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Scientific Conference
of Riga Technical University

**Scientific Problems
of Engineering Economics
of Construction and Real
Estate Management,
Regional and Territorial
Development ICEREE'2023**

Book of Abstracts

Institute of Civil Engineering
and Real Estate Economics

29 September 2023, Riga, Latvia

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**RIGA TECHNICAL
UNIVERSITY**

Faculty of Engineering Economics and Management
Institute of Civil Engineering and Real Estate Economics

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BOOK OF ABSTRACTS

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FOREWORD	6
I	7
CHALLENGES IN MODELLING THE IMPACT OF GREENER AND ENVIRONMENTALLY FRIENDLY SOLUTIONS APPLICATION IN LAST-MILE DELIVERY IN LATVIA: NATIONAL AND REGIONAL PERSPECTIVE	8
PRECONDITIONS OF DEVELOPMENT OF SUSTAINABLE SOLUTION FOR TRANSPORTATION SERVICES IN LATVIA	10
ASSESSMENT OF THE IMPACT OF ECONOMIC AND ADMINISTRATIVE INSTRUMENTS ON TRANSFORMATION TO A SUSTAINABLE MOBILITY	11
OPPORTUNITIES FOR THE WOODEN PUBLIC BUILDINGS' DEVELOPMENT IN LITHUANIA	13
MAIN RESULTS WITHIN CLI-MA PROJECT WITH REGARD TO IMPROVE ENERGY PERFORMANCE LEVEL OF RESIDENTIAL BUILDINGS	15
II	16
DIGITAL TWIN AS A TOOL FOR GREEN HYDROGEN PRODUCTION OPTIMIZATION	17
DIGITAL TWINS IN URBAN ENERGY COMMUNITIES: A DATA ACQUISITION AND PROCESSING MANAGEMENT PROBLEM	19
THE CONCEPT OF ENERGY COMMUNITIES IN THE EUROPEAN UNION	21
URBAN RENAISSANCE: NAVIGATING SUSTAINABLE URBANIZATION FOR REGIONAL PROSPERITY	22
ASSESSMENT OF IMPLEMENTATION OF CIRCULAR ECONOMY FRAMEWORK IN THE SRI LANKAN CONSTRUCTION SECTOR	23
IDENTIFYING POTENTIAL HOUSEHOLD WASTE AS SECONDARY RAW MATERIALS IN THE CONSTRUCTION INDUSTRY: A CASE STUDY OF SRI LANKA	24
RETROSPECTION OF DEVELOPMENT OF CIRCULAR ECONOMY CONCEPT	25
FROM INDUSTRIAL REVOLUTION TO THE NEED OF CIRCULAR ECONOMY IMPLEMENTATION	26
UNDERLINING THE NEED OF CIRCULAR ECONOMY IN URBAN ENVIRONMENT	27
CONCEPTUALIZATION OF SYNERGY IN URBAN ENVIRONMENT	28
THE PROCESS OF ABOLISHMENT OF MUNICIPALITY REAL ESTATE RIGHT OF FIRST REFUSAL IN LATVIA	29
EFFICIENCY AND EFFECTIVENESS IN BUSINESS AND BEYOND: CRITICAL AND ANALYTICAL APPROACH	30
VALUES OF HIGHER EDUCATION INSTITUTIONS: THEIR CRITICAL AND ANALYTICAL EVALUATION	31
THE CONTEMPORARY DYNAMICS OF QUANTITATIVE EFFECTS OF BUSINESS PARTNERSHIPS OF CONSTRUCTION ENTERPRISES	32
TECHNOLOGICAL ADVANCEMENTS IN REAL ESTATE MANAGEMENT ASSISTANCE OF VIRTUAL 3D TOUR	33
LOW-RENT HOUSING CONSTRUCTION OPPORTUNITIES	34

SITUATION IN ENERGY CERTIFICATION OF RESIDENTIAL BUILDINGS IN LATVIA	35
THE EFFECT OF EXTERNAL AND INTERNAL FACTORS ON MANAGEMENT EFFECTIVENESS WITHIN INDIAN CONSTRUCTION COMPANIES	36
CIRCULAR ECONOMY STRATEGIES IN BUILDING DESIGN: PRIORITIZING SUSTAINABILITY THROUGH BEST-WORST DECISION-MAKING METHOD (BWM)	37
ECONOMIC CRISIS ADAPTATION IN SRI LANKAN CONSTRUCTION: PATHWAY TO PROSPERITY	38
COMPATIBILITY OF LVS EN 16310:2020 WITH CONSTRUCTION DESIGN METHODS	39
TECHNICAL CONDITION OF SOVIET-ERA APARTMENT BUILDINGS, RELATED PROBLEMS AND POSSIBLE SOLUTIONS IN LATVIA	40
DEVELOPMENT OF THE MUNICIPAL REAL ESTATE STRATEGY IN LATVIA	41
FACTORS INFLUENCING THE ADOPTION OF SMART BUILDING AND SERVICE PREFERENCES IN SRI LANKA	42
COMPARATIVE ANALYSIS OF THE CONSTRUCTION SECTOR OF LATVIA AND AZERBAIJAN	43
ENVIRONMENTALLY FRIENDLY CONSTRUCTION DEVELOPMENT STRATEGY IN LATVIA	45
THE CONSTRUCTION COST INDICES: THE CASE STUDY IN LATVIA	46
DISTINCTIVE CHARACTERISTICS OF CONSTRUCTION MATERIALS AND THEIR EVALUATION APPROACHES IN LATVIA AND UKRAINE	47
MARINE CADASTRE AND SPATIAL PLANNING ASPECTS IN THE BALTIC SEA REGION: COMPARISON OF LATVIA AND POLAND	49
ANALYSIS OF MULTI-APARTMENT RESIDENTIAL HOUSING MANAGEMENT PROCESSES	51
PUBLIC REAL ESTATE MANAGEMENT IN THE UNITED KINGDOM	52

FOREWORD

Within the framework of the annual 64th International Scientific Conference of Riga Technical University (RTU), the Institute of Civil Engineering and Real Estate Economics (ICEREE) of RTU Faculty of Engineering Economics and Management organizes the conference “Scientific Problems of Engineering Economics of Construction and Real Estate Management, Regional and Territorial Development”. The conference provides a discussion platform for researchers, where everyone can get to know the latest developments, research findings, ideas and their application in construction science and engineering economics. The conference brings together scientists, researchers and PhD students from all over the world every year.

The goal of RTU 64th International Scientific Conference Section “Scientific Problems of Engineering Economics of Construction, Real Estate Management, Regional and Territorial Development” is to promote scientific discussion on topical issues of construction management, real estate, regional and territorial development, as well as to publish the latest research results in the field.

The book of Abstracts contains 36 abstracts which are related to the following thematic fields of the Conference:

- 1) Problems and tendencies of construction management and real estate engineering economics at the local and global level;
- 2) Local and global development tendencies and scientific problems of regional and territorial development, and
- 3) Preconditions and challenges of improving last mile deliveries in Latvia.

Book of Abstracts contains insights obtained as a result of the development of the following research projects:

- 1) Latvian Science Council’s fundamental and applied research programme project “Development of Model for Implementation of Sustainable and Environmentally Friendly Last-Mile Distribution Transportation Services in Latvia” (TRANS4ECO), project No. lzp-2022/1-0306, 01.01.2023.- 31.12.2025;
- 2) Erasmus+ project “Sustainable Public Buildings Designed and Constructed in Wood” (Pub-Wood), No. 2018-1-LT01-KA203-046963;
- 3) Erasmus+ project “Design and Construction of Environmental High Performance Hybrid Engineered Timber Buildings” (HybridTim), No. 2020-1-DK01-KA203-075045;
- 4) European Climate Initiative (EUKI) project “From Housing Manager to Climate Manager” (CLI-MA). Agreement number: 81263938. Project processing number: 17.9045.0-002.77.

