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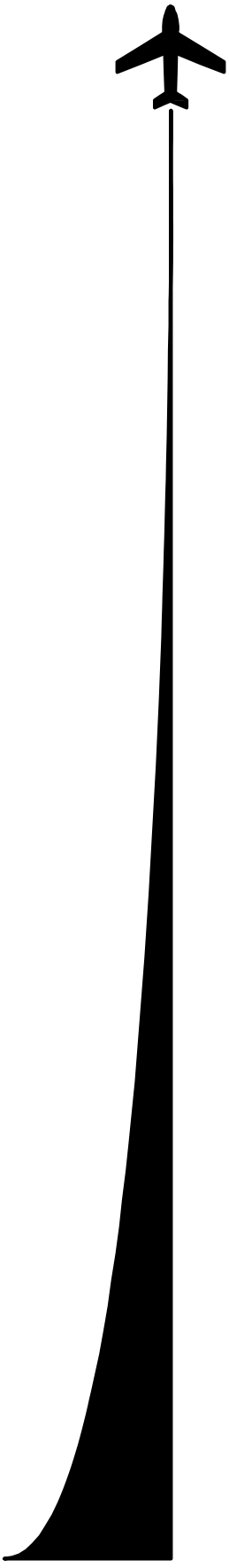

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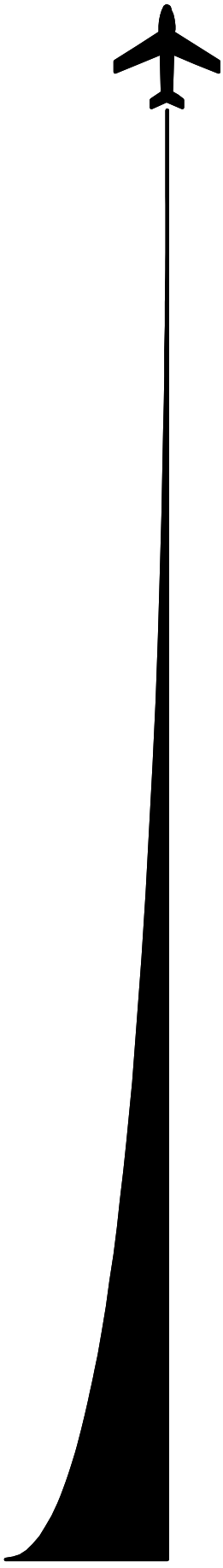

Session 1

Computer Problems of the Information Society and the Modern Electronics

Informācijas sabiedrības datorizācijas problēmas un mūsdienu elektronikas pasaule

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Transport and Telecommunication Institute, Valērijas Seiles 1, Riga, LV-1019, Latvia

ENHANCING SUPPLY CHAIN WITH BLOCKCHAIN

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Keywords: Blockchain technology, supply chain management, sustainability, comparative analysis

The supply chain management is a vital component in assisting the movement of goods and services from suppliers to customers to become the skeleton of the corporate operations. However, the traditional supply chain has also been met with different barriers that include inefficiencies, opacity, and vulnerability to criminal activities (Min, 2019). These problems unleash the potential difficulties and reduce the credibility among the stakeholders. As a consequence, to this, blockchain technology, with its in-built features, presents a promising solution approach that specifically addresses these impediments.

One of the blockchain's major strength is the decentralized, immutable databases system which can improve the supply chain management by enhancing the visibility, traceability and safety as a whole. According to Ada *et al*. (2021), blockchain technologies is able to increase the transparency and efficiency of the supply chain by enhancing visibility and speed. Likewise, the word of Clauson *et al.* (2018) on this can be given as the role of blockchain in the health supply chain management that brings reliability and transparency. Aside from that, Dutta *et al.* (2020) says about the worldwide application of blockchain in the area of supply chains as well with the challenges and the areas for research.

The purpose of this research is to examine how blockchain technology can be useful in the supply chain system and also explore any extra benefits and problems that are likely to come up as a consequence of this integration.

In the research a mixed-method approach was applied that includes quantitative and qualitative techniques like comprehensive literature review and case study analysis. The literature review involved a variety of sources including academic journals, conference proceedings, and industry documents that build on two themes: the blockchain technology and supply chain management in the food industry. Along with theory, the learning process has also included looking closely at real-world examples such as design issues and case studies to provide an understanding of how they are made and the difficulties than may arise during that process.

A profound comprehension of whether blockchain technology has the capacity to enhance the efficiency of the supply chain was the result of the research. The study intended to determine the crucial factors of success and also present the challenges of blockchain adoption in businesses and public policies, so as to make business and policy-makers informed about the opportunities and factors that they should consider in blockchain adoption (Shakhbulatov *et al.*, 2020). Besides this, the findings also aided in providing directions for the academic field in the study of blockchain technology's intersection with supply chain management, which will guide the academic discourse in the future.

