenges within processing of passengers, in light of types of current major threats, in a way ensuring positive passenger experience within their journey.

In addition, within the scope of this paper, presented initial outcome of study research among professional aviation stakeholder’s environment, on current threats in the area of security and protection of airport infrastructure.

The airports are a very demanding environment: seasonal traffic, fluctuating passenger volumes and last minute changes mean there is a lot of flexibility required in order to meet specific needs of airport authorities and their clients or the passengers (Dolnik, 2009). The aviation security has been always perceived as priority for Civil Aviation Authorities and other regulatory parties, in charge of protection and security of public transport. One of the main reasons, why aviation being one of the most regulated means of transport in sense of security, is the fact of continues serious risk and vulnerability for terrorist attacks. Instead of continues implementation of strict security measures, the number of incidents and breaches within aviation international security environment, being updated almost at daily basis, all around the world. Therefore, the primary role of all aviation regulatory and professional stakeholders is to effectively protect and secure variety of aviation ecosystems such as airports and airlines. Those ecosystems have become the important element of our global economy, and element of strategic competition between the regions and markets.

Statistically flying remains the safest mode of travelling compared to other modes of transportation. However, simultaneously terrorists and criminals continue in their quest to explore new ways of disrupting air transportation and the challenge to secure airports and airline assets remain real. This calls for greater awareness of security concerns in the aviation sector.

The key element, how to protects against terrorist modus operandi, is to stay ahead of recent threats, incidents and breaches occurring worldwide. It requires implementation of effective data sharing systems, in order to proactively monitor potential risks and vulnerabilities within different type of aviation ecosystems.

Described activities shall in primary focus on training and quality control aspects, allowing to raise the detection capabilities in the field of dangerous and prohibited items (IEDs, CBRN threats), as well as detect unusual behaviour amongst passengers and aviation personnel.

References
RISK MANAGEMENT IN CRISIS MANAGEMENT PROCESS

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Keywords: risk, risk management, crisis management, crisis situations, security

Crisis management consists in preventing crisis situations, preparing them to take control over them by means of planned actions, reacting to emerging threats, removing their consequences and reconstructing resources and infrastructure. In the context of the presented definition, risk management is an action aimed in particular at preventing threats and reducing its negative effects to an acceptable level through pre-planned activities. The one of the important aspects of threats prevention is identification, analysis and assessment of the risk of potential events that may contribute to the emergence of a crisis situation.

The aim of the article is to outline the risk management issues in the crisis management process. The article presents the essence of risk, selected methods for its identification, analysis and evaluation. It done classified of critical threats, with particular emphasis on threats to people, property and the environment.

There were also presented the needs of entities responsible for crisis management in Poland in the area of risk assessment.
SAFETY PROBLEMS IN THE IMPLEMENTATION OF PAYING TRANSACTIONS WITHOUT CASH

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\textbf{Keywords:} crime, legal tenders, detection process, security of the bank client

The study will present a problem related to the protection of banking systems resulting from the protection of electronic means of payment. Main problem with protection of transactions made with the use of payment cards, online banking or use ATMs is due from threats in the banking area system and the way, which our important data are transmitted over the network.

This work will present the rights and obligations of the bank's service provider in ensuring the security of his clients in the area of electronic banking. Threats of users: payment cards, internet banking and ATMs, result from the desire to unauthorized and criminal gain financial resources.

Crimes against payment means are strictly related to offenses punishable in the Polish criminal code, containing among others falsification of documents, identity theft and false testimony.

The issue will include a description of system solutions that banks introduce to protect their clients and it will show the rights of law enforcement services in the event of a criminal act. In addition, this text is intended to indicate the manner in which the service provider is obliged to provide the investigators with electronic evidence in the area of the criminal offense against the means of payment.

The study will constitute a description of the tasks (including securing evidence of crime) in the process of detecting perpetrators of crimes against means of payment, in the system of cooperation between the service provider and the bank with law enforcement services, with fully protecting the rights of bank clients.
INFORMATION SUPPORT SYSTEMS FOR CRISIS MANAGEMENT

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**Keywords**: decision support systems, crisis response, social cybernetics

The main goal of the research is to determine the level of importance of the IT decision support systems for the efficiency of crisis management processes, and business continuity systems. Such detailed research problem determines the specific goals involving: 1) identification of the key processes for the continuity of operation within the system; 2) establishing the relationship between the decision time and system continuity; 3) exposing the methods and means proper for optimizing of decision-making time in crisis management situations.

The final development of the research problem required the use of inquiry procedures, prior to analytical involvement, centred on the theory of strategy, as well as the SWOT techniques and desk research techniques. Certain primary, as well as derivative propositions of the theory of autonomous systems (TSAs) have been accepted as already defined. The terminological conventions contained within the TSA were also used, along with the derivative concepts significant to the specific rules of defining the theory.

The innovative goal of such scrutiny, extending the existing state of scientific knowledge in security research, which is at the same time a praxeological directive, is to show that information processes are the foundation of the system’s autonomy, i.e. maintaining the business continuity. Nonetheless, decision-making time is a key parameter in crisis management. Therefore, streamlining information flow (communication) and shortening the decision-making time at the level of management and contractor duties requires the implementation of the IT systems that are able to obtain and handle the data in real time.

In the environment of the modern information revolution and the imminent data flood, the implementation of IT management support systems is a prerequisite for upholding the efficiency of information processes in the crisis management cycle and, as a consequence, of the system’s continuity. This implies a new quality in the crisis management setting, but at the same time it conveys the new challenges and pressures for the system operators, which should be monitored and taken into account in the decision-making processes on an ongoing basis.
DIMENSIONS OF SECURITY SYSTEM COMPLEXITY
AND RISK DETECTION PRAXIS

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Keywords: security system, threats assessment, complex systems, innovations, security

The multidimensional spectrum of security predicaments in current global settings forces a question about compatibility and complexity of various solutions to threats and dangers. The number of problem responsive solutions grows, yet, the ability of countering is not always a guarantee. The institutions responsible for security of a State in various fields of its operations must deal with those problems strategically, however, this is also an issue in any field of operation, including business and management, and others.

The author researches the problem stemming from a following question: How complexity of a system, or systems using different approaches, technologies and techniques retain unity of the whole, and its capability in practical response to threats. This is considering the fact that the innovative techniques and new technologies have at the same time, the ability for fast response, but also for multiplications of false results, and new threats. This concerns the security system as a whole, and particularly, among the others, security guarantees and strategic national security planning, including the crisis management and state institution involvement.

The research is done using comparative, analytical and phenomenological methods focusing on factors of various nature linked to theoretical propositions. The base terminology used refers to security studies and political science, but is generative of other scientific and academic fields. As author suggests in his research hypothesis, the multiplication of complex system solutions brings about new variables, and therefore, also possible failures. This may arise from unpredictability, too complex of a system, innovation unknowns, or unity failure, and human errors, among the others.

The scope of research is bound by information gathered from legislative process, scientific solutions, crisis management systems, and computer science, and others. Its aim is both, presentation of problems and arising possible threats, with solution propositions, as well as presentation of solutions in crisis management or other systems, worked out by the researchers of the Military University of Technology in Warsaw (Cybernetics Faculty, in the Institute of Organization and Management and its National Security Dpt.)
TESTING OF THE DRIVERS ABILITY TO ASSESS THE DISTANCE ON THE ROAD WHILE DRIVING

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Keywords: dilemma zone, distance assessment, active safety

The article is a continuation of the study of the behaviours of drivers while approaching the intersections with traffic lights. It is an element of the active safety system of traffic participants. Previous studies carried out by authors assessed the state of the theoretical knowledge of drivers. It was assessed how to behave correctly when the green light was changed to yellow while the driver approach the intersection with triple-colour traffic lights. For many traffic participants, theoretical knowledge turned out to be insufficient. At that time, the ability to correctly assess the distance of the vehicle to the intersection was not studied.

This study presents the results of testing the ability (accuracy) of the distance assessment on the road by drivers, when approaching the stop line of the intersection. The existence of a so called "dilemma zone", its extent and location relative to the stop line is not physically determined prior to the intersection. When the traffic light signal is changing, the driver must assess his distance to the intersection. What is more, the driver must also accurately assess and determine the location of the 'dilemma zone' and decide, whether to continue driving or start the stopping of the vehicle. When approaching an intersection with a changing signal, the driver finds himself in a risky situation. Sudden braking might surprise the following driver and lead to the rear end collision. If the drive is continued, the driver might enter the intersection after the red light signal has already turned on. Making the right decision depends, among other things, on the accurate assessment of the distance of the vehicle from the intersection with a minimum error. The driver must do it in a very short time. Extending the decision-making time is detrimental to the driver.