Organizing Committee of ICEREE2023



CHALLENGES IN MODELLING THE IMPACT OF GREENER AND ENVIRONMENTALLY FRIENDLY SOLUTIONS APPLICATION IN LAST-MILE DELIVERY IN LATVIA: NATIONAL AND REGIONAL PERSPECTIVE

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Abstract. Shift towards greener transport technologies is facilitated by various stakeholders and groups via the legislation (as the EU Green Deal) and individual preferences. Last-mile freight delivery technologies experience significant changes in applied technologies and potentially applicable technologies as drones, automatic transport robots, automatic trucks. However, a limited research attention is paid on the impact on all other economic activities (multi-sectoral approach) and regional impact as many studies purely focus on solutions, limited sectors, city, or region where applied. Hence the aim is to estimate the potential impact on economic activities and regional development caused by the shift towards greener and more sustainable transport technologies in last-mile delivery in Latvia. The applied elaborated modified input-output model with regional block models the sectoral impact according to NACE 64 economic activities, using bottom-up approach computed results for major 10 sectors and two regional perspectives: NUTS 3 (6 regions) and urban-rural typology (3 territories). The results claim that overtaking and applying in postal and courier services (H53) representing last-mile delivery amid NACE classification leads to a notable impact on various service economic activities rather manufacturing, and due to geographical location of production, then NUTS 3 regions and urban-rural typology territories are modelled. The results indicate high sensitivity to modelling assumptions and selected benchmark country, nonetheless valuable as additional information for urban planning, regional transport, and economic stimulus policy elaboration for broader scale of impacts caused.

Keywords: *green logistics, input-output, last-mile delivery, postal and courier services, sustainable transport*

JEL Classification: C67, L87, O47, R15

Acknowledgement. *This research was funded by the Latvian Science Council's fundamental and applied research programme project "Development of Model for Implementation of Sustainable and Environmentally Friendly Last-Mile Distribution*

*Transportation Services in Latvia" (TRANS4ECO), project No. lzp-2022/1-0306,
01.01.2023.- 31.12.2025.*

PRECONDITIONS OF DEVELOPMENT OF SUSTAINABLE SOLUTION FOR TRANSPORTATION SERVICES IN LATVIA

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Abstract. In the end of 2017, Federal Administrative Court in Leipzig (Germany) allowed cities and communes in Germany to impose bans for diesel cars in order to reduce the level of nitric oxide in the air. This decision radically changed and car market in the Germany, EU, both set a new challenge for transportation sector. As results in the EU, in legislative level, from 2035 is prohibited to trade with a new diesel car. Set of countries, cities such as Paris (France), Madrid (Spain), Athens (Greece), Warsaw (Poland) significantly limited use of an old or/and diesel cars. In this way Latvia shows a lag in the scientific and practical aspects of solving the problem. The research goal is to underline necessity to development of sustainable solution for transportation in Latvia, as well as to show possible solutions to the problem. The study is based on a statistical analysis of the use of freight transport in Latvia and the EU. Mathematical models being developed show the impact of decisions made on the economy and environment in Latvia.

Keywords: *Logistics, Mathematical Modelling, Regional Economy, Sustainable Development, Transportation Economics*

JEL Classification: C50, P25, Q01, R4

Acknowledgement. *This research was funded by the Latvian Science Council's fundamental and applied research programme project "Development of Model for Implementation of Sustainable and Environmentally Friendly Last-Mile Distribution Transportation Services in Latvia" (TRANS4ECO), project No. lzp-2022/1-0306, 01.01.2023.- 31.12.2025.*

ASSESSMENT OF THE IMPACT OF ECONOMIC AND ADMINISTRATIVE INSTRUMENTS ON TRANSFORMATION TO A SUSTAINABLE MOBILITY

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Abstract. In line with the EU Green Deal, Member States must play an active role in reducing greenhouse gas emissions. One of the economic instruments used by the Member States is environmental taxes (Brizga et al., 2022), which has an impact on public and private mobility. Transport is an important source of greenhouse gas emissions throughout the European Union. For example, in Latvia, transport is the second largest source of pollution for 29% of the total volume and one of the only sectors where emissions continue to increase, as more and more people switch from public transport to private cars (Jurušs & Brizga, 2017).

The aim of the study is to assess what would be the best solutions for achieving the indicators set out in the Green Deal in the field of transport, especially assessing the impact on socio-economic aspects. The study uses quantitative methods for statistical analysis and forecasting the impact of multifactorial nonlinear regression.

It should be noted that in recent years, the COVID-19 pandemic and the energy crisis have had a significant impact on public and private mobility (Brizga J. & Jurušs M., 2023). The study utilized statistical and Google tracking data on transportation, along with surveys on remote work and economic indicators. Factors like government measures, energy costs, work patterns, and security attitudes significantly impacted people's mobility. Findings reveal that COVID-19 minimally affected the economy and employment, while energy crises and inflation had a larger impact. Both crises altered spending: the pandemic led to savings, whereas energy crises increased costs. These external shocks, though disruptive, offer a chance for policymakers, activists, and researchers to support sustainable mobility transitions. Such cases should prepare cities and nations for future transport management through understanding changing modes and drivers of transportation.

Tax measures might not be sufficient for the transformation towards sustainable mobility. It is necessary to promote both the use of alternative means of transport

(e-car) and to look for other solutions. One of the prerequisites for the development of e-car use is an appropriate accessible infrastructure (charging stations). That is why the European Union is actively thinking about how to promote it. In this context, the Council of Europe has already adopted a new law on more recharging and refuelling stations across Europe (Council of the EU, 2023). Renewable energy should also be promoted in transport, in this regard the new Renewable Energy Directive intends to raise the renewable energy target in transport from 14% to 29% (European Parliament, 2023). Future studies should more focus on the impact of both the economic and administrative tools on the transmission of sustainable mobility.

Keywords: *Environment, Green Deal, Mobility, Taxation, Transportation*

JEL Classification: H23, O13

Acknowledgement. *This research was funded by the Latvian Science Council's fundamental and applied research programme project "Development of Model for Implementation of Sustainable and Environmentally Friendly Last-Mile Distribution Transportation Services in Latvia" (TRANS4ECO), project No. lzp-2022/1-0306, 01.01.2023.- 31.12.2025.*

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OPPORTUNITIES FOR THE WOODEN PUBLIC BUILDINGS' DEVELOPMENT IN LITHUANIA

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Abstract. As one of the most environmentally polluting economic areas, the construction sector is on the path of rapid transformation to a more climate-neutral sector. New materials and technologies are being sought that could be applied in construction processes in order to ensure energy efficiency, resource savings, lower costs, and the durability of buildings. The transition to sustainable construction is underway, and the aim is to use natural and environmentally friendly building materials for the construction of new public buildings.

The research aimed to analyse the opportunities of developing wooden public buildings in Lithuania. The SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis technique was applied for this purpose.

Analysis revealed that the development of wooden public buildings has many strengths and opportunities. Wooden buildings positively impact the climate and human health; the construction of such buildings is faster than construction using other materials; construction costs are reduced; and the carbon footprint is minimized. The use of wood as a naturally renewable raw material ensures the compliance with the principles of the circular economy.

The development of wooden production factories in Lithuania ensures the creation of new jobs and the absorption of EU investments. Support from EU funds enables workers to acquire relevant qualifications and thus compensate for the lack of skilled labour in the country.

Even in the presence of restrictions on the height of buildings, the wide possibilities of wooden architecture do not create obstacles for low-rise construction in Lithuania. In addition, wood can be used in combination with other materials, like steel and concrete; thus, hybrid buildings can be built.

It can be assumed that the construction of wooden public buildings will significantly expand in the future. The Lithuanian government is now drafting

regulations that would require all future public buildings to be at least 50% built of natural materials.