The result of this research aims for decentralized, effective data keeping and ethical and sustainable source in supply chain. With ever-growing sophistication and interconnectedness of supply chain operations, more innovative solutions were sought to enhance both efficiency and traceability. Blockchain as a technology capable of dealing with those issues was identified as a tool with a built-in feature of security and decentralization for transactions management and the development of shared knowledge. Using blockchain technology, businesses can have the ability of enhancing streamlining their supply chain processes, reduce costs and also enhance trust

between all stakeholders (Wang *et al.*, 2020). This research contributed positively to the understanding of strengths and challenges of blockchain in supply chains thereby enhancing stable and successful supply chains in the digital era.

The research is supervised by Dr.sc.ing. Professor Mihails Savrasovs.

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REMOTE SCAN & RECOGNITION OF HUMAN'S SIGNATURE

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Keywords: Hand, recognition, finger, tracking, image, processing, computer, vision

The use of signature is one of the many ways to identify a person, and one the few using physical means. However, since the COVID-19 pandemic, physical contact for signature recording has been discouraged. As such, there was a will to change traditional method of signing to render them contactless. Studies (Mascarelli *et al*., 2023) has shown that tracking a finger in 3D space using computer vision and deep-learning algorithms such as Google's MediaPipe and MiDaS have proven to be quite effective but still lacking in performance. This studies however, presents an improvement in contactless means of identifying a person's signature which is independent of biometrics such as retina, facial or voice recognition.

To address these, an addition of a second camera is considered, with the aim of better estimation of the depth of the signature. Hence the use of two cameras would be employed. Also, the primary camera would be placed at an angle, and as one might not be drawing on the imaginary plane parallel to it, some transformations of the drawing are to be made to replace it relative to that plane.

Also, since previous algorithms had some trouble determining the interruption of one's signature. This work is expected to improve them in defining the start and the end of the signature.

Acknowledgements

The research is supervised by Dr.sc.ing., Professor Aleksandrs Grakovskis.

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COMPARATIVE DATA VISUALIZATION BETWEEN FRANCE ANDLATVIA

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Keywords: Data visualization, power BI, comparative analysis, France, Latvia

Data analysis and visualization techniques are crucial for making effective decisions in modern environments. This research project seeks to compare: cultural and societal dynamics, philanthropy and volunteerism, and environmental factors in France and Latvia using data from sources, sophisticated data analysis and visualization tools.

This study aims to provide a thorough comparison between France and Latvia in specific sectors, emphasizing important similarities and differences. Dashboards and visuals created through Power BI allow stakeholders to easily explore and comprehend data. The analysis results in insights and recommendations that are meant to guide decision-making in pertinent areas.

The process of research involves detailed gathering of data from sources like the World Bank (The World Bank, 2024), Eurostat, The Central Statistical Bureau of Latvia (CSB, 2024), and INSEE France to maintain the trustworthiness and precision of the datasets. By using Power Query, we perform tasks like eliminating duplicates, managing missing data, and ensuring data consistency to prepare datasets for analysis. During model selection, different methodologies and approaches are examined to identify the optimal model for achieving desired outcomes in an efficient and effective manner. This process takes into account factors like speed, accuracy, interpretability, and scalability of the models. The method of analytical includes utilizing descriptive statistics, exploratory data analysis (EDA), and possibly predictive modeling methods to discover trends, patterns, and insights within the datasets. Visual representations such as charts, graphs, and maps will be used to efficiently communicate discoveries and understanding.

This summary highlights the significance of thorough data collection, cleansing, model choice, and analysis approach in carrying out comparative research studies. It recognizes the use of advanced tools such as Power BI (Addepto, 2018) as a tool for achieving a goal rather than the main focus of the study, and emphasizes the technical aspects of the research process.

The research is supervised by Dr.sc.ing., Professor Nadezda Spiridovska.

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Transport and Telecommunication Institute, Valērijas Seiles 1, Riga, LV-1019, Latvia

ENHANCING DECISION-MAKING IN INFORMATION SYSTEMS WITH AI TOOLS: A CASE STUDY ANALYSIS

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Keywords: Decision-making, information systems, AI tools, enhancing, case study analysis

Decision-making in information systems are vital for any organizations' success. AI tools have emerged as a promising strategy to enhance decision making (Raman and Phoon, 1990). Applying AI technology, organizations can draw useful conclusions from huge and complex data sets.

This thesis aims to analyze the effectiveness and impact of Artificial intelligence (AI) tools in enhancing decision-making in information systems through a case study analysis. The rapid development of information technology has led to the gradual application of artificial intelligence technology in various fields. The development of artificial intelligence technology has exceeded expectations and has the potential to significantly transform various industries. In the era of big data, AI technology offers opportunities for researchers and managers to improve decision-making processes. According to previous research, AI has the potential to be a game changer in project management by accelerating productivity and increasing project success rates.