Pilot surveys were conducted on a group of over 200 people. For this purpose, a questionnaire was prepared and four vehicle positions with known distances to the stop line were proposed. The vehicle positions symbolized the set of traffic bollards next to the road. The respondents assessed the distance between individual bollards, as vehicles in front of the stop line. The results confirmed the initial hypothesis that there is a large error of distance assessment made by drivers. This causes making wrong decisions about behaviour while approaching the intersection. At this moment, there are no road markings (that are helpful to the drivers) that would indicate the critical distances to facilitate correct actions. This situation is encouraging to committing offenses and the occurrence of collisions and road accidents. In the conclusions, the need for additional training drivers was indicated. In addition, it is necessary to consider marking the critical points on the road, e.g.: the "dilemma zone", enabling and facilitating the correct assessment of distance and choosing the right behaviour.
FATIGUE LIFE DEPENDENCE ON NON-UNIFORM HARDENING EFFECT AFTER SURFACE ROLLING

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Keywords: rolling, material hardening, fatigue

Fatigue failure of high strength steel shafts in different mechanisms leads to expensive replacement of shaft or the entire mechanism. Fatigue failure usually takes place in stress concentration areas. One of the effective methods to improve shafts fatigue characteristics is surface hardening by rolling (Nalla et al., 2003). In order to reach maximum fatigue life of the shaft the process of calibration, selection of rolling parameters (roller section radius, curvature, rolling force, etc.) (Juiermi and Altenberger, 2007) and non-uniform rolling influence are described in this article. The task was to design a bolted joint that has to fail by shear under specified load conditions. To ensure these requirements two grooves with certain geometry are made on bolt’s surface. Grooves decreased fatigue life of the bolted joint several times. In order to repair fatigue characteristics, groove areas were hardened by surface rolling. Several computer models were made in order to select optimal hardening parameters and understand how non-uniform hardening effects fatigue life. Numerical results were verified by experimental data. As a result, necessary rolling parameters were selected and fatigue life of shafts with stress concentrations (grooves) increased no less than 3 times.

Acknowledgements

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References

IDENTIFICATION OF RELIABILITY MODELS
FOR NON-REPAIRABLE RAILWAY COMPONENT

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Keywords: non-repairable component, reliability characteristics, failure distribution, censored observation

The reliability analysis of technical object, particularly determine the lifetime distributions over time, requires knowledge of the course of functional characteristics of elements included in a given system (Gertsbakh, 2000; Lewis, 1994). Having a database of damage times for individual elements, it is easy to determine the average working time to damage the element and the standard deviation for this time, the problem arises when selecting the appropriate form of distribution. Incorrect determination of the type of damage distribution of technical object elements may cause a large error in the results of the reliability and durability assessment of the system (Andrzejczak and Selech, 2017). Not having enough data to verify the hypothesis of the form of distribution, commonly, depending on the case considered, the form of the density function of damage or cumulative distribution is assumed. Knowing the course of the probability of damage over time, preventive actions can be taken before the risk of damage reaches the limit value, thus avoiding financial losses and ensuring an adequate level of security (Patra et al., 2008; Wang et al., 2012). The paper presents methods for assessing the reliability of tested elements for the first failure using the most commonly used distributions in the reliability theory. The results of calculations were compared for several cases. The calculations were carried out for selected components of the rail vehicle.

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References

GENERALISED GAMMA DISTRIBUTION IN THE CORRECTIVE MAINTENANCE PREDICTION OF HOMOGENEOUS VEHICLES

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Keywords: cost of corrective maintenance, general gamma distribution, component lifetime

In the investigation of vehicle failure processes, due to damage to individual parts, a family of generalized gamma distributions becomes particularly important due to high flexibility. The distribution of gamma was generalized by Stacy in the publication (Stacy, 1962). This generalized family of distributions includes a number of specific subfamilies of distributions: one- and two-parameter subfamily of gamma distributions, family of exponential distributions, families of Erlang, Maxwell, Weibull, Reyleigh and Pearson distributions, families of chi-square and chi distributions, family of seminorm distributions and family of exponent-power distributions (Andrzejczak, 2003; Cox and Oakes, 1984). The estimation of lifetime parameters of selected vehicle components is carried out on the basis of the operational database of a fleet of homogeneous urban transport vehicles from the first five years of their operation. The exploitation of vehicles of this fleet is planned for 25-30 years in comparable conditions. During this time, vehicles will achieve mileage of 1.5-2 million km. It is expected that in such a long time the costs of any vehicle service will exceed the costs of their purchase. In addition to planned vehicle maintenance, there will also be unplanned operations caused by current damage to vehicle components. The research being carried out is dedicated to predicting unscheduled service costs. In the parameters estimation of the generalized gamma distribution, the so-called right-censored life-times are included (Andrzejczak, 2002; Lawless, 1982). The generalized gamma distribution will be used to predict selected costs of corrective maintenance of vehicles in subsequent years of operation. To estimate these costs, conditional subfamilies of the generalized family of gamma distributions will be used.

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IMPACT OF SULPHATE REDUCING BACTERIA ON BIOCORROSION OF PIPE STEELS

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Keywords: main gas pipeline, damage, steels 17G1S-U and 20, biocorrosion

It is known that biocorrosion is one of the most widespread degradation processes that occur in oil and gas mains. The methods of its inhibition are not always effective, since most of the dangerous microflora shows enhanced adhesive ability to the walls of the pipelines and forms a biofilm in the form of sticky mucus under a layer of corrosion.

The greatest biodamage is caused by sulphate reducing (sulphate renewing) bacteria (SRB). SRB are actively involved in anaerobic biocorrosion. They are heterotrophic microorganisms that form corrosively active metabolites (H₂S, NH₃, CO₂, carboxylic acids). They also cause the destruction of oil and gas mains. Of particular danger is the fact that corrosive lesions are localized and can develop into transient ulcers. In addition, being located in the lower part of the pipe under the layer of corrosion products is typical of them.

These bacteria change the corrosion activity of the soil due to the accumulation of products of their life, in particular, hydrogen sulphide and iron sulphide. In addition to the localized corrosion, these compounds increase the risk of sulphide corrosion cracking, or hydrogenation of the pipe wall.

The purpose of this research was to determine the regularities in corrosion steels 17G1S-U and 20 under the influence of SRB of type Desulfovibrio sp. strain Kyiv-10 and their relation to the microstructure of steel.

Specimens of pipe steels 17G1S-U and 20 with the size of 10 x 30 mm were investigated. SRB cells of type Desulfovibrio sp. strain Kiev-10 were grown on a liquid Postgate’s B medium in a thermostat at a temperature of 28 °C for 14 days. Pure colonies of sulphate reducers were obtained on a semi-liquid Postgate’s B medium by seeding a ten-fold dilution. The variants with additional injections into the system of inhibitors were also studied. Inhibitors were organic nitrogen-containing compounds:
- inhibitor 1 - 1,8-dioxo-3,3,6,6,9-pentamethyl-10-phenyl-1,2,3,4,5,6,7,8,9,10-decahydroacridine;
- inhibitor 2 - hexamethyldodecylammonium chloride.

The control medium was Postigate’s B sterile nutrient medium for the cultivation of SRB bacteria.

Corrosion rates of specimens from steels 17G1S-U and 20 were detected in the presence of organic inhibitors in a sterile Postgate’s B medium, which was inoculated by SRB bacteria. The impact of the inhibitor nature on the degree of protection of steel specimens under the development of anaerobic corrosion under the influence of SRB is investigated. High bactericidal properties of inhibitor 2 and a significant protective effect from microbial corrosion caused by SRB have been proved.
Session 8

Sustainable Transport Interchange
CONCEPTUAL MODELS FOR BETTER INTEROPERABILITY BETWEEN ROAD AND RAIL TRANSPORT IN LITHUANIA

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Keywords: interoperability, multimodality, transport network, transport infrastructure

One of the main strategic goals declared in the common European transport policy – development of efficient, environment-friendly, sustainable transport system (Rodrigue, 2015; Wagener, 2014; Comtois, 2013). The key prerequisites for the realization of this ambitious goal is development of national and international co-modal transport systems, that actually are based on the interoperability of different transport modes (Allsop, 2012; Beškovnik and Twrdy, 2012; Jaržemskienė, 2007). However, interoperability itself is also hard to implement without proper arrangement of legal framework, organizational measures and, last but not least, interconnected transport infrastructures of different transport modes (common multimodal transport network) (Reis et al., 2013; Tsamboulas, 2008; Limbour and Jourguin, 2009). Therefore, main object discussed in the given article – obstacles preventing efficient interoperability between the road and rail transport modes in Lithuania. It should be no surprise that despite huge financial investments made and construction works carried out during the last few decades, there is still a lack of proper infrastructure links and nodes assuring smooth interaction between road and rail transport in Lithuania (Jaržemskienė, 2007). As a logic outcome of that, the main goal of this article is to present the results of the study aimed at identification of key shortages of transport network in Lithuania, identification of factors that led to such situation and discussion of conceptual model that might be useful in changing current situation. In order to reach this goal, article starts with short theoretical introduction discussing concept of interoperability and multimodal transport networks which supports interoperability (Balint, 2012; Beškovnik, 2010; Hesse, 2010; Brien and Yuen, 2008; Bergqvist 2008). This is followed by presentation of results of the study depicting status of Lithuanian transport network problems and reasons behind them. The third part of the article is dedicated to presentation of conceptual model that could be applied to eliminate identified problems of interoperability between road and rail transport modes in Lithuania. Article ends with summarizing conclusions and recommendations.

References
TECHNIQUES FOR SMART LOGISTICS SOLUTIONS’ SIMULATION: A REVIEW

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Keywords: City logistics; Last mile distribution; Stakeholders; Evaluation

Today, cities devise their own Sustainable Urban Logistics Plan (SULP) to improve the sustainability of their distribution system. Modern SULPs, following the development of the technology, consider smart measures and policies e.g. pick-ups and deliveries by electric vehicles, bicycles or drones, city lockers, ITS systems for planning/routing, crowdsourcing services and other, which aim at mitigating the negative effects of the freight transport in the urban area. The effectiveness of these measures, however, is not certain as it is proven that one solution does not fit all, whereas their performance relies on the city and measures’ characteristics. To better understand and assess the impacts of a solution in a city context, ex-ante evaluation of the solutions through modelling is advised.