Keywords: *development, Lithuania, sustainable construction, SWOT analysis, wooden public buildings*

JEL Classification: I21, L74, O13, Q23, Q51

Acknowledgement. *The findings of the research are based on the Erasmus+ projects “Sustainable Public Buildings Designed and Constructed in Wood” (Pub-Wood), No. 2018-1-LT01-KA203-046963 and “Design and Construction of Environmental High Performance Hybrid Engineered Timber Buildings” (HybridTim), No. 2020-1-DK01-KA203-075045.*

MAIN RESULTS WITHIN CLI-MA PROJECT WITH REGARD TO IMPROVE ENERGY PERFORMANCE LEVEL OF RESIDENTIAL BUILDINGS

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Abstract. During the period from October 2020 to March 2023 with the financial support of the European Climate Initiative (EUKI) project “From Housing Manager to CLimate MAnager” (CLI-MA) has been implemented. Main goal of the project was the promotion of the residential buildings renovation process as a component of EU climate policy. Within the project, market research regarding the scope of existing and required skills of building managers on topics related to the mitigation of climate change caused by buildings was prepared. Market Research Analysis was presented during CLI-MA workshop “Future of housing management” during CLI-MA international workshop on 30th September 2021 during the 62nd International Scientific Conference of Riga Technical University “Scientific Problems of Engineering Economics of Construction and Real Estate Management, Regional and Territorial Development”. After these events, the preparation of the pilot training has started. The pilot training called “Climate change and technical, political, legal, economic, and social aspects of improving the building energy performance” covered 24 hours and was held online for 65 existing housing managers. The main result of the project was the inclusion of energy efficiency and climate aspects from the training scheme in the existing study programs Real Estate Management and Civil Construction and Real Estate Management. Besides the professional development, the course “Management of building renovation and energy efficiency projects” offered by RTU Institute of Civil Engineering and Real Estate Economics Competence Centre was improved.

Keywords: *climate policy, energy efficiency, housing manager, residential building*

JEL Classification: Q49, R39

Acknowledgement: *This work was supported by the European Climate Initiative (EUKI) project “From Housing Manager to CLimate MAnager” (CLI-MA). Agreement number: 81263938. Project processing number: 17.9045.0-002.77.*



DIGITAL TWIN AS A TOOL FOR GREEN HYDROGEN PRODUCTION OPTIMIZATION

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Abstract. Hydrogen, a colourless and odourless gas, is the most abundant element in the universe. It has a high energy content and can be produced from a variety of sources, including natural gas, coal, biomass, and variable renewables. It has been recognized as a promising alternative energy carrier that can contribute to a sustainable and low-carbon energy future. Its diverse range of applications across various sectors, including transportation, industry, and power generation, has garnered significant interest from governments, industry, and academia.

Most hydrogen today is still produced as a by-product of fossil-fuel refinement – using methane with carbon monoxide as a by-product. Meanwhile, the hydrogen produced by electrolysis represents less than 1 percent of all the world's hydrogen production. In order for hydrogen to be a viable source of clean energy, the cost of electrolysis needs to decrease significantly.

One way to achieve it could be usage of a digital twins – a computer-simulation programs that can track and adjust the operations of a physical device in great detail. The close monitoring of hydrogen electrolyzers that digital twins provide could help streamline the devices' operation and bring down the cost of electrolysis as a result.

Firstly, a digital twins could reduce the cost of electrolysis is by monitoring the technical performance of electrolyzers. It can track the operations of electrolyzer components like electrodes, membranes, or pumps to see which parts may be likely to fail and to proactively make recommendations for scheduling maintenance. such prediction maintenance capabilities could save operators many hours of production time when electrolyzers would otherwise be taken offline to enable unscheduled troubleshooting.

Secondly, digital twins can help operators by having direct control over electrolyzers. Rather useful application of direct control can be adjustment of electrolyzers' energy consumption based on the power grid's current energy mix. When larger amount of renewable electricity is fed into the system, digital twins

can direct electrolyzers to ramp up production, therefore making the production of hydrogen even greener.

Keywords: *data acquisition, digital twins, energy communities, sensor input, smart metering*

JEL Classification: Q49, Q42, Q56.

DIGITAL TWINS IN URBAN ENERGY COMMUNITIES: A DATA ACQUISITION AND PROCESSING MANAGEMENT PROBLEM

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Abstract. A digital twin is a virtual model of a real-world object or space. Within the built environment, a digital twin is a digital or a web-based representation of a physical building, system, or sequence, scaling all the way up to a city or utility grid. A digital twin can represent everything within a building and can offer real-time data about how those assets are performing.

In a context of energy communities (ECs) in city environment, the digital twin can be used to sustain community activity, accelerate public engagement in the energy transition, improve energy self-consumption, reduce carbon emissions (CO₂) and perform optimally coordinated decision-making.

The process of creating a digital twin can be divided into three stages. The first stage is data acquisition and processing, the second stage is data analysis and modelling, and the third stage is data visualization.

At the core of any digital twin is the existence of data. The amount of data depends on many factors, such as the purpose of the digital twin, the desired accuracy of the correlation between the digital twin and the real object, the number of sensors, the availability of historical data, etc.

Sensors, smart meters, external databases like historical weather data, electricity and gas market data, as well as various programs for data modelling can be used as data sources. As sensors become more accessible, opportunities to collect processes at the community level and pass this information on to a data platform are increasing. The sensors provide the community with both historical and real-time data. New data is added to historical data to continuously generate new information and adapt to changing realities. Often a key requirement for sensors is the ability to install and maintain them in properties that are already built and occupied. Historical data is needed to train machine learning algorithms to make future predictions and identify the parameters that most influence community performance. Also, historical data can be used to predict community disruptions

that are likely to occur in the future.

Before creating a digital twin, it is necessary to answer the following data acquisition and processing management related questions: who owns the data and who owns the digital twin itself: is it owned by the developer or by the EC; what is the role and main responsibilities of each involved party in the development and operation of the digital twin; who is responsible for data recovery, content quality, data storage and sharing; what are the possible risks of data acquisition, accumulation, analysis and use; who is responsible for the consequences caused by data errors, damage or incompleteness.

Keywords: *data acquisition, digital twins, energy communities, sensor input, smart metering*

JEL Classification: Q42, Q49, Q56

THE CONCEPT OF ENERGY COMMUNITIES IN THE EUROPEAN UNION

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Abstract. According to the objective approved by the Council of the European Union, a climate neutral European Union must be achieved by 2050. This means that in the period up to 2050, the European Union must significantly reduce greenhouse gas emissions and find ways to offset the remaining and unavoidable emissions. According to the policy makers of the European Union, the introduction of the concept of energy communities is a way to restructure the energy system, thus allowing citizens to actively participate in the energy transition and thus as energy users in residential buildings enjoy greater benefits.

When getting acquainted with the scientific literature on energy communities, there was a great uncertainty about the concept of energy communities and different understanding of it by different authors. Therefore, the study of the energy community concept is problematic due to several aspects. Firstly, different terms are used in the scientific literature to denote the same concept. For example, the term “energy community”, “energy cooperative”, “community energy project” can mean the same citizen initiative in the field of energy. Secondly, the term “energy community” can also be understood as conceptually completely different concepts in different studies.

Moreover it follows from the Directive (EU) 2019/944 of the European Parliament and of the Council on common rules for the internal electricity market and which amends Directive 2012/27/EU Recital 43, that in accordance with this directive, only pre-existing resident electricity initiatives as determined categories are recognized as “residential energy communities” at the Union level.

Therefore, it is essential to clarify the conceptual difference between energy communities, mutual trade and collective self-consumption, based on both the analysis of the European Union directives and the scientific publications that discuss the concept of energy communities in relation to the above mentioned directives.

Keywords: *energy communities, energy efficiency, EU Directive, renewable energy*

JEL Classification: L74

JEL Classification: K32, P28, P48, Q28, Q43, Q48

URBAN RENAISSANCE: NAVIGATING SUSTAINABLE URBANIZATION FOR REGIONAL PROSPERITY

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Abstract. This research investigates the intricate relationship between urbanization and regional development, providing insights into strategies for sustainable city planning and management. With the unprecedented global trend towards urbanization, understanding its impact on regional prosperity is of paramount importance. This study employs a mixed-methods approach, combining extensive literature review, data analysis, and bibliographic analysis to shed light on the dynamics of urban and regional growth. Our findings reveal that urbanization, when approached with sustainability in mind, can serve as a catalyst for regional rejuvenation. Through in-depth case studies from diverse global regions, we identify best practices and lessons learned in sustainable city planning and management. By leveraging smart urbanization strategies, such as efficient infrastructure development and eco-friendly policies, cities can become drivers of regional progress. The main conclusions drawn from this research underscore the need for integrated planning, collaboration among stakeholders, and a commitment to environmentally responsible practices. Additionally, we emphasize the importance of leveraging cultural heritage and tourism as tools for regional development in the context of urbanization.