The effectiveness and effect of AI tools in decision making in information systems is studied through a case study analysis. This thesis discusses the case of five organizations that have adopted AI tools for much better decision making in Information System (IS). The case studies extend across healthcare, manufacturing, finance, retail and engineering. Each case study evaluates the way the organization utilized AI tools, the way decision making processes were enhanced, problems encountered, and results achieved. Analyzing these diverse case studies, this analysis aims to demonstrate just how AI tools impact decision making in IS.

Researchers can explore how AI tools impact decision-making in information systems using a mix of scientific methods. Qualitative approaches like case studies with interviews and document analysis (Merriam, 2020) delve into the decision-making process and AI implementation. Additionally, surveys and data analysis (Creswell & Creswell, 2018) provide quantitative insights into the effectiveness of AI tools. By comparing case studies (Eisenhardt, 1989), researchers can identify common themes and patterns across different industries and organizations. The evaluation focuses on improved decision-making through accurate and timely analysis of complex data, as well as the ability to overcome human biases (Tversky & Kahneman, 1974). Additionally, business benefits like increased operational efficiency, cost savings, and a competitive edge are considered. The results suggest that AI tools can significantly enhance decision- making in information systems by improving data analysis, reducing human bias, and delivering tangible benefits to organizations

The study also performs a comparative analysis of the case studies to determine themes and patterns across industries in addition to organizational contexts. Some main findings about the usefulness and effect of AI tools in IS decision making are analyzed. Firstly, AI tools have assisted to make much better decisions by supplying accurate and timely data out of complex and large datasets. Next, AI tools have helped organizations overcome conventional decision-making hurdles as information overload and cognitive biases to make far better-informed choices. Thirdly, the tangible benefits of AI tools implementation are operational efficiency enhancement, cost savings and competitive advantage for organizations. However, this study offers valuable

insights for leveraging AI to improve information system decision-making. It provides actionable recommendations for managers to integrate AI and boost organizational performance. While the research acknowledges limitations in information security, ethics, and skilled personnel, the case studies also highlighted industry-specific challenges. Future research could address these challenges by exploring mitigation strategies and delve deeper into the long-term effects of AI on decision-making within organizations, including potential user resistance.

This study contributes to the current knowledge base by offering useful suggestions on how you can use AI tools to help much better decision making in information systems. This study seeks to give managers actionable insights on reconfiguring or adding elements to leverage AI to enhance organizational performance and profits.

The research is supervised by Dr.sc.ing., Professor Boriss Mišņevs.

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PERSONAL INFORMATION MANAGEMENT USING ADAPTIVE INFORMATION SYSTEMS

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Keywords: Adaptive systems, human-computer interaction, personal information, information overload

Nowadays, in a world where digital data is more prevalent than ever before, people struggle to handle their data in an organized and efficient manner. A paradigm shift in information management systems toward a customized and adaptable framework is required due to the exponential growth of data sources as well as the varied and changing preferences and needs of users.

A variety of high-tech devices and gadgets are used by people, including laptops, tablets, smartphones, personal computers, microcontrollers, smart watches, and smart homes. Nearly 60% of people worldwide use the Internet, according to the most recent statistics. In average individual consumes around 74Gb per day (Heim, 2017), which contributes to information overload and limits the amount of information that the human mind can handle.

One area that is frequently affected by information overload is personal information management. People have difficulties organizing and managing their personal information, according to various research studies. Managing large amounts of data, storing personal information in different formats across numerous devices, managing various kinds of personal information, and projecting the future value of personal information are some of these challenges (Jones, 2017). Individuals put a lot of time and energy into organizing their data, but they frequently find it challenging and ineffective (Oh, 2019).

Due to human uniqueness, all people have different information preferences, backgrounds, levels of education, methods for processing information, and cognitive capacities (Arnold, 2023). Humans are unique and have individual information demand and processing capabilities. These requirements raise a significant concern about information systems' inability to address information overload with a "one approach fits all" solution.

Adaptive Information Systems (AIS) is a relatively new direction of research on the crossroads of Information Science, Human-Computer Interaction and Artificial Intelligence. It is an alternative to the traditional "one-size-fits-all" approach in the development of Information Systems. Adaptive Information Systems build a model of the goals, preferences, and knowledge of each individual user, and use this model throughout the interaction with the user, to adapt to the user's needs (Palm, 2020).

The process of organizing personal information is very individual and consists of 6 common stages that an individual passes: initiation, identification, temporary categorization, examination, selection, and categorization (Oh, 2019). Therefore, there are multiple places where information overload can occur in transition between stages. Considering that information overload is a user-personal problem, adaptive information systems allow involve an adaption process inside the information system activate reinforcement learning for building knowledge about the user's recorded behavior in information processing. As a next step collected knowledge AIS is used for performing self-adaptive changes inside the system with the final goal of reducing information overload.