This study aims at identifying and analysing good practices implemented in case studies and deepen into the international trends, which apply in techniques for urban distribution systems’ simulation, through modelling. Specifically, this paper extends the review of current state of practice in modelling smart logistics solutions, performed by Karakikes and Nathanail (2017), by interrelating transport, financial and demographic data of the urban area with the simulation technique, stakeholder category and solutions’ characteristics, identifying similarities and differences and explaining the implications and specific requirements in each combination. Based on the review results, clusters of simulation techniques associated to solutions are formed to serve as guidance to interested stakeholders regarding impact assessment of innovative and smart distribution systems.

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References

POSSIBLE CONSEQUENCES OF THE IMPLEMENTATION OF TRANSPORT INTEGRATION IN THE RIGA PLANNING REGION

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Keywords: public transport, transport integration, public transport authority

The Latvian capital Riga and surrounding area together form the economic and political centre of the Republic of Latvia and the biggest urban agglomeration in the Baltic states. It faces some distinct challenges in terms of public transport (PT).

The years after Latvia regained its independence in 1991 were characterized by a modernization of the country and an integration into the European Union. While the PT fleet has gradually modernized, and modern means of fare collections have been introduced with some operators in recent years, the PT services still lag behind most Western European cities in terms of transport integration (intermodal journeys with a unified ticket, coordinated timetables, etc.). The road infrastructure is congested during peak hours, especially the bridges crossing the river Daugava, while PT passenger numbers are declining (Rīgas satiksme, 2017).

The City of Riga and the municipalities in the surrounding area also lack common planning and coordination in the transportation field, which reflects the current trends of suburbanization in the area (OECD, 2017).

A possible solution is transport integration, aiming to make public transport more convenient to use and therefore more attractive for passengers. This paper answers the questions: How could the public transportation system be improved by measures that promote transport integration? What consequences would the implementation have?

To answer these questions, this paper analyses the current situation, reviews literature on concepts of transport integration and its consequences and develops two conceptional designs with different approaches on the implementation of transport integration which are then evaluated for their consequences on passengers, transport volume, costs and revenue, and environment.

Two conceptual scenarios for the are developed: Scenario A features the implementation of a system of ticket integration for Riga and the surrounding area using a unified smart card, while ticket prices, discounts, and planning authority stay with the current authorities responsible for them. Scenario B covers implementation of a Public Transit Authority that acts as governing body regulating the ticketing and pricing system for all modes of PT in Riga and the surrounding area as well as being responsible for marketing, timetable coordination, and financial compensations. Operations still are carried out by individual PT companies.

The consequences of Scenario A will be relatively minor. Convenience for passengers for multimodal journeys will increase, which might lead to a small increase in passenger numbers and especially interchanges. As ticket prices, except for small discounts, will stay the same, the revenue loss is expected to be minimal. The implementation of the unified e-ticket system will account for costs of around €19 million, while some savings will be achieved through the centralization of the fare collection and distribution. Measurable environmental effects are not expected.

Scenario B will lead to a substantial increase in the attractiveness of multimodal journeys and a decrease in ticket prices for those journeys. The overall transport volumes are expected to rise by 2%–5%, depending also on the accompanying measures. The number of journeys including an interchange is expected to rise. Aside from the costs of the equipment of the new ticketing system of around €19 million, losses of revenue due to the new tariff system are
expected to occur. Centralization of business planning and operation is expected to reduce the costs in the range of €3.4 million. Measurable environmental effects will not unfold in a short period.

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References

ENVIRONMENTALLY FRIENDLY TRANSPORT INTERCHANGES: ACTIVE TRAVEL ACCESSIBILITY AND POLICY

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Keywords: Soft transport modes; Interchange accessibility; Strategic plans; Good practices

Environmental pollution is one of the greatest problems of contemporary society. Its effects can be experienced in every aspect of everyday life. Its causes can be traced in a multitude of human activities, including transport. The need for transport has grown as technology has advanced, as is the ease with which it can be facilitated. This has led to a rise in a lot of different types of pollution, like air and noise pollution. The effects can be mediated by reducing the need for transport by private vehicles (Garling et al., 2009). This is more easily achieved in large scale transport through facilities like transport interchanges. But, it is a lot more difficult to achieve in respect to the access to these facilities. This requires a targeted approach and specialized infrastructure and measures to encourage active travel (i.e. walking and cycling) accessibility to the interchanges (Tsami et al., 2013). These measures can be of either hard or soft nature. Hard policy is a more aggressive kind of policy, taking steps towards reducing motorized vehicle usage, mainly by increasing its operational cost and through infrastructure changes. On the other hand, soft policy consists of actions aiming to give the traveller incentives towards using an alternative mode.

This research focuses on active travel accessibility and the required actions to achieve a satisfying level of non-motorized access to urban interchanges. To this end, a systematic literature review was conducted, related to active travel policy measures and actions, as well as to measures aiming at the promotion of walking and cycling and the improvement of access to public transport terminals. This process was necessary in order to identify good practices and successful interventions implemented in Europe, but also to indicate potential legal, operational and infrastructure gaps and bottlenecks.

Based on the above, the public transport system of Riga, Latvia was investigated in terms of legislation, infrastructure, safety and space availability, addressing active travel accessibility to and from the main urban interchanges: Riga International Coach Terminal, Riga Central Railway Station and Riga Passenger Port Terminal.

The critical assessment of the literature review findings, and the analysis of the Riga transport system, facilitated the drafting of recommendations for stakeholders and decision makers, who wish to put together action plans geared towards tackling the issue of active travel accessibility at urban interchanges.
References


A CROSS-CASE ANALYSIS OF RIGA INTERCHANGES’ INFORMATION SERVICES AND TECHNOLOGIES

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Keywords: Public transport; terminals; information services; comparison analysis

The European Commission in 2001 built a path towards upgrading urban interchanges in order to increase public transport usage (EC, 2001). The design of an optimal interchange depends on local framework and individual circumstances. Various issues in quality are important for good interchange management and operation and priorities may significantly differ among different interchanges.

The integration of information systems and ticketing as well as the application of other Intelligent Transport Systems (ITS) and services for users are crucial for the improvement of the travel experience and the appeal of the public transport terminals. Accurate, valid and timely information enhances the level of users’ convenience and improves the efficient operation of the transport system (Grotenhuis et al., 2007).

The Latvian transportation development guidelines (2014-2020) formulated the following objectives (LR Ministru kabinets, 2013):
- Available and affordable public transport, which ensures access throughout the whole country by providing a convenient and unified public transport system with good connections between bus and rail services.
- Unified public transport planning in intercity and regional routes.
- Unified policy on tariffs.
- Unified tickets.

The aim of this paper is to investigate and assess the performance level of four interchanges in Riga, Latvia, towards the provided information systems, ticketing and other ITS services. The interchanges studied are the following:
- Riga International Coach Terminal, which is an important interchange in Baltic Countries that supports intermodal trips, including international, national and urban connections.
- Riga Central Station, which is the main railway station in the wider area, very well situated in the city centre.
- Riga International Airport that is the largest international aviation company in the Baltic countries and the main air traffic centre in this region offering regular passenger, cargo and postal delivery to the cities of Europe and world, and renders both aviation and non-aviation services.
- Riga Passenger Terminal Port that serves cruise ships, ferries, super yachts, sailing yachts, navy vessels and other non-cargo ships.

In order to achieve the aim of this study, a structured form was used for face-to-face interviews and key stakeholders of each interchange were invited to give their feedback in a number of items, including:
- Regulations and guidelines on the requirements for information provision to travellers.
- Information provision about emergencies.
• Information provision by retailers or restaurants at or near the interchange to their customers.
• Information provision to travellers with disabilities.
• Sharing of information among different operators.
• Ticketing purchase options.
• Intelligent systems in the interchange area.

The comparison of the interchanges studied in this paper revealed clear differences in the level of information systems currently implemented. As the interchanges are different in terms of transport modes and operators involved, age, size and their role in the wider urban environment, it is clear that the needs and benefits of various intelligent transport systems and services are also different. Considering that all terminals are characterized by multiple stakeholder involvement, a clear governance model, addressing the provision of reliable information to travellers, is very important for good centralized management that is needed to ensure that all crucial issues are included in daily interchange operations.

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References

OPTIMIZATION OF INTERACTION OF AUTOMOBILE AND RAILWAY TRANSPORT AT CONTAINER TERMINALS

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Keywords: container transportation, loading and unloading mechanisms, railway transport operators, container terminal parameters

The movement of goods by enlarged cargo units, in containers, facilitates the integration processes of transport systems and facilitates the interaction of automobile and railway transport, thereby speeding up and reducing the cost of transportation.

The creation of an intermodal transport chain leads to a number of issues of strategic, tactical and operational level of planning and operations management (Caris et al., 2008; Tsamboulas et al., 2007). One of the reserves to reduce costs in the field of container transportation is the optimization of the interaction of automobile and railway transport at transport hubs (Marinov, 2009; Bontekoning et al., 2004). A lot of studies have been devoted to the issues concerning tactical and operative planning of operations at land container terminals. Most studies on the maintenance of terminal capacities consider minimizing the costs of container processing and an efficient use of storage facilities.

The solutions are, as a rule, reduced to a minimum of the total mileage, total waiting time or general equipment delays. Let us also note the work of Sadovskaya (1984), in which sound recommendations were proposed to improve the operational planning and management of loading and unloading facilities for the processing of large-capacity containers at the container site, which allow reducing idle hours of automobile transport during the processing of containers.

Thus, in accordance with the conducted analysis of studies on the problem of the efficiency of the use of technical means at container terminals, it was established that practically all the studies in the field of cost optimization were performed without taking into account the weight characteristics of the containers.

As a result of the analysis of research on the problem of effective use of technical means at container terminals, it was established that in the offered methods on optimization of costs weight characteristics of containers are not taken into account.