Keywords: *sustainability, sustainable regional development, urbanization, urban planning*

JEL Classification: Q56

ASSESSMENT OF IMPLEMENTATION OF CIRCULAR ECONOMY FRAMEWORK IN THE SRI LANKAN CONSTRUCTION SECTOR

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Abstract. Concerns have been raised that the construction sector in both developed and developing countries has become a major environmental issue. This is mostly due to the excessive use of raw materials and energy sources. Moreover, the industry now follows the “take-make-dispose” linear economic paradigm. The circular economy idea was just brought to the sector based on the fundamental principles “reduce, reuse, recycle”, and yet the construction industry in Sri Lanka has failed to comply with this emerging framework. It is presently being debated throughout the world whether the 3R concept is adequate to achieve optimal industry sustainability. As a result, the 3R principles have lately expanded into a 10R framework. Consequently, the purpose of this article is to determine the possibilities and barriers to implement the 10R framework in the construction sector in Sri Lanka. The study was conducted using a qualitative research method. A semi-structured questionnaire was used to gather data and gain expert opinions on various options. This research takes a qualitative, in-depth look at how the 10R principles of circular economy might be applied to construction projects. Construction professionals may boost the ecological sustainability of building projects by using the recommended circular economy guidelines.

Keywords: *barriers, circular economy, construction, Sri Lanka, sustainability, 10R principles*

JEL Classification: L74, O13, Q01, Q53

IDENTIFYING POTENTIAL HOUSEHOLD WASTE AS SECONDARY RAW MATERIALS IN THE CONSTRUCTION INDUSTRY: A CASE STUDY OF SRI LANKA

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Abstract. The construction sector contributes significantly to waste generation and resource depletion. Identifying potential household waste for reuse and recycling as secondary raw materials has emerged as a key technique for addressing these environmental concerns. This study uses the Colombo municipality in Sri Lanka to identify and evaluate household waste products having the potential to be reused as secondary raw materials in the construction sector. The study employs a mixed method for data collection and analysis. First, a questionnaire survey of industry experts was conducted to identify and assess the requirements for household waste that may be utilised in the construction sector, followed by a complete literature analysis to determine the reuse applications of potential household waste. The findings of this study will be useful in identifying and evaluating household waste items that may be recycled as secondary raw materials in the construction sector. It would also help to establish sustainable waste management techniques and circular economy practices in Sri Lanka. The study's findings can help policymakers, waste management authorities, and stakeholders in the construction industry to implement effective waste management practices and promote the use of recycled materials in construction projects, reducing environmental impact and conserving natural resources.

Keywords: *construction industry, household waste, secondary raw materials, Sri Lanka*

JEL Classification: L74, O13, Q01, Q53

RETROSPECTION OF DEVELOPMENT OF CIRCULAR ECONOMY CONCEPT

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Abstract. The concept of circular economy has been the tool of choice to address global environmental issues in the 21st century. However, concept's origins can be traced back several decades in the 20th century. Therefore, authors used critical literature review to identify and address concepts that have formed the modern circular economy. Results show that there have been more than 50 concepts and ideas that have shaped the concept of circular economy. The value and usefulness of waste has been emphasized already in 1945 within Economy of Permanence concept. Since then, such concepts as Spaceship Earth Economy, Tragedy of the Commons, Limits to Growth, Ecological Design, Industrial Ecology, Reverse Logistics, Biomimicry, Natural Capitalism, Industrial Symbiosis, Cradle to Cradle, Performance Economy, Degrowth, Blue Economy, Sharing Economy and other have shaped and paved the desired development direction of global society and formed modern circular economy.

Keywords: *circular economy, environment, environmental issues, retrospection*

JEL Classification: R11, Q01, Q53

FROM INDUSTRIAL REVOLUTION TO THE NEED OF CIRCULAR ECONOMY IMPLEMENTATION

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Abstract. Since the start of the industrial revolution, a massive expansion of economic activity has taken place exacerbating such global environmental issues as climate change, deforestation, loss of biodiversity, air, water and land pollution and others. The main reasons behind that are current consumption and production patterns, which to a major extent are according to the linear economic model. It consists of the extraction of resources, production, consumption and disposal. Since Industrial Revolution economic growth has been achieved on increasing extraction of natural resources, production of standardized goods, overconsumption of these goods and disposal at the end of their initial lifetime. Many scholars and practitioners have warned society of limitations of linear growth, but the way of operation has not experienced significant change. The idea of circular economy has developed from the first half of 20th century, and this concept is considered to be a key for our future that by eliminating waste, reusing products and components and recirculating materials can lead society towards climate goals and conservation of natural resources. Within the concept of circular economy, the emphasis is on the use of renewable resources. The non-renewable resource reserves are depleted each time they are mined to extract materials for production. In circular economy these materials are recycled and returned back into the economy reducing the pressure on non-renewable resource reserves. In an ideal circular economy tools and machinery should use renewable energy, thus vanishing the need for fossil fuels. Results reveal that circular economy implementation is a gradual process and the greatest barriers are social and financial.

Keywords: *circular economy, energy, environment, industrial revolution*

JEL Classification: R11, Q01, Q53

UNDERLINING THE NEED OF CIRCULAR ECONOMY IN URBAN ENVIRONMENT

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Abstract. It is no secret that global environmental issues are in the agenda of governmental bodies and scientific community as well as society which is feeling the impacts of these environmental challenges. Majority of people around the globe are subjects of urban environment and the percentage of city inhabitants is expected to grow in the following decades. Therefore, it is crucial to address environmental issues in city level. A promising concept which is gaining more and more attention among scientists and governmental bodies is the circular economy as it holds the potential to tackle resource depletion and climate change. Current research is aimed at identifying circular economy strategies and approaches to implement circular economy in urban environment. Methodology includes the analysis of recent literature and statistical data. Results outline that even though cities are the main drivers of carbon emissions, they are also centres of innovation and economic growth. They are uniquely positioned to support approaches of circular economy by implementing R strategies – refuse, rethink, redesign, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, recover – and adapt these approaches from product to industry levels. It is concluded that to unlock the potential of circular economy in urban environment, governance bodies of cities need to create a shared circular economy vision with measurable targets and inclusive strategies; establish supportive financial and regulatory instruments; empower collaboration across sectors, stakeholders and governance levels; and enforce assessment mechanisms to help cities learn from experience and scale up circular economy practices.

Keywords: *circular economy, city, climate change, environment, urban environment*

JEL Classification: R11, Q01, Q53

CONCEPTUALIZATION OF SYNERGY IN URBAN ENVIRONMENT

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Abstract. The multifaceted changes in the world economics and the uneven and unbalanced growth of the world regions, as well as the rapid increase of technological progress have determined the importance of the sustainability of human habitable space, its impact on the city and significance of urban environment change in the circumstances of the development of regions at national, continental and global scale. Each city is unique in its historical and territorial aspects. The location is a theoretical intersection of the territorial settlement (place of residence), socio-communicative (place of interaction) and mental (place of existence) structures. The author of current research emphasizes necessity to synthesize those problems, as well as those solutions in creating measurements of the urban environment. Author used systematic literature review aiming to evaluate the influence of synergy on urban environment.

Urban synergy effect is the phenomenon that occurs when the interactions and connections among different elements of the urban environment create greater value and benefit than the sum of their individual contributions. The aim of urban synergy is to achieve a collaborative and holistic approach to urban development, where multiple perspectives are considered and combined to create better planning solutions and development.