The current study introduces a conceptual model of an adaptive personal information management system. This model incorporates various user characteristics that contribute to

calculating the information overload ratio. Based on this ratio, the system triggers actions aimed at reducing information overload for the user. By focusing the measurement of information overload, the system adopts a proactive approach to enhancing the user's information management experience. The study also demonstrates simulation results for two scenarios: when user experience information overload and when AIS triggers actions to mitigate it.

The research is supervised by Dr.sc.ing., Professor Boriss Misnevs.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 18-19
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EMPOWERING A LARGE LANGUAGE MODEL WITH NEW DATA: PARAMETER EFFICIENT FINE-TUNING VS. IN-CONTEXT LEARNING

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Keywords: Large language models, question/answering, chatbot, parameter-efficient fine-tuning (PEFT), in-context learning (ICL)

The growing area of Large Language Models (LLMs) has significantly transformed text processing (Brown *et al.,* 2020), providing advanced capabilities in tasks such as text summarization, text generation, language translation, and question answering. This study focuses on the application of LLMs in the Question/Answering domain and the development of a chatbot capable of comprehensively addressing inquiries related to specific subjects."

The project also entails a comparative analysis of two prominent methodologies within the LLM framework: Parameter-efficient fine-tuning (PEFT) (Sanh *et al.,* 2019) and In-context learning (ICL) (Yang *et al.,* 2019). To achieve the study objectives, we followed a step-by-step plan. Firstly, we collected a specific set of data that matches our topic well. Next, we selected a pre-trained model that fits our needs (Lewis *et al.,* 2020). We then initiated the training phase by utilizing both PEFT and ICL methodologies on two separate instances of the selected model."

These methods involve unique strategies; Parameter-efficient fine-tuning focuses on fine-tuning the model's parameters (Sanh *et al*., 2019), while In-context learning specializes in integrating contextual information (Yang *et al*., 2019). A detailed comparative analysis between the two trained models was carried out by adjusting different settings to optimize them for the most accurate answers and clear responses (Raffel *et al*., 2020). By closely examining each method's strengths and weaknesses, we gained valuable insights into how well models solve research problems. The results revealed significant highlights on the importance of selecting the right methods when using LLMs for practical purposes. This study sets the stage for future improvements in understanding human language and creating conversational AI.

In summary, this research offers a meaningful contribution to the advancement of Large Language Models and their utilization in Question/Answering, paving the way for further advancements in natural language processing. It provides a comprehensive overview of the methodologies involved, their implications, and their potential for enhancing the capabilities of Large Language Models in real-world applications. By addressing the challenges and opportunities in this field, this study contributes to the ongoing evolution of language understanding and conversational AI systems.

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EVALUATING THE EFFECTIVENESS OF EXISTING INTRUSION DETECTION SYSTEMS IN SMALL AND MEDIUM-SIZED ENTERPRISES (SMEs)

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Keywords: Cyber threats, intrusion detection, SME, NIDS, suricata, snort, datasets

The rapid development of cyber threats in recent years has resulted in substantial alterations in the cybersecurity landscape. Due to their critical role in many economies, small and medium-sized enterprises (SMEs) are becoming more and more susceptible to these dangers. When one realizes how serious the situation is, it becomes necessary to put in place strong defences. Intrusion Detection Systems (IDS) are among the most effective techniques available for protecting networks from online attacks. But there are particular difficulties in implementing and managing IDS in SMEs, which are frequently caused by a lack of funding and experience. There are few IDS systems available with open-source as well as paid subscriptions.

In order to strengthen network security in SMEs, this research is to evaluate the efficacy of current IDS management systems in SMEs, pinpoint their advantages and disadvantages, suggest improvements, and eventually create a customized IDS management system. Not only deficiencies in the current systems identified, but they are also intended to be filled by offering SMEs workable and realistic ways to effectively manage their IDS. Considering mainly two Network intrusion detection systems (NIDS) which are regularly used by SMEs in the present days are SNORT and Suricata. These are the popular, powerful, flexible and Open-source NIDS in the present industry. Snort and Suricata, each has a wide range of community gives supports to enhance the systems and releases time-to-time updates.

There are several researches were performed to compare these both NIDS. To provide a strengthened solution of IDS management, an extensive assessment on research articles were carried out in this area. In 2019 Faud *et. al.* (2019) has conducted a comparison analysis between Snort and Suricata under the operating systems of Window 7 and Linux with definite CPU specifications. The experiments concluded that Suricata has performed well on Windows operating system and Snort has performed well on Linux. In 2013 White *et.al.* (2013) have developed a rigorous testing framework that examines the performance of both systems by scaling system resources. According to the results, a single Suricata instance can provide noticeably better performance than an identical single Snort instance. These experiments were conducted by using the system resources of AMD 8439 Opteron class processor and a 4 socket by 4 Memory Bank motherboard with different rulesets and pcap files. By varying the workloads and rule sets, several tests were conducted and findings demonstrated that Suricata outperforms Snort, even in the scenario where predicted Snort to perform better—a single core.