The developed methodology allows developing management decisions aimed at increasing the efficiency of container terminals, as well as reducing investments in their technical development.

The main economic entities of the automobile-railway communication are distinguished, including the owner of the railway infrastructure, the operator of the railway rolling stock, the container terminal and a road carrier.

The developed model of interaction between participants in the transportation process will be able to reduce losses associated with excessive increase in the standards of the working fleet and the empty run ratio, as well as to shorten the delivery time.

References


UNSUPERVISED LEARNING-BASED STOCK KEEPING UNITS SEGMENTATION

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Keywords: Stock keeping units aggregation, unsupervised machine learning, clustering, inventory grouping, DBSCAN

An average inventory system contains immense number of stock keeping units (SKUs). In general case, it is computationally impossible to consider each item individually and manage it under individual inventory policy. As far back as late 80’s, an essentially important question has arisen: “how to aggregate stock units into groups so that the resulting inventory policies are sufficiently close to those policies that would have been generated if every unit was treated individually?” (Ernst and Cohen, 1990). Nowadays the development of the efficient methodology for defining SKU’s groups is still relevant. Thus, it becomes an extremely tempting opportunity to take advantage on the state-of-the-art unsupervised machine learning approaches in order to finally solve this long-standing problem.

This study discusses the application of various algorithms for clustering analysis to solve the SKU-aggregation problem. Namely, such algorithms as K-means, mean-shift and DBSCAN are compared based on the internal and external evaluation. The research utilizes dataset provided by the “Trialto Latvia SIA”. The dataset under consideration contains 9240 SKUs with 14 features. Since SKU’s groups should take into account all attributes with a sufficient impact on the certain inventory operation, considered features include information beyond the inventory cost and volume that are used in classical ABC analysis. Besides, the work pays special attention to comparing various validation and feature-scaling approaches.

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References

EVALUATION OF THE IMPACT OF THE NUMBER OF PICKING LOCATIONS ON THE TOTAL COST OF WAREHOUSE

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Keywords: picking locations, picking process, replenishment of stock keeping units, picking route

Use of the smart systems becomes very popular in logistics. It is also very important to develop smart picking system for warehouses of the logistics centres. In Latvia most of logistical centres is using primitive picking technologies: the paper picking, RFID picking or more developed picking technologies such as: visual picking, picking by voice. Generally, it depends on velocity of order lines picked per paid man hour. In this paper it is discussed picking area (PA) which is located into storing area (SA). The one row rack storing system available in the definite warehouse. Picking process will be realized by picking handling units and customer units. The ground level and first level of pallet racks are used as PA. The one picking location of each stock keeping unit (SKU) consists of 2 pallets: 1 pallet on ground level and second one on the first level of rack. The replenishment is appropriated for moving the SKU’s from SA to PA to avoid out of stocks in picking time interval. If picking location reaches critical stock level for single stock keeping unit, replenishment starts by the signal in warehouse management system. This approach is called as the Red Card principle (Apsalons, 2012).

The picking cost is optimising criterion for evaluation of the variants of organizing orders’ picking process. The two approaches of the layout of SKUs in PA is analysed in this article: single picking location for each single SKU – the replenishment is realised in picking process and various picking locations for each single SKU – the replenishment is realised just only before picking process or after it. The main purpose of paper is to evaluate impact of the layout of PA on the total picking cost of the warehouse referring to approaches of the layout of stock keeping units in PA. The definition of the scientific problem is to obtain mathematic algorithms of evaluation of picking cost for these two approaches of the layout of SKU’s in PA. The object of the research is storing and picking areas. The subject of the research concerns the total handling cost interconnection of replenishment process with the picking process.

The logical algorithms to evaluation of the impact of the number of picking locations on the total cost of warehouse have been developed by authors. However, a choice of appropriate approach of the layout of SKUs in PA is unequivocally. Generally, it depends on the speed of the turnover of each SKU. For single picking location for each single SKU the replenishment is realised in picking process. If picking quantity of any single SKU in replenishment time interval exceeds available picking quantity at picking location, then out of stock occur.

References
Session 9

Transport Economics and Policy
THE SOCIO-ECONOMIC IMPACT OF GREEN SHIPPING: A HOLISTIC VIEW FROM THE BALTIC SEA REGION

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Keywords: SECA regulations, clean shipping, maritime occupational health, socio-economic risks

Green shipping enjoys high attention on the environmental agenda of the Baltic Sea Region (BSR). After implementation of SECA regulation in BSR in 2015 the next step towards cleaner shipping will be the NECA regulation which will come into effect from 2021. But both emission control measures represent only partial aspects of the socio-economic impact of green shipping comprising occupational health, safety and environmental issues. Literature review reveals that a holistic view on green shipping effects is neglected taking under account the occupational health aspects of the maritime workers together with the environmental impact on casual inhabitants of BSR.

SIRC (2018) investigated in several studies that it is not still clear if green jobs are safe for workers and it poses new challenges for occupational health and safety – such as new emerging risks related to new technologies, dangerous chemicals, processes, workforce and demographic changes. Traditionally, shipping is perceived to be a relatively dangerous industry which requires a special risk assessment including health and safety aspects (Schröder and Prause, 2015; 2016). It is well known that working environment in maritime sector faces the physical, ergonomic, chemical, biological, psychological and social factors, which could lead to occupational diseases, accidents and harm since maritime sector workers are often exposed to long hours of work, demanding working conditions, isolation, rigid organizational structures and high levels of psychological stress and physical fatigue. (Kalle and Paju, 2016; Reinhold et al., 2014; 2015).

The authors of this research participated in a couple of research projects dedicated on both the risk assessment of maritime works as well on the general socio-economic impact of clean shipping. The paper explores the working conditions of Estonian shipping workers, to determine their health problems and to evaluate different aspects of the green job in maritime sector. These results will be confronted and discussed with the outcomes of the ongoing EnviSuM project which focuses on the socio-economic impact of SECA regulations (Olaniyi et al., 2018). The presented research is empirically validated by using survey results, primary data analysis and expert interviews.

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References


IMPACT OF JOINING THE EUROPEAN UNION
ON THE DEVELOPMENT OF TRANSPORT POLICY
IN THE REPUBLIC OF LATVIA

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Keywords: public administration, integration in the EU, impact assessment, transport policy

Over the past 25 years Latvia has rapidly evolved into a modern European state. Dramatic changes in the political and economic system of Latvia also were accompanied by the reforms in the field of public administration. Public administration reforms started at the beginning of 1990s and the current planning period (2014 - 2020) is already the fourth stage in the development of public administration policy. However, in the author's opinion, the greatest influence on the development of the state administration system was left to the process of preparation for Latvia's accession to the European Union and becoming a member of the EU.

Transport is one of the central elements of the process of European integration, which helps to create an internal market conducive to employment and economic growth. Transport policy is one of the common policies of the European Union that has existed since the beginnings of the EU (European Commission, 2011), as it was considered essential to guarantee three of the four freedoms of common market set out in the Treaty of Rome in 1957: the freedom of movement of people, services and goods.

In Latvia, as elsewhere in Europe and in the world, transport plays an important role in the economy and in providing access. Transport share in Latvia's GDP has been around 10% in recent years, with around 9% of the population employed in the sector. Overall evaluating there is no doubt that Latvia's transport sector has evolved as a member of the European Union. The implementation of the EU legislation and technical, social and environmental standards has taken place; very significant investments have been made for infrastructure development.

At the same time, it is difficult to find out any comprehensive research on the particular impact on the Latvian transport sector of accession to the EU and the consequences of this accession. Therefore the aim of this paper is to try to answer following questions:

• How process of joining of the European Union contributed to the development of the Latvian transport sector, and how has the transport policy changed in the period after accession?

• What are the economic, social and environmental consequences of Latvia's accession to the European Union in the transport sector?

In order to answer these research questions, it is necessary to determine, by means of ex-post impact assessment method, what are immediate or long-term political, economic, social, technical, environmental etc. consequences of Latvia's accession to the EU (Project ASSIST, 2012), of the acquisition of its legislative package acquis communautaire in the transport sector and of the attraction of EU funds to infrastructure projects in this sector. Paper also looks at the essence of the impact assessment system (Renda, 2006).

References


ASSESSMENT OF SECA RELATED ADMINISTRATIVE BURDEN IN THE BALTIC SEA REGION

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Keywords: SECA Regulations, Administrative Burden, Standard Cost Model, Clean Shipping, BSR

After the Sulphur Emission Control Area (SECA) regulation was enforced in January 2015, there were discussions on the possible negative effect on the maritime business in the Baltic Sea Region. At three years of enforcement, empirical results have allayed some of these fears. Notwithstanding, there are still unclear details regarding the administrative burden or information obligations placed on the maritime actors concerning their compliance activities.

Through the results of a survey and case study, the authors present the shipping line whose vessels ply the SECA waters. The discussion focuses on the identification of the presumed administrative burdens imposed by the SECA regulations on shipowners and second through and the analysis of the identified changes in administrative processes to comply with the regulation.

The study of the administrative burden of SECA regulations is important, as part of the costs from the compliance is important for sustainability and future policy deployment in the BSR.
EVALUATION OF A NECESSITY FOR SUBSIDIES FOR ELECTRIC VEHICLE PURCHASES IN LATVIA: 2013-2017

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Keywords: Electric Vehicles, TCO, EV policy, EV purchase subsidies

This article is evaluating if as of the 2017 there is an objectively justifiable necessity for governmental subsidies for purchasing electric vehicles (hereinafter – EV) in Latvia.