Results show that by working together and exchanging ideas, urban synergy can lead to more efficient use of resources, improved social and economic outcomes, and a healthier and more sustainable urban environment for everyone. The urban synergy effect is considered essential for achieving sustainable urban development and improving the quality of life for residents of the city. It helps to create a more efficient and effective urban system, where the use of resources is optimized, and the negative impact on the environment is minimized.

Keywords: *city, synergy, synergy effect, urban environment*

JEL Classification: O18, O44, P25, Q01

THE PROCESS OF ABOLISHMENT OF MUNICIPALITY REAL ESTATE RIGHT OF FIRST REFUSAL IN LATVIA

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Abstract. From all types of right of first refusal those given to the local municipalities is the most controversial, as it significantly hinders real estate transactions and constitutes an excessively burdening formality in real estate transactions. Procedure of exercising right of first refusal on real estate differs in countries across the globe. In Latvia the following conclusions can be drawn regarding the right of first refusal of local municipalities: 1) local municipalities exercise right of first refusal in very rare cases; 2) the local municipalities lack funds to use the right of first refusal; 3) employees of the local municipalities believe that right of first refusal are introduced to implement municipal functions, they are laid down in the law and hence they are legally grounded and necessary; 4) employees of several local municipalities think that right of first refusal of local municipalities does not impede transactions. During the research data were obtained from local municipalities regarding the number of cases when the right of first refusal were exercised between 2015 and 2020. At the end of the research, the main conclusion was - there is a proven basis to abolish municipality real estate right of first refusal in Latvia. Legislation in Latvia was amended and the right of first refusal of municipality is canceled from January 1, 2023.

Keywords: *land management, real estate transactions*

JEL Classification: K11, R3

EFFICIENCY AND EFFECTIVENESS IN BUSINESS AND BEYOND: CRITICAL AND ANALYTICAL APPROACH

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Abstract. Nowadays, the concepts of efficiency and effectiveness are gaining importance in business and beyond. This is due to the decline in the regenerative capacity of natural resources, climate change caused by environmental pollution, and the need to maintain the competitiveness of social systems as economic globalisation intensifies. The research results reveal that the pluralism of interpretation and extrapolation of these concepts is beginning to border on scientifically incorrect attitudes towards their interpretation and application in research and practice. Moreover, in many scientific sources, efficiency and effectiveness are interpreted differently and/or in a way that is inconsistent with the nature of effectiveness. This creates a fertile ground for pseudo-scientific knowledge in the academic information space and reduces the scope for applying these concepts in practice in the context of maintaining the competitiveness of an enterprise or other organisation in a constantly changing business environment. This situation is largely due to the lack of a general form and general mathematical models of the concepts. Therefore, this study critically analyses the content of the concepts “efficiency” and “effectiveness” and identifies the elements that make up their content in order to use them for the development of general mathematical models. The research results are of great importance for the evaluation of business performance and for management decision-making in order to improve the competitiveness of enterprises. In addition, general mathematical models of the concepts “efficiency” and “effectiveness” can be applied to the analysis of the performance of other organisations, creating a favourable ground for the achievement of goals under conditions of limited resources, as well as for limiting the intensity of the decline in the regenerative capacity of natural resources.

Keywords: *critical and analytical approach, effect, effectiveness, efficiency, general mathematical model, natural resources*

JEL Classification: C20, D61, I26, M21, Q20

VALUES OF HIGHER EDUCATION INSTITUTIONS: THEIR CRITICAL AND ANALYTICAL EVALUATION

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Abstract. Along with the growing intensity of globalisation, today there is an increased focus on values in politics and society in the Western world. The public interest in values has also been noticed by researchers in the social sciences, and the number of publications on various aspects of value formation and transformation has increased significantly over the past decade. Higher education institutions have also noticed this trend and have, therefore, defined values that can be useful for achieving their goals and attracting students and academic staff members. The research results demonstrate that often values are defined following fashion trends, ignoring the concept “value” and the defined value type in the content. Therefore, students and academic staff members are offered a broad spectrum of values that are not interrelated, some of which are utopian and do not correspond to the real world, its prevailing threats and opportunities. Moreover, the definition of values for higher education institutions in one country lacks the common dimension that would be necessary for the higher education institutions of a particular country that are the most important elements of a national education system. Thus, the values of higher education institutions are more focused on competition among themselves than on cooperation for common measures to improve the competitiveness of the national higher education system, creating additional barriers to gaining new competitive advantage in order to catch up with the best higher education institutions in Europe and worldwide.

Keywords: *competition, critical and analytical approach, higher education institution, value*

JEL Classification: I20, I23, M37, M53

THE CONTEMPORARY DYNAMICS OF QUANTITATIVE EFFECTS OF BUSINESS PARTNERSHIPS OF CONSTRUCTION ENTERPRISES

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Abstract. In the context of recent European history, the quantitative effects of business partnerships of construction enterprises have changed dramatically. To a large extent, these changes concern the partners of construction enterprises – the suppliers of resources. For political and moral reasons, many manufacturers of construction products in Latvia and in several other EU countries have had to withdraw from a partnership with a number of construction enterprises. In order to continue construction work, construction enterprises and companies in many other sectors have been forced to restructure their partnership in order to create the necessary flow of resources from other countries in Europe and on other continents. This led to a sharp increase in the prices of economic resources used in construction, resulting in an increase in the prices of the construction products being in manufacturing. To accomplish the objectives and to reach the aim of the study, purposefully selected, mutually compatible and complementary research methods have been applied, thus forming a unified research methodology. The research results show that the restructuring of partnerships of construction enterprises has resulted in different quantitative effects with dynamic fluctuations by economic resource groups and types of construction products. For some construction resource groups, price increases exceed those of energy resources with regard to their share in the production of a respective resource type. Many construction enterprises use the restructuring of business partnerships to ensure that the prices of the products they produce exceed the rate of increase in the prices of economic resources. Thus, entrepreneurs in the construction sector and in several other sectors of the economy are taking advantage of the situation for greedy purposes in order to increase profits. As a solution, extraordinary fiscal policy measures should be taken to mitigate price increases, which may be more effective than increasing the refinancing rate.

Keywords: *partnership effect, partnership of construction enterprises, profit, resource price increase*

JEL Classification: I74, N64, O11, O12, O23, P17

TECHNOLOGICAL ADVANCEMENTS IN REAL ESTATE MANAGEMENT ASSISTANCE OF VIRTUAL 3D TOUR

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Abstract. Over the past decades, more efficient real estate management opportunities have significantly expanded and improved. Complex methods, innovative techniques, and a constantly evolving spectrum of information technology have become readily available for common use. When managing real estate for short-term or medium-term rentals, planning, servicing, and ensuring accommodation quality are inseparable aspects, as is providing suitable housing. This process begins at the very first step when potential tenants request a viewing of the preferred property. The situation of the past few years demonstrated that the real estate business was one of the most affected economic sectors by the COVID-19 pandemic. Potential buyers or tenants could no longer physically visit and experience the space as before. Faced with this new reality, there was a need to find a tool to enhance the real estate management strategy by presenting the property. One such tool became the 360-degree photography and virtual tour. The aim of this study is to assess the practical applicability of 3D video tours and evaluate the advantages and drawbacks in short-and-medium-term rental business.

Keywords: *innovative techniques, real estate management, short-and-medium-term rental business, 3D video tours*

JEL Classification: L85, R30

LOW-RENT HOUSING CONSTRUCTION OPPORTUNITIES

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Abstract. One of the problems in Latvia is the availability of quality housing at an affordable price. There is still a lack of private investments in the construction of rental apartment buildings in Latvia, despite a stable demand for affordable rental housing. The lack of investment is due to both household purchasing power and the economic viability, or profitability, of rental housing construction projects compared to alternative real estate projects. One of the challenges in Latvia is ensuring the availability of housing that meets modern construction standards and energy efficiency requirements at an affordable price. This is one of the basic needs of the population, and therefore, the availability of housing that meets the demands of modern life is one of the current priorities of the country.