Based on the previous researches, the main goal of this thesis has decided to assess the effectiveness of NIDS control solutions between Snort and Suricata, while the experiments were conducting on AMD Ryzen 5 Processor specification and using different rulesets and workloads in the present day scenario in the SMEs. In this paper, we have developed an effective testing methodology that evaluates both systems performance when system resources are enhanced. We tested the IEEE dataset workloads against the engines running the ET-Free Rules and ET-Pro rulesets using more latest versions of both Snort and Suricata. The study intended to highlight the

advantages and disadvantages of Snort and Suricata versions, suggest enhancements based on actual data, and ultimately aid in the suggesting an efficient IDS management system customized to the unique requirements of SMEs.

Our findings show that, when both Snort and Suricata are used in their normal setups, there are significant scaling issues. We present the scalability of a multi-instance configuration for Snort. The capabilities, features and functionalities are learned on current IDS, different workloads were analysed to identify the practical ramifications and difficulties faced by SMEs when managing IDS. Snort and Suricata were compared with one another and assessed how well they performed. The study concludes with a thorough comparison of both NIDS management systems, which added to our understanding of how effective these systems are in the particular setting of SMEs. With the goal of giving SMEs a comprehensive and useful evaluation of their IDS management, this multi-pronged approach gave insightful analysis and helpful suggestions for improving cybersecurity safeguards in these crucial businesses.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 22-23
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THE AUTOMATED BUSINESS PROCESSES INTEGRATION AND ITS IMPACT ON SMEs IN LATVIA

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Keywords: SMEs, BPA, RPA, Latvia

In the rapidly changing world of the 4th industrial revolution, small and medium-sized enterprises (SMEs) must integrate disruptive technologies to ensure sustainable growth. In Latvia, SMEs hold a significant presence, constituting 99.8% of economically active merchants and commercial companies, with 92.1% categorized as micro-enterprises (OECDiLibrary, 2022). SMEs are defined as companies with a staff count of up to 250 employees, a turnover lover of 50 million €, or a balance sheet total of less than 43 million € by the European Commission (EC) (Eurostat, 2022). The Latvian economy is largely based on service industries including transportation, information technology (IT), and financial services (ITA, 2024). Business Process Automation (BPA) has been gaining increasing importance in the management of companies and organizations since it reduces the time needed to carry out routine tasks, freeing employees for other more creative, and exciting things (Moreira *et al*., 2023). The research aim is to investigate the integration of automated business processes within Latvian SMEs, focusing on identifying specific challenges and opportunities and deriving practical recommendations from global use cases, creating a framework (guidelines) that can answer the research questions: how the IT and financial sectors within Latvian SMEs leverage automated business processes to overcome challenges and seize opportunities, and what impact do automated business processes have on operational time efficiency within Latvia's IT and financial service industries?

Through a literature review, surveys, and case studies across various SMEs, this research investigates the adoption and implications of BPA in automating business processes.

The research explores the potential of BPA to enhance task automation in SMEs, focusing on its implementation across various companies in the information technology and financial sectors to improve efficiency and allocate more time to strategic tasks.

This research aims to develop a conceptual framework based on the comparison between the results from surveys/interviews and previous studies to incorporate automated business processes in SMEs. To achieve this, the following tasks were undertaken:

1. Literature review on business process automation in SMEs.
2. Conduct surveys and interviews with Latvian SMEs to gather empirical data.
3. Develop a conceptual framework for business process automation in Latvian SMEs.
4. Prepare practical recommendations for evaluating the benefits of business process automation.

The expected result of the work is the creation of a conceptual framework for automating business processes.

The research is supervised by Dr.sc.ing., Professor Mohammad Soltani.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 24-25
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BEST PRACTICES FOR MANAGING REMOTE TEAMS

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Keywords: Remote teams management, remote work process, distance work, virtual teams, remote technology, leadership

The relevance of the selected research topic is explained by the current shift towards remote work, which has changed the working environment for many businesses globally. This trend has become so popular due to the several factors, such as, change in working age population generations, technological development and digitalisation, digital and software infrastructure improvements, and the latest shocks of Covid-19 pandemic, which forced businesses to switch to a remote mode of work. Looking at the changes in working-age population generations, according to Timmes (2022) Millennials today are the largest working age population group and are predicted to make up 75% of the workforce by 2025. Millennials are people born between 1981 and 1996, which means that today they are 28 – 43 years old. As noted by Appel-Meulenbroek *et al.* (2019), the demands of Millennials, compared to the previous generations, differ in relation to the need for higher flexibility and freedom, which means that they tend to prefer to work remotely, with flexible schedule rather than in an office with fixed schedule. Looking at the impact of Covid-19, Howe *et al.* (2021) notes that it had significant impact on the way businesses operate today: during the pandemic there was a forced shift to remote work, but today many businesses have kept this format, at least, partially, due to its benefits, such as cost reduction and higher flexibility for employees and management and improvements in job satisfaction. Therefore, taking into account the latest changes in the work environment, it is important to ensure that management practices are developing along with them.