Electric cars today in many countries have turned from exotic vehicles, used only by environmental devotees, to everyday means of transport. They are seen as a way to decrease CO2 emissions and as such their purchase and use is subsidised by many countries. Latvia also subsidised their purchase for a brief period in 2013, however after the end of subsidies the sales of EVs have been disappointing. Therefore, this research was commissioned by the government of Latvia as a part of the task of finding the most cost-effective way to increase EV sales and fulfil the requirements set out to member countries by European Union environmental policies.

The analysis was carried out using Total Cost of Ownership (TCO) approach and comparing all costs for electric and internal combustion engine vehicles using pair analysis. The time period was chosen to assess how the technological and market developments had affected the requirement for government subsidies for EV purchase since the development of Latvia National Electromobility plan in 2013.

The study demonstrated that there was a significant difference in TCO and subsequently in the justification for purchase subsidies between various classes of vehicles as well as even within a single class of cars, depending on the vehicle manufacturer, which prohibited providing unambiguous answer. Hence, several possible approaches for subsidies were examined in order to recommend the most effective form for subsidizing EV purchases.
ASSESSMENT OF THE INFLUENCE OF SOCIAL-CULTURAL ENVIRONMENT IN THE CONTEXT OF GLOBAL LOGISTICS

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Keywords: transport, logistics, research, socio-cultural, socio-economics, global logistics

The modern aspects of the supply and logistics chains cannot be restricted by national borders. The strategists of the national transport policy must address new challenges of globalization to attain common pursuits by harmonizing actions when advanced international transport chains and corridors are established. Constantly changing and improving business environment demands re-assessing and re-analysing the importance of logistics and marketing as well as its functions and interaction. The links between logistics and marketing are significant as merging these functions and adapting it into company’s activities may increase profits and improve the quality of services. On the other hand, the important factor is the environment in which all these matters emerge. In this case, the awareness of socio-cultural environment becomes vital.

The aim of this research – to conduct an assessment on the role of the socio-cultural environment in the context of global logistics.

The analysis of company’s activities from the perspective of socio-cultural environment involves essential factors influencing these activities: traditions, language awareness, negotiation skills, attitudes towards overtime work, etc. However, the awareness of socio-cultural environment is not of the least importance. The article provides assessment results on the role of the socio-cultural environment in the context of global logistics. As suggested by results, the socio-cultural environment has a major impact on global businesses, especially logistics. Diverse regions are distinguished for its characteristic socio-economic environment which often causes certain difficulties in international negotiations that are common in logistics activities. The research results have shown that the role of the socio-cultural environment in global logistics is perceived equally important in all regions, however there are differences in respondents’ attitudes when it comes to gender, such as: male respondents tend to be more in favour of the overtime work in comparison to their female counterparts; according to male respondents, religion and diverse celebrations do not have a substantial impact on logistics business while female respondents think the opposite. Despite geographical differences, the most valued aspects by the employees of transport/logistics sector are as follows: work results, order of performing operational functions, and support from their co-workers. Slightly different priorities can be seen whilst examining important elements in family life and business: the third most important criterion in Europe, Scandinavia and North America is obeying to the rules and norms, while the second most important criterion in Russia and North America is the established order. Taking into account the most important criteria in logistics sector, all respondents agree that qualitative communication skills and rapid response are fundamental in logistics business. This once again proves that in different regions the impact of socio-cultural environment on global logistics is equally valued.
Session 10

Innovative Economics
WHO ARE LATVIAN WOMEN ENTREPRENEURS OF SMALL BUSINESSES? A PRELIMINARY STUDY

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Keywords: women entrepreneurs, Big Five Personality model, social factors, behaviour

In the contemporary world of advanced technologies, the Internet and financial challenges, the aspiration of women for actualization of their needs, including financial independence, is growing stronger. Women have gained more opportunities for self-actualization not only in areas traditionally associated with female roles in societies, but similarly to men, women have been starting up their own enterprises. Latvia is not any exception. Latvian data indicate that Latvian women tend to be active in establishing new enterprises and joining boards of directors in large companies. In fact, Latvian women seem to be the most active business founders in Europe: according to research, conducted by the Stockholm School of Economics (SSE) in Riga, 10 percent of women aged between 18 and 64 in the country have started their own businesses (The Baltic Times, 2014) of which the majority of women entrepreneurs lead small or micro-companies, which results in that about 40% of all small and micro-companies in Latvia are run by women (LIAA, 2018).

Given the context, the aim of this research was to identify some key factors that affect women’s decision to open and continue to sustain their own companies. Considering the possibility that these factors might be common to many more women than there is a number of businesses opened and led by women, another key aspect to consider was the personality of these women. Within the social psychology framework and in particular within the research area of individual differences, the Big Five model of personality, as a dispositional model, has been widely used, which is why it was deployed for this study, too. This research used Soto and John’s (2017) 30-item Big Five questionnaire, which was combined with 23 face-to-face interview questions designed by these authors in an effort to consider the Big Five personality traits in relation to business questions and socioeconomic factors that had impacted the decision of women entrepreneurs to open and continue to have their own enterprises.

As for the specifics of the research question, similarly to the study of Zhao and Seibert (2006), it was hypothesized that successful Latvian women entrepreneurs would score higher on Conscientiousness and Openness to Experience and lower on Agreeableness and Neuroticism. Based on different findings on Extraversion, this trait was suggested playing a moderate role (Brandstatter, 2011; Ciavarella et al., 2004; Zhao and Seibert, 2006).

Based on the results of the study, a sociopsychological profile of Latvian women entrepreneurs was created in relation to socioeconomic factors of their residence. These findings were discussed in the context of international research.

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TOURISM TRENDS AND A NEW DISTRIBUTION METHOD OF LATVIAN DOMESTIC AND INBOUND TOURISM SERVICES

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Keywords: domestic tourism, inbound tourism, statistics, regional services, global distribution, service aggregator

The tourism trends analysis explores the main trends for Latvian domestic and inbound tourism providing statistical data collected over a 10-year period. The research uses government statistical absolute data and relative data stemmed from the author’s assessment. The paper outlines low consumption of Latvian hotel resources, non-resident accommodation demand and the number of the nights spent fell on the year according to data released by the government, showing a sluggish acceleration of inbound tourism revenue, with a general decrease in non-resident spending per day and rural tourism stagnation and insufficiency of the local government administrative and financial resources to support Latvian long-term tourism sustainable development and growth. The paper highlights the significance of the tourism economy and offers new and efficient technology of regional service aggregation in the framework of the New Distribution Capability model introduced by the International Air Transport Association, in cooperation with airline carriers, Global Distribution Systems and international travel association designed to encourage Latvian tourism competitiveness, expand innovation and boost dynamic growth.
LINKAGE BETWEEN MANAGEMENT OF LONG-LIVED NON-FINANCIAL ASSETS AND PERFORMANCE OF LATVIAN COMPANIES LISTED ON THE BALTIC STOCK EXCHANGE

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Keywords: long-lived non-financial assets, management, financial performance

The research paper studies whether there is any influence or linkage between the management of long-lived non-financial assets and performance of Latvian companies listed on Baltic stock exchange within the system of corporate governance.

The research paper is based on the analysis of theoretical literature and research papers within the area of information provided about companies’ financial statements and the management of long-lived non-financial assets. Furthermore, the research focuses on investigation and analysis of mutual influence between the management of long-lived non-financial assets and performance of Latvian companies listed on Baltic stock exchange within the system of corporate governance.

The aim of this research is to provide the proof to the assumption that there is linkage between the management of long-lived non-financial assets governance and performance of Latvian companies listed on Baltic stock exchange within the system of corporate.

This research is limited to the performance of Latvian listed companies on Baltic stock exchange and research period is from year 2007 to year 2017.

Results of this research might be of interest of academic researchers as well as educators and practitioners analysing information provided in financial statements of listed companies on stock exchange as well as any other companies having significant proportion of long-lived non-financial assets from ones’ balance sheet value. Conducted research enabled to define new recommendations relating the management of long-lived non-financial assets management.
THE CONTINUITY OF LOCAL GOVERNMENTS IN POLAND DURING DISASTERS

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Keywords: continuity of government, risk assessment, crisis management

Emergencies, disasters or generally speaking disruptions affect all segments of the population (Ficoń, 2007). Because of increasing risk of natural and manmade disasters (Szwarc and Zaskórski, 2012), it is necessary to establish effective systems that prevent, prepare to, react and recover after disruptive incidents (Blyth, 2009; Szwarc and Zaskórski, 2015; Tucker, 2015; Zawiła-Niedźwiecki, 2008).

The article focuses on the issue of ensuring continuity of local governments in Poland. According to the international and national legislation or standards, the recommendations and requirements were presented.

It is a fact, that during emergencies, public administration used to be challenged by various factors like staff absenteeism, outage of power or the limitation of other critical resources (Szwarc and Zaskórski, 2017). Organizations that function in a such environment are exposed to the impact of various factors. Despite the difficulties, it is crucial to continue the critical processes.

A risk of disruptions in public administration there is not just a hypothetic or theoretical phenomena. A few examples of those incident were recognised and analysed (Were da et al., 2016). Continuity is an important part of security system of any organization, as well as preventive measures. Therefore it is strongly recommended to establish comprehensive take on security.

Local governments are vulnerable to different kind of threats (Szwarc, 2014). Some of them listed in this article could be treated as the common problems of public administration in Poland. However, both risk assessment and business impact analysis should be conducted in every institution (Zawiła-Niedźwiecki, 2014).

This paper details practical considerations for building successful continuity of local government programmes based on the Business Continuity Institute’s Good Practices Guideline, the international BCM standard ISO 22301 (Drewitt, 2013) and polish law requirements. As it is strongly emphasizes in this article, continuity is an universal problem and should be considered in holistic way (Zaskórski et al., 2011).