To promote the construction of rental housing, in 2022, the Cabinet of Ministers adopted regulations to support the construction of residential rental houses within the framework of the European Union's Recovery and Resilience Mechanism Plan "Establishment of a Financing Fund for Low-Rent Housing Construction". The research aims to explore low-rent construction capabilities and their implementation strategy.

By developing rental housing through the support mechanism of the European Union, it is planned to provide housing for households that are too wealthy to receive social housing or housing allowances but whose incomes are not sufficient to obtain a mortgage loan. Some countries have addressed the issue of housing affordability by establishing housing development funds. Taking this experience into account, the Organization for Economic Cooperation and Development has developed recommendations for the long-term operation of a Housing Affordability Fund in Latvia.

The study uses qualitative methods which cover sector-specific documents and their research. The statistical analysis will explore the current state of the rental housing market, prices and identify market challenges and opportunities.

Keywords: *housing affordability, housing investment, low-rent housing, rent building*

JEL Classification: D14, D23, D24, E22, E61, G21, G23, R21, R31

SITUATION IN ENERGY CERTIFICATION OF RESIDENTIAL BUILDINGS IN LATVIA

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Abstract. Energy certification of buildings in Latvia was started in 2010, but until 2016 energy performance certificates (EPC) were issued in paper form, and there are no data about number of certificates in this period. Since 2016, EPC of buildings should be registered in the Construction Information System (BIS). 1702 valid EPC of residential buildings were registered in BIS in 2023. 94% or 1599 of residential buildings' EPC were issued to multi-apartment buildings and 6% (103) to one- and two-apartment buildings. The dynamics of issuing EPC for multi-apartment buildings is very uneven. It can be explained with the implementation of EU funds programme, as an EPC is a compulsory requirement to receive co-financing. The purpose of energy certification in most cases (97.1%) was voluntary (included certification for EU funds programme), in 2.7% of cases compulsory (state or local government buildings), and 0.2 % of cases an EPC was used to sell the building. 55% EPC corresponds for the E class buildings (heating consumption (HC) >125 kWh/m² a year), 32% for the F class buildings ($100 \leq HC \leq 125$ kWh/m²), 7% for the D class buildings ($80 \leq HC \leq 100$ kWh/m²), 4% for the C class buildings ($60 \leq HC \leq 80$ kWh/m²), and only about 2% of buildings correspond the A and B classes ($HC \leq 60$ or $HC \leq 40$ kWh/m²). 87% of residential buildings correspond to the two lowest EPC. The average heating consumption level in multi-apartment buildings is 137 kWh/m² a year. According to the Ministry of Economics, one-apartment houses are much less efficient than multi-dwelling buildings.

Keywords: *energy certification, energy efficiency, residential buildings*

JEL Classification: Q49, R39

THE EFFECT OF EXTERNAL AND INTERNAL FACTORS ON MANAGEMENT EFFECTIVENESS WITHIN INDIAN CONSTRUCTION COMPANIES

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Abstract. The purpose of this study is to define and clarify the idea of improving management effectiveness within Indian construction companies. We conducted an online survey with an Indian construction company and used correlation analysis to thoroughly examine how both external and internal factors affect management effectiveness. The survey includes demographic questions, ratings on a scale of 1 to 5 for management aspects, ratings on a similar scale for internal and external factors, and ratings on a similar scale for potential improvement suggestions. With the help of descriptive statistics and frequencies, the mean efficiency values were calculated using SPSS and Excel to analyse the collected data. To establish links between the variables and the effectiveness of the company, correlation analysis was also carried out. The primary conclusions of the study highlight the critical importance of focusing on employee relations, meticulous tracking of work output, integration of technology, and adherence to established protocols as key factors in improving management effectiveness. The research also reveals significant problems with the management system, such as a preference for sanctions over incentives. It establishes that internal and external factors have equal weight in influencing management effectiveness, emphasising the need for an all-encompassing strategy that is flexible enough to support long-term advancement in construction company management practices.

Keywords: *Company management, construction company, construction company management efficiency, management efficiency*

JEL Classification: G32, J5, O33, O31, R00

CIRCULAR ECONOMY STRATEGIES IN BUILDING DESIGN: PRIORITIZING SUSTAINABILITY THROUGH BEST-WORST DECISION-MAKING METHOD (BWM)

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Abstract. In recent years, the construction industry has actively embraced circular economy principles in building design and construction, guided by standards like ISO 20887 and EN 15804+A1. This paper explores the integration of Life Cycle Assessment (LCA) and circular economy considerations in the design stage. Building Information Modelling (BIM) is employed to create and assess three building models: wood, concrete, and steel frames. LCA assessments are conducted following EN 15804+A1 and Building Circularity methods. The Best Worst Decision-Making (BWM) method streamlines decision-making by analysing extensive LCA data to identify critical design factors. The findings underscore the significance of material selection, particularly in the often-neglected A1-A3 (product and transport stage) life cycle stages. Material choices significantly impact embodied carbon and Global Warming Potential (GWP) throughout a building's life cycle. Reusability and recyclability of materials are crucial considerations in alignment with circular economy goals. BIM facilitates the analysis of material reusability and recyclability during design, offering practical insights. In complex LCA scenarios, BWM proves effective in guiding sustainable construction decisions, outperforming the TOPSIS method. Despite its potential, our literature review reveals that BWM remains underutilized in sustainable building decision-making. This study advances circular economy principles in building design, providing a robust foundation for informed and sustainable decisions. By combining BIM, LCA, and BWM, it underscores the construction industry's commitment to reducing environmental impact and fostering long-term sustainability and Green Building Design.

Keywords: *Best Worst Decision-Making (BWM), Building Information Modeling (BIM), circular economy, circular economy integration, green building design, Life Cycle Assessment (LCA), reusability*

JEL Classification: Q01, Q53, C44, R52

ECONOMIC CRISIS ADAPTATION IN SRI LANKAN CONSTRUCTION: PATHWAY TO PROSPERITY

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Abstract. The construction industry is a critical sector in the nation's economic growth, accounting for a sizable share of GDP growth. However, it is the most vulnerable industry to a financial depression, whether local or worldwide. The present economic crisis has had an impact on the Sri Lankan construction industry, with more than half a million employees lost their jobs in the previous year. Many major construction firms have either paused or abandoned their projects and shifted to overseas construction. Therefore, understanding the consequences of financial crises regarding construction initiatives in Sri Lanka, as well as anticipated post-crisis growth paths in this sector, necessitates a thorough examination. The goal of this study is to extensively study the consequences of the 2022 economic crisis on Sri Lankan construction projects and investigate remedies that might start a post-crisis rebound. The study utilized a mixed-method approach, combining quantitative and qualitative research methods. Purposive sampling was used to choose construction industry participants from various backgrounds in order to get a varied range of perspectives. The findings of this study not only emphasize the negative consequences of the crisis but also reveal prospects for development within the industry. The article offers construction professionals and other industry stakeholders useful insights about the foreseeable future of the country's construction sector. The research looks at prospective growth areas such as the development of infrastructure, sustainable construction strategies, and the usage of emerging technology. The findings of the research can help to ensure that the sector has a robust and productive future.

Keywords: *Construction industry, economic crisis, post-crisis growth, resilience strategies, Sri Lanka*

JEL Classification: G01, J21, L74, O18

COMPATIBILITY OF LVS EN 16310:2020 WITH CONSTRUCTION DESIGN METHODS

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Abstract. Public procurement is more regulated and controlled by laws, processes and procedures than private procurement. The specificity of Latvia is related to the fact that in the construction process the contracting authority (employer - public entity) often tries to control the whole process, regardless of the chosen method of implementation of the construction project and the obligations of the construction process participant. As a result, the employer assumes the roles of several participants in the process, and this often leads to conflicts. To some extent, this can be expressed in one word: *imprévision* (lack of foresight).

By breaking down the construction process into distinct phases and understanding the importance of each phase, selecting the necessary standards, contracts and engaging the right participants in the right and timely way, the construction process can be managed more efficiently, and other positive outcomes measured in terms of quality, time and money can be achieved.