This thesis aims to discover best practices for managing remote teams and develop recommendations for businesses, focusing on management process and the tools that can make this process easier and more effective.

The thesis is based on the analysis of a particular company. The Company X has met several challenges in relation to remote work and managing remote teams during the Covid-19 pandemic. Today the company mostly operates offline, however the employees have an option to work remotely 1-2 days a week, which causes some issues to the work process and therefore, is not encouraged. The thesis therefore, will focus on the issues the company had during the forced shift to remote operations during the pandemic, the current situation within the company, and the benefits it can gain from developing effective means for remote work and remote teams management.

The research is based on the use of mixed qualitative-quantitative research methodology. Qualitative method: an interview with industry experts in order to gain an insight on the current situation with remote team management in Latvia and to discover effective methods for managing remote teams. Quantitative: a survey of employees with an aim to determine the benefits and challenges they are facing when working remotely. Object of the research: Remote teams management, subject of the research: Managerial practice and technological solutions.

This thesis results provide the ways to achieve successful remote team management from the managerial theory perspective and from technological solution perspective by exploring successful remote team management practices, analysing the latest research in this area and conducting an empirical study on the main benefits and challenges of remote work in the context

of Latvian enterprises. The results include the framework for setting up and managing remote teams, the selection of technological solutions and a setup of leadership for achieving high motivation and involvement of personnel.

The research is supervised by Dr.sc.ing., Associate Professor Nadezda Spiridovska.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 26-27
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FRAMEWORK OF INFORMATION SYSTEM FOR SUSTAINABILITY REPORTING

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Keywords: Corporate sustainability reporting directive, environmental social governance reporting system, sustainability, framework, information system

The concept of sustainability defined as the equilibrium among environmental integrity, social equity, and economic viability, sustainability underscores an imperative for transformative shifts in societal attitudes and practices regarding resource consumption and environmental stewardship.

In response to these exigencies, the European Union, in collaboration with member states, has articulated a suite of sustainability objectives. This initiative was catalyzed by the Paris Agreement of 2016, which ambitiously targets a cap on global warming to 1.5°C and a reduction in greenhouse gas emissions by 43% by the year 2030. Subsequently, the Corporate Sustainability Reporting Directive (CSRD), effective from January 2023, represents a pivotal advancement, establishing enhanced reporting requirements for the fiscal year 2024 for qualifying entities. Predicated on Environmental, Social, and Governance (ESG) considerations, and categorized into distinct scopes, this reporting framework aims to furnish a transparent delineation of an entity's sustainability profile. Such disclosure is intended to facilitate informed assessments by investors, non-profit organizations, and other stakeholders regarding the entity's sustainability performance, thereby enabling more strategic planning and target setting in pursuit of sustainability objectives.

Reporting procedures seem to be challenging and time-consuming for the entities. Despite the clear sustainability benefits of data reporting, entities may face challenges because of the wide range of different criteria of the reports. There are main questions explored during the research work:

1) What are the main criteria for ESG reporting for the entities, and which key performance indicators must be included in the reporting framework?
2) How do ESG reporting frameworks impact the quality and comparability of the reported data?
3) What are the challenges associated with implementing ESG reporting in different industries?

The main hypothesis of the study is that the comparability and reliability of sustainable development data reported by enterprises can be achieved using information systems with a unified framework that considers all the necessary components of sustainability.

The objective of this study is to enhance the comparability and reliability of sustainability data reported by enterprises by development of framework for information systems supporting ESG reporting requirements.

To achieve this goal, the following was done in the work:

- A comparative analysis of ESG reporting systems was performed.
- General criteria and key performance indicators affecting the comparability and reliability of data have been identified.
- Identified the main challenges organizations face in meeting ESG reporting requirements.

- Performed an analysis of features and capabilities that are critical to the success of the information system, including data integration capabilities, scalability, user friendliness, and support for real-time data analysis.
- An architecture of ecosystem and corresponding framework of information environment are proposed to make decisions on the development of policies and initiatives in the field of sustainable development.
- A roadmap for future research is proposed, focusing on the continued development of information systems in sustainability reporting, the integration of new technologies (particularly AI, blockchain) and the study of new sustainability indicators.

Various research methods are used in the research work, such as quantitative and qualitative research, case studies, interviews, and literature reviews.

The results achieved through an integrated approach during the study not only confirm the hypothesis of the dissertation, but also contribute to practical solutions in the field of sustainability reporting.