References
BUSINESS CONTINUITY ASSURANCE IN CREATIVE INDUSTRIES

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Keywords: business continuity (BC), business intelligence (BI), risk, creative enterprise, creative industries, cloud computing (CC)

Creative industries can be defined as a sets of business entities, created by creative enterprises, which are market-oriented and deal with the creation, production, distribution and/or spread of creative goods through the media (Kasprzak, 2013), (Markiewicz et al., 2016). Nowadays, creative industries are playing an important role in the economies of different countries. Demand on creative goods has been increasing rapidly. Not only a demand is not enough for creative firms to grow in a sustainable way. A reasonable action seems to be here an implementation and development of risk management processes, which forms the basis of BCM (Zawiła-Niedźwiecki, 2014).

The aim of the article is to develop the concept of BC assurance in creative enterprises in Poland with the use of BI systems’ environment. The paper contains major areas of risk relating to designing activities in creative enterprises. These areas are combined with the results of the empirical study. The primary method of research is CATI (N = 104 Polish creative enterprises).

Based on the literature analysis, it can be concluded that the main risk areas are: the level of competences of managers, as well as competences of creative workers (Porfírio et al., 2016), systematic improvement of skills (Hennekam and Bennett, 2016), recruitment processes and talent management (Ratalewaska, 2014), worktime and discontinuities in obtaining of incomes (Hennekam and Bennett, 2016), transfer of responsibility of the employee to the employer or entrepreneur (Lampel and Germain, 2016), as well as disposition of creative employees (Patten, 2016).

In the literature, there is also underlined the importance of factors such as: global and national fundraising, creative activities’ digitalization, as well as public awareness of designing processes, internationalization of creative work, and quality of the higher education system (Baculakova and Gress, 2015). It should be also mentioned that important role is played by the quality and richness of historical data, forecasting processes, as well as the use of ICTs (Kembaren et al., 2014). Key processes are also learning of enterprises and knowledge transfer, as well as the evolution of network structures (e.g. clusters) (Lee, 2015; Boix et al., 2015; Olko, 2017).

On the basis of the empirical study it can be noted that the basic areas of risk are: finance, enterprise’s activities on the market, regulation, project scheduling and project management processes, as well as technical conditions for implementation of innovation processes.

The above key areas of risk – identified both on a global and Polish scale – give rise to develop a holistic concept of business continuity assurance to enterprises from creative sectors. It is worth noting the role and importance of information resources (Zaskórski, 2012a), network structures and enterprises’ cooperation, as well as knowledge management. Having regard to the progressivism and a high degree of internationalization of creative enterprises, it seems to be worth to enable ICTs, in the concept of ensuring the business continuity, to increase enterprise’s efficiency, as well as shape the level of its security (Woźniak, 2015). In the case of creative enterprises, it is reasonable to use simple and low-capital intensive ICTs as the cloud computing (Zaskórski, 2012b). The CC technology gives the ability to use the potential of BI systems,
increasing effectiveness of information and decision-making processes supporting business (design) processes, and reducing risk of losing valuable information resources (Zaskórski, 2011).

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References

THE MECHANISM FOR CREATING AN EFFECTIVE INTERNATIONAL STRATEGIC ALLIANCE IN THE FIELD OF AIR TRANSPORTATION

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Keywords: air transport, international strategic alliance, efficiency

International strategic alliances in the sphere of air transportation represent a promising form of integration of companies in the 21st century, ensuring the implementation of a global strategy for business development. According to the definition of the International Air Transport Association (IATA), "a strategic alliance of companies is a form of long-term partnership of two or more companies that seek to jointly strengthen their advantage over competitors by optimizing the use of available resources, including increasing the value of brands and increasing opportunities to capture market share, improving the quality of service for an appropriate improvement in profitability".

The performed analysis of the air transportation industry for 2014-2016 allows us to generalize a set of trends that directly affect the creation and development of strategic air alliances. The share of passenger transportations on international routes is increasing every year, with 22% of the world's air traffic concentrated on just 300 routes. Each of them annually carries more than 1 million passengers, the volume of world passenger traffic annually increases by an average of 5%. The fastest growing and competitive market for air travel is Asia. The number of passengers in this region for the year increases by 9%. Growing competition is largely stimulated by the development of low tariff carriers, while they are heavily concentrated on traditional markets - Europe and the USA. In the industry there is both vertical and horizontal integration. Alliance forms of interaction have become not just a form of business integration, but also a necessary condition for existence on the market in the context of globalization. The main reason for the formation of airline alliances abroad is the expectation of a synergetic effect due to cost reduction, which is important in times of global financial and economic crises and natural disasters. Forming a strategic alliance is a complex and multi-step process that requires an instrumental-analytical justification.

The research is aimed at developing a mechanism for creating an effective international strategic alliance in the field of air transportation, which includes a set of analytical procedures and methodologies based on expert assessment methods and mathematical and statistical tools grouped into four stages. The first stage "Analysis of the current state of business and identification of the strengths and potential of the alliance from the perspective of strategic development" is aimed at assessing the company's market position, the level of competition, aimed at finding opportunities and prospects for companies to participate in an international
strategic alliance. The second stage "Development of an alliance strategy" involves the development of an algorithm for doing business, as well as formalizing the goal with a balanced system of indicators and determining the synergistic effect due to new opportunities made in the hidden resources of the company itself or in its new partners. The stage ends with the development of a strategic map. The third stage "Forming the optimal structure of an alliance for the implementation of the strategy" is to develop the structure of the alliance, communications and channels of communication within it in such a way that, in conditions of uncertainty, the structure ensures strategic flexibility for the alliance as a whole and for the company that is part of it. The fourth stage "Assessment of the effectiveness of the alliance" is to calculate the economic benefits of cooperation based on the developed methodology to assess the effectiveness of the alliance. As a result of the research carried out, the mechanism for creating an effective international strategic alliance in the field of air transportation is justified, and the advantages and risks for the companies belonging to the alliance are determined.
THE PRINCIPLES OF CREATING A BALANCED INVESTMENT PORTFOLIO FOR CRYPTOCURRENCIES

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Keywords: cryptocurrencies, balanced profitable investment portfolio

Despite their newness, cryptocurrencies have by now acquired a certain popularity due to convenience in making payments, high speed of transactions and the application of modern technology to ensure transaction security among other things.

The aim of this research is to evaluate cryptocurrencies as an investment instrument.

The tasks of the research are: (i) to evaluate a hypothesis about potential profitability of the cryptocurrency investment portfolio, (ii) analyse cryptocurrency investment profitability, (iii) assess the attractiveness of creating an investment portfolio of cryptocurrencies and (iv) provide recommendations to a potential investor for creating an investment portfolio comprised of cryptocurrencies.

The research methods used include statistical data analysis and econometric modelling. The authors collected data on the historical exchange rates of cryptocurrencies from July 2017 to January 2018 and studied their correlations, covariances and the return on investment. The research was conducted using SPSS Statistics and Excel software.

The authors have analysed the econometric models and instruments applied in the creation of an investment portfolio and determined the criteria to assess investment attractiveness of specific cryptocurrencies. Applied results were obtained using correlation-covariance analysis yielding a balanced profitable investment portfolio according to the Markowitz model.

The results of the research are that cryptocurrencies can be an attractive investment instrument, and that the proposed hypothesis about the profitability of the cryptocurrency investment portfolio could not be rejected. The authors showed that indicators such as: market capitalization, the objectives of currency creators (issuing tokens on different resources to currency holders, bounty programs, etc.), trend assessment, and the analysis of reproducibility and replicability of the platform on which the cryptocurrency is built, can be used to assess the attractiveness of cryptocurrency.

As a result of the research, the authors also developed recommendations in forming a balanced investment portfolio with cryptocurrencies. Any investment portfolio should be created considering investor objectives and obey a logical relationship between risk and profitability. Therefore, cryptocurrencies should not be correlated; an investment portfolio should include seven to twelve cryptocurrencies – to safeguard against the risk of the loss of the entire portfolio; cryptocurrencies should be liquid, that is be freely exchangeable to a fiat currency on an appropriate exchange (e.g. dollars, euros). Investors should also consider regular rebalancing of the portfolio, which could help increase profitability.
AN INFORMATION-THEORETIC APPROACH TO FINANCIAL DECISION MAKING

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**Keywords:** ambiguity, rationality, behaviour under risk and uncertainty, portfolio choice, investment decisions

The aim of this article is to provide a decision protocol to treat financial optimization problems for an individual facing uncertainty in the sense that probability distributions are uncertain. Such decision-making problems are typically modelled with multiple priors’ models (Gilboa and Schmeidler, 1989) or with ambiguity aversion and non-additive capacities (Schmeidler, 1989). One of the main challenges in the academic literature is to apply those approaches to practical finance problems. We use information-theoretic notions to discuss and treat the robust and reliable decision making approach in a way that differs from the standard academic treatments such as those mentioned above. We advocate that decision makers should pick the most uncertain distribution given the observed statistics. Incidentally, we discuss and analyse the axioms underpinning standard Expected Utility decision making and portfolio theory. We suggest to use information theoretic approaches based on Entropy to pick the most uncertain distribution. We thus make the link between the financial decision-making literature and entropy-based approaches.

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THE PROBLEMS OF CHANGING RULES OF FOREIGNERS EMPLOYMENT IN POLAND

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Keywords: employment, foreigners, labour market

The article presents the problems in employing in the European Union and third countries citizens in Poland, especially according to low (The act from 20 April 2004; The act from 20 June 2017; The act from 15 June 2012; The act from 12 December 2013). In the context of a large scale foreigner migration to Poland, predominantly arriving from the non-EU Eastern Europe countries, many entrepreneurs are facing a problem of how to employ him/her and which formal issues need to be settled in order to finish the process in accordance with the law. Employment of foreign workers derives from the deficit of employees from Poland. Employee shortage may both influence the worsening of companies’ conditions and cause the state’s economic slowdown. These problems include as well the road transport sector which currently lacks about 100,000 professional truck drivers.