The structure defined in EN 16310:2013 – “Descriptive terminology for engineering services for buildings, infrastructure and industrial installations” is convenient for the compatibility of the planned process with the chosen construction design method and can ensure effective process management control, clear separation of rights and responsibilities of the process participants and achievement of the desired results.

Keywords: *construction design, construction process, engineering consultant, FIDIC, LVS EN 16310:2020, public procurement*

JEL Classification: L74

TECHNICAL CONDITION OF SOVIET-ERA APARTMENT BUILDINGS, RELATED PROBLEMS AND POSSIBLE SOLUTIONS IN LATVIA

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Abstract. More than half of Latvia's population lives in Soviet-built, serial apartment blocks that have reached or are rapidly reaching the end of their useful life. The State Audit Office has acknowledged in its report that an effective approach to housing security in the country is non-existent and that the funds needed to renovate the buildings exceed the owners' ability to pay.

The main problems - the actual technical condition of these buildings is unknown (technical studies are needed), there are no freely available management fee savings for residents to pay for fundamental studies and repairs or renovations, there is insufficient or difficult access to public support for improving energy efficiency and the overall technical condition of buildings. Apartment buildings are also one of the largest contributors to greenhouse gas emissions (36%), a problem which is relevant in the context of the national climate targets for 2023.

In order to establish the actual technical condition of the buildings and to develop the most affordable improvement solutions, it is necessary to carry out a technical study for each of the apartment buildings, identifying the problems specific to each series and individual to each building, taking into account the different conditions to which the buildings are exposed in their daily operation. Such an approach would allow the development of standard solutions to the problems specific to each series, saving resources and ensuring a higher quality of renovation works.

The question remains how to address the financial support needed for comprehensive technical studies and the development of standard solutions. Is the technical condition of apartment buildings only a problem for residents (apartment owners), property managers, municipalities or at national level?

Keywords: *apartment buildings, climate, construction process, property manager, standard solutions, technical condition of buildings, technical studies*

JEL Classification: L74

DEVELOPMENT OF THE MUNICIPAL REAL ESTATE STRATEGY IN LATVIA

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Abstract. The real estate industry plays an important role in the economic development of the country. It makes a major contribution to GDP both in the country and in the European Union, providing prosperity and jobs. According to Central Statistics, the share of real estate operations in GDP of Latvia reached 9.9 % in 2022. In order to expand this sector, it is essential to develop a real estate strategy at the municipal level. Real estate plays a significant role in the social and economic development of municipalities. Real estate tax is an important source of revenue for municipalities that finances public services and infrastructure projects as well as provides housing for residents. It is not always necessary to create a separate municipality's real estate strategy, these may be plans for the development and maintenance of real estate, which are included in the general development strategy of the municipality. Local governments may use special zoning and motivating rules to promote the development of real estate that meets the economic goals of a particular settlement. The development strategy of real estate should be based on a sustainable living environment, ensuring a high quality of life and affordable real estate for the residents of the municipality. The most important direction of the strategy is the use of technologies and innovations that increase the productivity of the municipality's work.

Keywords: *development strategy, municipality, real estate*

JEL Classification: Q49, R39

FACTORS INFLUENCING THE ADOPTION OF SMART BUILDING AND SERVICE PREFERENCES IN SRI LANKA

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Abstract. The fast growth of smart technology has transformed the worldwide real estate industry, resulting in a major increase in the use of smart buildings as well as associated services. This study explores the primary factors impacting the adoption of smart building technologies and service preferences in the context of Sri Lanka, a country with an increasing curiosity about integrating smart solutions into its built environment. Many difficulties that the community face can be solved by smart building technology. For example, environmental contamination and resource depletion, such as water and fossil fuels. In Sri Lanka, smart building adoption is at a primitive stage. As a result, the purpose of this study is to assess user comprehension of smart building service preferences and adoption from a Sri Lankan perspective. The methodology combines a questionnaire survey to collect data from the community and a literature review to identify service preferences and factors influencing smart building adoption. A content analysis of the selected literature was performed to determine key factors and preferences. Twenty-three service preferences and four factors that influence smart building adoption were identified from the previous studies. According to the results, most of Sri Lankans are unfamiliar with smart building technologies and concepts. The most essential elements impacting smart building adoption are competency to utilize new technology, preference for smart building features, and user satisfaction. When developing the smart building concept in Sri Lanka, it is advised that people's understanding of smart building technology is to be increased and that the most important service preferences be considered.

Keywords: *building management system, service preferences, smart buildings, Sri Lanka*

JEL Classification: L85, O33, O53, R22

COMPARATIVE ANALYSIS OF THE CONSTRUCTION SECTOR OF LATVIA AND AZERBAIJAN

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Abstract. Each country has a number of indicators and areas that determine the economic situation and well-being of the population. One of these industries is the construction sector. The revival in the construction sector indicates of economic development in the country. The construction sector around the world has a special share in economic development and, in particular, strengthening the sustainability of the economy. This sector is a type of activity from multilateral sub-sectors. The development of the construction sector leads to the revival of a number of industries: the furniture industry, the construction materials market, the banking sector, the labour market. In this view researching of this field and theme is actual.

The main industries in the Latvian construction market are infrastructure construction, commercial construction, industrial construction, institutional construction and housing construction. In terms of 2022, the largest share is occupied by the construction of infrastructure.

The revival of the construction sector in Azerbaijan is due to oil revenues. Increasing investment in the development of the construction sector is one of the priority tasks of the government and certain measures are being taken in this direction.

Research focus: The aim of the study is to identify factors influencing the development of the construction sector in the two countries. To this end, as in the period of research, were taken 2000-2022 years and observations were made on the changes that were taking place in this sector.

Research methods used: During the investigation, statistical indicators of Latvia and Azerbaijan in the field of construction were provided. The results were obtained using methods of observation, analysis, synthesis, generalization.

The results and the main conclusions and recommendations: The analysis identified factors affecting the construction sector of both countries by study

period and presented the results and recommendations.

Keywords: *construction sector, economic growth, GDP, investments, non-oil sector*

JEL Classification: L85, O1, Q48

ENVIRONMENTALLY FRIENDLY CONSTRUCTION DEVELOPMENT STRATEGY IN LATVIA

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Abstract. The topicality of topic is determined by global problem of greenhouse gases – carbon dioxide in the world. Latvia as a Member State of the European Union is bound by the Kyoto Protocol.

The aim of research is to study the strategy of environmental friendliness in Latvia and to develop proposals for its improvement. To achieve the goal, several tasks are set: to assess the existing state of affairs, regulatory enactments, regulations, guidelines, EU common guidelines, the Green Deal; to study the historical aspects in the formation of the strategy; to study the possibilities of using renewable building materials; to study construction trends, statistical data; to analyse the possibilities of using wood in construction in Latvia; to study the importance of insulation programs in construction; to offer possible improvements and calculate their potential benefit.

To achieve the goal, environmentally friendly programs for the promotion of construction, industry research, scientific literature were studied. Civil engineers, managers of construction companies and an architect were interviewed. The survey created by the authors interviewed residents about the issues of environmentally friendly construction.

In accordance with the aim of the research, conclusions have been drawn and proposals have been made for the improvement of an environmentally friendly strategy in Latvia.

Keywords: *CLT technology, CO2 emissions, energy efficiency, Green Deal, passive house, productivity, sustainable construction, sustainable development*

JEL Classification: R30

THE CONSTRUCTION COST INDICES: THE CASE STUDY IN LATVIA

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Abstract. In recent years, there have been signs of an increase in the cost of various construction projects, which indicates that the changes in the construction cost index are also increasing.

In today's situation, when joint international construction projects, such as Rail Baltic, are implemented in the European Union, the question arises about the fluctuations of construction costs not only in Latvia but also in other European Union countries.

In order to compare the indices of construction costs in different countries of the European Union, it should be concluded that these indices are created considering different criteria depending on different categories of construction works, such as residential buildings, engineering structures and other groups. Most of the member states of the European Union publish construction price indices, which often differ both in terms of their type and purpose, as well as in terms of the volume of construction activity and the items included in the creation of the index.