The research is supervised by State Emeritus Scientist, Dr.sc.ing., Dr.habil.sc.ing., Professor Igors Kabaškins.

RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 28-29
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RECOMMENDATION FOR DESIGN MOBILE APPLICATION IN EVENT MANAGEMENT INDUSTRY

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Keywords: Mobile app, user interface, user experience, event management, event app

In an era where digital presence has become key to success in almost every industry, the event management industry is no exception. Developmental trends in the field of digitalization in the event industry are closely associated with mobile technologies.

According to Cardoso *et al.* (2024) event apps permit to facilitate the event logistic, ease the event organization, event apps are a marketing and communication tool by promoting the event and having a great part regarding the brand image, plus, the several data collection methods prove that event applications increase the participants' engagement, the attractiveness of the event, the interactions, the event interactivity but also improve the customer experience.

The research of any aspect of event-based mobile social networks, usage of mobile devices or mobile applications before, during and after events are the most promising frontiers. This is in line with the trend of the event industry as outlined by experts who speak about the digitalization in event industry. While digital technologies in the event industry are widely believed to have massive potential, the concrete influence of the internet of things, artificial intelligence or special-purposed mobile applications for events on customer experiences still needs to be explored (Romanova, 2024).

The motivation behind this venture comes from the critical need to bridge the gap between event organizers and potential attendees by improving accessibility, engagement and the overall event experience through technological innovation. This research seeks to fill this gap by developing targeted recommendations for mobile application design in the event management sector.

The goal of this research is to construct a comprehensive framework for mobile application development in event management, focusing on user-centered design and functionality. This involves identifying the critical needs of both event organizers and attendees, and proposing a design that bridges these requirements with innovative technological solutions.

The methodology adopted for this study includes an in-depth analysis of current market trends, user expectations and technological advancements. This includes researching feedback from event organizers and attendees to understand their concerns, preferences, and features they find most valuable in an event management application. In addition, the study includes a comparative analysis of existing applications in the market, identifying their strengths and weaknesses to extract useful insights for the proposed design.

Expected outcomes of this research include a set of practical recommendations for the development of a mobile application tailored to the event management industry. These recommendations will focus on user-centered design, innovative features for engagement and interactivity, and the integration of advanced technologies.

In conclusion, the move towards digital solutions in the event management industry is not just a trend, but a necessary evolution to meet the changing dynamics of organizing and experiencing events. The proposed recommendation for mobile application design, with its emphasis on user experience, innovation and integration of advanced technology features, represents a progressive solution to the challenges currently faced by the industry. This study

highlights the importance of taking a strategic approach to mobile app design, emphasizing the need for constant feedback, iteration, and alignment with technological advances to remain relevant and provide value to both event organizers and participants.

This research is supervised by Dr.sc.ing., Professor Irina Pticina.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 30-31
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ENHANCING INVERSE KINEMATICS FOR SINGULARITY-FREE TRAJECTORIES IN ROBOT MANIPULATORS

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Keywords: Kinematics, singularities, heatmap, trajectory, robot, singularity index

Path planning enables a robot to determine the most direct and obstacle-free route from a starting point to the desired destination. It relies on different methods such as inverse kinematics (IK) algorithms which play a crucial role in robot manipulators. Precise and efficient control of robot manipulators is vital for various applications such as industrial manipulation tasks. The inverse kinematics algorithm determines the joint configurations needed to position the end effector at specific locations. Current studies can generate trajectories containing singularities, which can lead to control problems. This results in the robot losing dexterity, controllability and also performance limitations.

This project addresses the challenge of singularities in robot manipulator trajectories which should be done the easiest way possible and without requiring too much effort. To avoid singularity problems, our study will be split into two parts. The first step will contain the creation of the heat map that allows visualizing proximity to singularities along computed paths from an iterative inverse kinematics algorithm. The heat map will leverage singularity indices to quantify closeness to singularities at each configuration (Hong, 2012). The second part will focus on improving the given algorithm enhancement for singularity avoidance for smooth, singularity-free trajectories.

Algorithm modifications under consideration include integrating the singularity indices as constraints or cost terms within the IK optimization according to Zaplana *et al.* (2022), and analysing the manipulator Jacobian to identify and avoid singular or near singular configurations (Wang *et al.*, 2022). Thanks to Monte Carlo analysis, a new method of mapping and detecting singularities has been developed according to Stejskal *et al.*, (2022). The fact of considering robot manipulators with redundant degrees of freedom provides some flexibility to navigate around singularities, as noted by Petrovi'c *et al.*, (2021). Also, the singularity problem is often faced but trying to be solved with either algorithms based on singular value (Zhao *et al.*, 2021) or based on the Jacobian method (Zhang *et al.*, 2021). Singularities are also close to the question of robot stiffness according to Gao *et al.*, (2023). Simulation experiments were conducted on common manipulator models to validate the effectiveness of the enhanced algorithms compared to baselines.