At present over then half companies have troubles of finding candidates to work. The troubles have caused by low unemployment, furthermore many workers emigrate.

According to the Main Statistics Office (MSO) (2018), 2.5 million Poles stay abroad. Demand for workers is high and it is reason of good state of Polish economy.

According to MSO, Gross Domestic Product (GDP) in IV quarter in 2017 grew rate about 5.1%.

Furthermore, the situation of demography influences on labour market, the problem is to decrease young workers. Population growth in Poland is below zero.

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2. The act from 20 June 2017 on change of engagement promotion in institutions of labour market and other acts Dz. U. z 2017 r, pos. 1543.
MANAGEMENT OF LIQUIDITY AND PROFITABILITY IN COMMERCIAL BANKS

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Keywords: profitability, liquidity, assets and liabilities management, effective resources, profitable assets

Issues of liquidity and profitability management are currently highly topical for every commercial bank. Those banks, which operate with surplus liquidity, encounter the problem of profits that are less than optimal. Other banks, which conduct aggressive policy aiming to place all the available resources with maximum efficiency, are forced to seek solutions to the problem of locating additional liquid funds, in order to ensure timely fulfilment of liabilities. In this paper the author offers a methodology for evaluating the optimization of the balance between profitability and liquidity in commercial banks. This methodology is based on the analysis of bank’s active and passive operations, which results in determining the amount of effective (profitable) resources, which is compared with the actual amount of profitable assets to discover the level of optimization of profitability and liquidity. The potential application and viability of the offered methodology is shown on the example of Latvian commercial banks. After analysing active and passive operations of Latvian commercial banks, the author develops recommendations to optimise profitability and liquidity.
CORPORATE INCOME TAXATION: CHALLENGES OF E-COMMERCE PLATFORMS

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Keywords: Digital Economy, Corporate income tax, Profit split, Fair taxation

Sales turnovers, profits, hence taxes collected from businesses operating in digital economy are rising worldwide, including the EU (European Commission, 2017). Moreover, growth is expected to continue in also in the future. This arises additional challenges for different tax administrations on how to tax profits of such businesses as their operational models no longer fit in traditional taxation models. Consequently, taking into account that usually such businesses operate in different countries, the question is how to attribute fair amount of profits of such businesses to respective jurisdictions.

This is due the fact that businesses operating in digital economy have critical differences in their business models compared to the ones operating in traditional economy as further discussed in the research paper. Changing business models outline the need for new principles for taxation of such businesses in order to achieve fair taxation as recently pointed out by the European Commission.

There are different businesses operating in digital economy, such as, ride-to-hire companies (e.g., Uber, Taxify etc.), e-commerce retailers (e.g., Amazon, E-bay) and social networks (e.g., Facebook) etc. The aim of this research paper is to establish concepts of international taxation that allow fair taxation of digital businesses. This research paper focuses specifically on corporate income taxation of e-commerce platforms.

The research paper in more detail outlines the methodology used in order to determine key profit drivers of e-commerce platforms. It should be specifically stressed that from upstream sources as per traditional business models, e-commerce platforms have changed its operations to downstream sources - i.e. customers. Subsequently, as finding suggested that the most appropriate method for determination of profits to be taxed by each jurisdiction is profit split method, application of the method was simulated. Similar ideas and approaches on how to tackle issues arising from corporate income taxation on businesses operating in digital economy also are supported by the Organization of Economic Cooperation and Development (hereinafter – OECD) member states as well as researches.
Session 11

Education and Training in Engineering
ON HIGHER EDUCATION REALITIES: SUPPORTING EDUCATION AND RESEARCH

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Keywords: Educational management, teaching, learning, research, writing

Providing high quality, relevant and widely accessible higher education is a central goal of the European Higher Education Area. New and emerging approaches to learning, teaching, writing and research made possible by new technologies, can complement, consolidate, support and further advance these efforts. Cost Action CA15221 – Advancing effective institutional models towards cohesive teaching, learning, research and writing development – addresses the challenge of creating synergy among the increasingly more specialised and centralised supports for the above activities, offering the most advantageous models and practices for supporting research, writing, teaching and learning. As there is a lack of professional conversations around the shared territory of support for the above areas, corresponding research across higher education institutions would illuminate intersections and contribute to institutional transformation based on complementary, coherent and integrated provision.

In line with the Cost Action CA 15221 objectives, the following objectives were set by the authors:

1) Studying the forms and methods of centralized support for research, writing, teaching and learning, which can be used in a modern university.
2) Examining what educational services, designed to facilitate effective teaching, learning, and research, are offered to students, academic and attending staff.
3) Defining basic processes and knowledge transfer schemes involved in the centralized model of support for research, writing, teaching and learning employed in a contemporary higher education institution.
4) Analysing how modern technologies and communication platforms allow for greater collaboration between all study process participants in the agenda of creating the common ground in terms of shared purposes, processes, knowledge, values and skills among centralized institutional supports for the four key activities in order to capitalise on their synergies.

The following research methods were used by the authors:
1) Analysis of technologies and communication platforms used for supporting teaching, learning, research and writing (TLWR).
2) Analysis of the main documents regulating centralized support for TLWR strategic plans, documents related to Quality Assurance in higher education, relevant publications, and study courses descriptions.
3) Conducting interviews with representatives of the management, research and academic staff of the university in focus.
DEVELOPING A MARKETING STRATEGY FOR A HIGHER EDUCATION INSTITUTION IN THE AGENDA OF CUSTOMER-DRIVEN EDUCATION

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Keywords: Higher education, marketing strategies, marketing reports

Modern higher educational institutions (HEIs) offer exciting, creative programs for thousands of students worldwide. The higher education industry is designated by development in creativity, training and employability for qualifications and degrees. According to UNESCO Tertiary Education data (2014), the number of tertiary students doubles every 15 years. Nevertheless, without using competitive marketing strategies, student enlistment numbers often fight to meet and surpass expectations. That is the reason advanced education organizations are employing creative marketing experts to maintain their foundations and studies stand-out and attractive. Remarkable advanced education promoting methodologies help bring issues to light while enrolling new students and attracting more resources. Universities are moving past such traditional methods as magazines and leaflets; they are rather pushing assets towards speaking to the always developing computerized advertising scene. There, they can have more extensive reach and more noteworthy potential in quickly expanding their program’s comprehension. There’re some specific challenges higher education marketers face today, for instance, limited marketing resources, media overloading, image based on previous information, etc.

Moreover, every year university applicants start a new lifecycle. Consequently, higher education market experts have to face a new target audience. That is why it is important to define the latest marketing strategies and trends, while re-evaluating the foundations to ensure the university sends the right message to the right audience. In order to create a competitive market position for a higher education institution in such circumstances it is necessary that it adopts marketing concept and philosophy and creates its strategy and activities in terms of market performance. The most important aspect of an effective strategy is making sure it aligns with the overall marketing and recruiting goals; a good strategy should also include a combination of digital activities (Dillon, 2017).

The aim of the paper is to examine some marketing strategies to be applied in a higher education institution in the agenda of customer-driven education. The following objectives were set by the authors:

1. To identify modern trends and challenges in the higher education industry in the context of developing an efficient marketing strategy.
2. To discuss some marketing strategies to be used in a contemporary university in the agenda of customer-driven education.

The following research methods were used by the authors:

1. Review of theoretical literature and EU documents on the research topic.
2. Analysis of the open-source marketing reports of some universities.

References

E-LEARNING AND E-TEACHING EFFECTIVENESS: ACADEMIC STAFF PERCEPTION

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Keywords: e-teaching; higher education, pilot survey, Latvia

E-learning is an instrument of open education and the digitalization of the education is one of the priorities stated by the European Commission. In turn, implementation of e-learning practices requires from teachers not only digital skills, but also motivation to work in e-environment.

The overwhelming goal of the planned large-scale research is to determine e-teaching value perceived by the academic staff members representing higher education institutions in Latvia and other countries.

The goal of the current paper is to reflect the results of the authors’ conducted pilot survey. The given pilot study follows the first one conducted by the authors in 2016 (Bierne and Titko, 2016). It was performed using the authors’ developed research instrument (questionnaire) at the University of Economics and Culture (EKA). The survey goal was to investigate the perception of e-teaching experience and to determine a Moodle platform value perceived by the academic staff. The authors focused on Moodle (Modular Object Oriented Dynamic Learning Environment) in their research, because it is the most popular IT-based tool used in study process in Latvia (Birzina, 2012). The underlying goal of the first pilot study was to test the research instrument in terms of its appropriateness for further usage in the large-scale research.

The survey results indicated several problems: 1) on the opinion of the respondents, many of questions required adjustments and clarification, they were not properly formulated; 2) the list of statements about e-teaching perception did not include some important e-teaching aspects; 3) some important factors affecting e-teaching efficiency were not mentioned; 4) on the other hand, the list of statements for evaluation was too large and consisted of too many less important statements for the investigated issue.

The initial questionnaire was amended, discussing the questions within the group of experts. According to the Gorbans and Bierne (2015) perception of e-teaching experience could be divided into two dimensions – pedagogical and managerial. Thus, the criteria for the academic staff members to be invited as experts were: 1) a long-term e-teaching experience, and/or 2) doctoral degree in Pedagogy.