As a result of the study, the authors conclude that the European Union member states, when developing a construction price index calculation system, are recommended to use the international or national classification, indicating that the national classification systems must be compatible with the international classifications.

Keywords: *classification systems, construction, construction cost, construction cost indices*

JEL Classification: L74

DISTINCTIVE CHARACTERISTICS OF CONSTRUCTION MATERIALS AND THEIR EVALUATION APPROACHES IN LATVIA AND UKRAINE

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Abstract. After Russia's aggressive invasion of Ukraine and devastating military action, Ukraine needs significant construction work to rebuild its war-ravaged infrastructure. Several Latvian construction companies have expressed their desire to participate in these construction projects on the territory of Ukraine, which has suffered from military damage.

In order to implement full-fledged construction projects, Latvian businessmen need to make adjustments and make a comparison between the construction regulations of the two countries. In Latvia, construction issues are regulated by the Construction Law and related regulatory acts. On the other hand, in Ukraine, construction issues are regulated by several laws, which are included in the national and local legislation systems, as well as various construction regulatory acts, which are not legally binding but are widely used in practice.

Compared to the production of the industrial sector, the production of the construction sector has several important differences. In the construction industry, technical characteristics are important, for example, geographical locations and natural conditions must be considered, as well as the client's specific requirements regarding the object to be built. In construction, production is very specific, and the process is characterized by the sequence of construction works and the connection between different stages of construction, as well as the need for material supply and labour organization.

Construction projects have complex legal procedures, and the maintenance and sustainable use of construction sites is an important aspect that distinguishes the construction industry.

Construction is often project-based, where short- and long-term planning and budgeting are critical. Financing sources and return on investment in construction projects are particularly sensitive issues. Construction projects require cooperation between various stakeholders, including entrepreneurs,

workers, customers and the public. Occupational safety and working conditions are particularly important in this industry.

Construction affects the environment, so it is important to consider aspects of environmental protection and sustainability, as well as comply with relevant regulatory standards and requirements.

The authors of the research conclude that each group of characteristics of construction products includes its own internal evaluation sub-criteria. These sub-criteria help to evaluate and analyse the characteristics of specific construction products. As a result of the research, groups of criteria will be developed, which will be applicable both in Latvia and Ukraine in the future, because each of the sub-criteria or evaluations of groups of features helps to more accurately understand and evaluate the aspects of a given construction project or production. This is very important to ensure a successful construction process and product quality.

Keywords: *construction, construction product, construction product peculiarities*

JEL Classification: L74

MARINE CADASTRE AND SPATIAL PLANNING ASPECTS IN THE BALTIC SEA REGION: COMPARISON OF LATVIA AND POLAND

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Abstract. The state of the Baltic Sea coast is a vitally important infrastructure element in the entire Baltic Sea region. In this region, marine cadastre issues and challenges are relevant in several European countries, and many international projects are being implemented to address these issues.

Quick and timely access to accurate and valid information is a very important condition for preventing potential threats to the Baltic Sea environment, developing policies and legislation to protect vulnerable coastal areas, understanding trends and predicting future changes. Likewise, better quality and more easily accessible marine data is a prerequisite for further sustainable economic development.

The baseline is the main reference and an important component of the Marine Cadastre. Land territories located near the sea coast are registered and maintained in the Cadastre Information System. Beginning in 2017, the registration of the coastal zone two kilometres wide from the Baltic Sea baseline was started in Latvia.

In this context, the analysis includes an understanding of the importance of the Baltic Sea region and its coastal areas, as well as the importance of the marine cadastre and the challenges affecting various European countries. It also includes tracking how Latvia began to register its coastal zone to improve the Marine Cadastre system and infrastructure. Such analysis is essential to understanding the global impact of these issues and the importance of local solutions.

In the research analyses the international and national regulatory enactments of each country regarding the use of maritime space both in Latvia and Poland. Laws and regulations related to the use of marine resources, environmental protection and economic development in both countries are examined. In addition, the economic resources and potential associated with the Baltic Sea territories and their economic growth are also evaluated.

The authors of the research conclude that the conducted analysis helps to understand what is the regulatory environment regarding the use of marine

resources and what opportunities and challenges are related to these resources in each of these countries. It can be useful for creating policies and strategies for the sustainable use of Baltic Sea resources and economic development.

The research analysed the information available on the EMODnet (*“European Marine Observation and Data Network”*) portal, accepting information as a potential basis for the creation of marine cadastre content, which in turn allowed the conclusion of the necessary data regarding the Latvian and Polish marine territories.

Keywords: *marine cadastre, marine data, EMODnet, marine spatial planning*

JEL Classification: O21; E22; R3

ANALYSIS OF MULTI-APARTMENT RESIDENTIAL HOUSING MANAGEMENT PROCESSES

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Abstract. In order to ensure a high-quality residential housing management and maintenance process, it is important to first accurately define the concept of real estate and understand how the technical condition of the building affects the real estate management process. It is necessary to compare this understanding and conclusions from the assessment of the technical condition carried out in Riga and Pieriga regarding multi-apartment residential buildings with the situation in Bochum, Germany.

The authors of the research have presented statistical data regarding the number of buildings in Latvia and Germany during the last five years.

In Latvia, the Construction Information System has been implemented, which includes not only the register of building tradesmen, but also the register of residential house managers, the question arises as to whether the manager must necessarily register in this system and how exactly the professional competences of the manager differ from the professional competences of the “house manager” competencies. Several similar systems and platforms for construction information management operate in Germany. Germany is a large country with many regions, and different federal states and cities may have their own systems and data management methods for the construction industry. These systems are used to facilitate construction project monitoring, permitting, and general construction data management.

The aim of the research is to study and compare the management processes of multi-apartment residential buildings, the processes of managing multi-apartment residential buildings in Pieriga, Latvia and Bochum, Germany, respecting the professional competences required for the activity of a real estate manager.

Keywords: *Analysis of residential housing management processes, residential housing, technical condition*

JEL Classification: L74; L85

PUBLIC REAL ESTATE MANAGEMENT IN THE UNITED KINGDOM

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Abstract. In the UK, public real estate management involves the management and supervision of assets owned by government bodies, public bodies and institutions. It includes various types of real estate such as government buildings, public land, cultural monuments, educational institutions, health care facilities and other real assets used for public purposes. Managing public real estate in the UK requires a multi-pronged approach that balances financial responsibility with the provision of essential public services and stewardship of valuable assets. It is a dynamic field that adapts to changing regulations, sustainability goals and technological innovations.

State real estate managers must be responsible for budgeting, financial planning, and resource allocation for real estate maintenance, repair, and improvement. This includes capital expenditure and operating budgets.

Compliance with building codes, safety standards and environmental regulations is essential. Properties must meet legal requirements and standards related to accessibility, energy efficiency and sustainability. Many public real estate facilities are used to provide essential public services, including health care, education, and administration. Ensuring these facilities are fit for purpose and managed effectively is a key responsibility.

Sustainable property management practices are becoming increasingly important in the UK. This includes energy efficient building design, green construction and sustainable land use practices to reduce the environmental impact of real estate assets. Modern real estate management often requires the use of technology, including the use of real estate management software and data analytics tools.

Over time, some public real estate may become surplus, obsolete or no longer fit for purpose. In this case, appropriate procedures are followed for the liquidation, sale or re-profiling of assets, which often include legal and ethical considerations. Transparency and accountability are the main principles of public real estate management. Transparency ensures that relevant real estate decisions and expenditures are available to the public, and accountability ensures that public

funds are used efficiently and responsibly.

The purpose of the research is to investigate and analyse the processes of managing and maintaining public real estate in Great Britain, including the management of government buildings, state land, cultural heritage objects, educational institutions, health care institutions and other public real estate. The research tasks are to understand how these processes are implemented, how efficiency is achieved and how sustainability goals are achieved.

Keywords: *public real estate property, public real estate management, technical condition*

JEL Classification: L74; L85