The research instrument used in the current pilot survey involved three sections: A) respondent profile questions B) perception of e-teaching, and C) e-teaching perceived experience. 37 representatives of EKA academic staff participated in the survey.

The next steps of the research are dissemination of the questionnaire among representatives of other Latvian higher education institutions and, further, among the academic staff members of the partner institutions in foreign countries.

References

SUPPORTING LIFELONG LEARNING IN TRANSPORTATION INDUSTRY – ALLIANCE E-LEARNING APPROACH

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Keywords: Lifelong learning; on-line platform; e-course requirements, framework

Lifelong learning is a critical condition for successful and fulfilling professional life in the modern economic environment. It reaches all possible areas of the economy, industries, and social aspects of people’s lives. The Transportation industry is a rapidly developing and changing sector of the economy, which requires highly educated and trained employees capable to manage effectively the current challenges and create innovative solutions to meet emerging economic and social requirements (Report on Education and training, 2014). So, it is a need to prepare the workforce impacts of many technological innovations. For instance, the arrival of automated vehicles in the next years is expected to affect a variety of fields, including public transit, insurance, environment and land-use planning. As a result, demands on the highly educated workforce will be changed rapidly, and the educational system hasn’t caught up to that reality.

It is expected that professionals in the transportation industry should have skills in different new areas, among them Information Communication Technologies and cooperative Intelligent Transportation Systems, Big Data, innovative sustainable transportation and mobility solutions. May be that doesn’t make sense for young people today, as many of them have undergraduate degree and join to Master degree, but for 90’s and 20’s graduates it is clear that continuing education is valuable. Ongoing professional learning and training are required to help employees to accept and implement effectively new changes in the industry and stay fit in the work-place.

The aim of this paper is to present the online learning environment that has been developed in frame of ALLIANCE project. ALLIANCE is a three-year project, supported by the EU HORIZON 2020 Programme aiming at promoting research and the exchange of information, between Transport and Telecommunication Institute (TTI), University of Thessaly (Greece) and the Fraunhofer Institute for Factory Operation and Automation IFF (Germany) (Alliance, 2016).

ALLIANCE project delivers a coherent educational/training program addressed to enhancing the knowledge of current and future researchers and professionals offering their services in Latvia and the surrounding region of the Baltic sea (Yatskiv et al., 2017). One of the significant project aims is the knowledge sharing through twinning activities and through a set of courses offered as part of the existing graduate programs, the joint training schools and seminars, that will be provided to a broader audience after project completion.

In this paper we developed requirements and the framework for online course preparing. Each online course should be developed on the basis of ALLIANCE courses of Sustainable Transport Interchanges Program (STIP) prepared in the frame of WP2 (Mitropoulos et al., 2017) and realised and discussed in different project activities. Each e-course consists of e-course
metadata, the e-course itself and an optional additional information material, providing explaining information to the course content in spoken (podcast/video) or written form.

Within the project activities an e-learning platform has been established, that will be used for the provision of online courses for PhD and MSc students, early careers researchers and other interested parties. It is obvious, that online learning is flexible and economic way to support lifelong learning.

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LOGISTICS MANAGEMENT GAMES FOR ACTORS OF GEOGRAPHICALLY DISTRIBUTED SUPPLY CHAINS

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Keywords: Management Games, Supply Chains, Logistics, Computer-based management games, VR-based management games

Management Games are a common method for training employees in production and logistics, both in expert knowledge and in soft skills. Typically, all participants are located in one room while playing the game. This allows for a face-to-face interaction among the participants and between the participants and the trainer. This facilitates the typical learning loop of a management game: play, analyse and improve.

For companies with supply chains covering different geographical locations and different time zones, the approach of having a management game seminar with all participants in one room leads to high costs due to traveling costs and lost time for traveling.

Multiplayer computer-based management games played through the Internet and multiplayer VR-based management games could enable companies to conduct management games with actors of geographically distributed supply chains without spending money and time on travelling.

This paper describes the main requirements for management games with actors of geographically distributed supply chains. Based on the requirements, the paper compares classical management games conducted as board games, multiplayer computer-based management games played through the Internet and multiplayer VR-based management games. Using the example of a typical supply chain, the paper suggests and describes a concept for a multiplayer computer-based management game that can be played with actors of a geographically distributed supply chain.
APPLICATION OF PROCESS APPROACH TO KNOWLEDGE MANAGEMENT IN EDUCATION INSTITUTIONS: COMPETENCE CENTRES

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Keywords: Competence centres, process management, educational technologies

Currently the world is on the threshold of sixth technological paradigm, which contours are visible in advanced countries with high level of innovative high-tech products development (Ewy and Gmitro, 2009). Transition to new paradigm is contingent upon large-scale investment both in means of production and personnel training system.

The concept of process knowledge management is considered to be applied in education establishments (Gitelman and Kozhevnikov, 2013; Llamosa-Villalba and Mendez-Aceros, 2010). The advantage of the process approach is management continuity provided at the interface of individual processes within their system, as well as within their combination and interaction. Competence Centres could be the basis for the process approach implementation in the universities; Competence Centres are structures or subdivisions of knowledge-based organizations aimed at seeking and transfer of new knowledge, providing consulting services, qualified specialists training (The Bloomberg Innovation Index, 2015).

The purpose of this article is to consider university Competence Centres as a tool for specialists training for the new technological paradigm, since in such institutional environment an infrastructure for the knowledge generation and transfer is established.

In Russia such Centres often perform the role of marketing structures and usually have no practical value, therefore the Centres are not of interest to large enterprises (The Bloomberg Innovation Index, 2015). The object of the article is to suggest the approach to reengineer the university Competence Centres, relying on the needs of students and future employers. As shown by surveys conducted in Bauman Moscow State Technical University (BMSTU) many students are interested in participating in research and technological entrepreneurship, but they face financial difficulties, as well as absence of competencies for implementing the idea. Whereas, future employers are not satisfied with the practical skills of graduates and believe that in a rapidly transforming world it is necessary to have a basic knowledge of the foundations of entrepreneurship in order to promote technological products.

Consequently, knowledge and competencies should be exchanged between representatives of different departments, universities, and enterprises at discussion platforms based on Competence Centres. The Centre should support technological implementation of the project: simplified access of students to production sites and laboratories of partner enterprises and the University should be organised. Students will study lean manufacturing and the fundamentals of technological entrepreneurship. To improve the effectiveness of educational activities, the activities of the University Competence Centre as a knowledge management process should be considered. The University will be the process owner, on which basis the Competence Centre will be organised. Process customers (students, future employers, society) play a significant part in such education quality management. Customer satisfaction monitoring requires an assessment of information about consumers' perception of the fulfilment of their requirements. This information, including process parameters, product parameters and customer
satisfaction, will be collected at the output of the process and will be analysed by the process owner in order to improve the process.

References
CONFLICT MANAGEMENT IN THE EDUCATIONAL PROCESS AT THE UNIVERSITY

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Keywords: management, conflict, faculty, students

One of the most important tasks of any organization management is the control of conflicts, which inevitably arise in the cooperation of people who have different social statuses and who differ in their roles and functions.

To the full extent it can be referred to the higher educational institutions, whose functioning could not get along without conflict manifestations. Despite the seriousness of this problem, the studies carried out concerning conflicts in the universities, in particular faculty-students conflict, are quite limited.

Although conflicts reveal the problems and contradictions that occur in the educational process, it is also obvious that they impede the effective solution of the basic tasks of education: teaching and learning. Therefore, it is necessary to predict and prevent the occurrence of conflicts, to diagnose them at an early stage of development, to regulate the process of conflict development, to facilitate their solution, i.e. conflicts need to be managed.

The conflict management must be constructive and lead to the desired result, to achieve this goal it is necessary to conduct a thorough investigation of the causes that give rise to conflicts, to study the positions of the conflicting parties, to reveal the problems, which have become the basis for appearance of the conflict. For this purpose, the Institute of Transport and Communications conducted an empirical study of the conflicts between the main subjects of the educational process: between academic staff and students, there also proposed the measures for administrating this type of conflict interaction. The students of all courses and forms of training, as well as a number of leading faculty of the university, participated in his study. The main methods of collecting information were questionnaire survey for students and interviewing for faculty.

The results of the study showed the following:
- Most of the students consider the university academic staff to be highly qualified specialists and respect them.
- Nevertheless, 65% of the surveyed students noted the presence of at least episodic conflicts with teachers (either by participating in conflicts directly or by watching fellow students having a conflict with teacher). Also, all the interviewed teachers indicated that the conflicts with students occurred in their pedagogical practice.
- Interpersonal conflicts (“teacher-student”) take place more often than conflicts between a student group and a teacher.
- According to the students, only 30% of conflicts resolved in the interests of both parties. Thus, mainly students remain unsatisfied with the results.
- According to the students’ opinion, conflicts are caused mainly by either bias and unreasonably high demands of the part of the faculty, or by methodological flaws in teaching.
- According to the academic staff, the most frequent causes of conflicts are the overstated self-evaluation of some students and their unpreparedness for studying at the university.

Not necessarily each of these reasons causes an open conflict. However, in the presence of a conflict situation, any incident can lead to a conflict – an open confrontation between the student and the teacher.
As the measures of controlling conflicts and their prevention, solution and regulation, the authors suggest the following:
- to use more widely the tactics of conflicts prevention;
- to diagnose conflicts that already exist;
- to dedicate a set of pedagogical seminars (with the participation of both faculty and students) and trainings to analysis of various conflict situations with the search for solutions to specific problems;
- to create a clear system of requirements and criteria for assessing knowledge for the course and for the specific work;
- to provide psychological assistance to the faculty working in conflict student groups, providing preventative measures before conflict situations appear.