Our study aids in the solution of the problem of singularity-free-based trajectory planning by developing a visual heatmap in Matlab that illustrates the closeness of a path to a singular configuration of the robot. Our research conducted the implementation of two different methods to calculate a determinant from which we were able to conclude about the closeness of the robot from a singularity. The first method is called the least square method, while the second method is called singular value decomposition. The results were used to incorporate the findings of this heatmap into the planning process itself, contributing to the advancement of inverse kinematics algorithms in ensuring smoother trajectories and efficient robot motion. This work has potential

applications in industrial manipulation tasks requiring precise end-effector control without encountering singularities that hamper the robot's performance and reduce its useful workspace.

This research is supervised by Ph..D., Professor Emmanuel Merchan.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 32-33
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COMPARATIVE ANALYSIS OF LLM-BASED APPROACHES FOR SQL GENERATION

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Keywords: Large language models, SQL generation, natural language processing, software development automation, multi-agent collaborative networks

The rapid development of Large Language Models (LLMs) has unlocked opportunities for restructuring software development processes in general as well as in such cases as converting natural language into SQL queries (Ross *et.al*., 2023). This study seeks to experimentally evaluate the effects of three LLM-based methods on the efficiency and quality of SQL generation. Evaluation (Yao *et.al.*, 2024) is being held based on following metrics: Correctness (degree to which the generated SQL code correctly answers the natural language question), Completeness (degree to which the generated SQL code covers all aspects of the natural language question) and Consistency (degree to which the generated SQL code is consistent with the natural language question). Studied LLM-based SQL generation methods include Specific LLMs tailored for SQL code generation like SQL Coder (Defog.ai, 2023) frameworks for generating SQL code (Vanna.ai, 2023) and Multi agent collaborative networks for transforming language into SQL (Wang *et.al.*, 2023).

The research utilizes a mix of literature review case studies and simulations. It offers a comprehensive review of the advancements in LLM-driven SQL generation encompassing concepts, technologies, methodologies, strengths, limitations, and ethical considerations. The study compares user experience and results (generated code and results of its execution in controlled environment) gained with different approaches to LLM-based SQL generation. The results indicate that all three methods can automate and enhance tasks related to generating SQL queries but exhibit varying outputs for same queries. The research compares how SQL generation models and collaborative agentic networks work to handle complex user queries among SQL databases.

Additionally, the study explores the practical issues related to implementing these methods in software development in general, and database management specific, including concerns about security, reliability, bias, transparency, and user confidence.

This research contributes by offering a comparison of LLM-based strategies for generating SQL from natural language. It discusses their advantages, drawbacks, and prospects. This research successfully bridges the gap between theoretical foundations and practical application of AI-augmented approaches while promoting the integration of LLM-based SQL generation, into automated software development processes.

The research is supervised by Dr.sc.ing., Professor Dmitry Pavlyuk.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 34
Transport and Telecommunication Institute, Valērijas Seiles 1, Riga, LV-1019, Latvia

RESEARCH OF BOOSTING ALGORITHMS VERSUS TRADITIONAL METHODS IN CREDIT CARD FRAUD DETECTION ACROSS VARIED DATASETS

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Keywords: Machine learning, boosting algorithms, fraud detection

Along with manual reviews and rule-based systems, data mining techniques like clustering and classification algorithms are essential in the field of credit card fraud detection as they help to identify fraudulent transactions (Gupta, 2019). However, because it can be challenging to collect training data, there hasn't been much study done on using machine learning to detect credit card fraud (Bhattacharyya *et.al*., 2011). More data has just become more accessible, but a thorough comparison of the many current machine learning methods has not yet been carried out. In many areas, it has been shown that boosting algorithms, such as XGBoost, AdaBoost, and Gradient Boosting Machine, perform better than conventional techniques. The Optimized light gradient boosting technique has been proven to outperform conventional methods in the context of credit card fraud detection, but using only highly unballanced dataset (Taha and Malebary, 2020). In order to detect credit card fraud, this research provides a thorough comparison of boosting algorithms and classical methods. We used three distinct types of credit card transaction datasets: one that was completely synthetic, one that had an equal proportion of 50% fraudulent and 50% valid transactions, and one that was highly unbalanced, with only 0.17% of all transactions being fraudulent. The real transaction datasets included 28 anonymized attributes such as time and location. Every algorithm used in this study was assessed according to its F1 score, accuracy, precision, and recall. The study offers recommendations which algorithm to apply in real-world situations, offering insightful information for future study and useful implementation in the field of credit card fraud detection.

The research is supervised by Dr.sc.ing., Professor Nadezda Spiridovska.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 35-36
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UNSUPERVISED MACHINE LEARNING APPROACH FOR HIERARCHICAL GRAPH-BASED REPRESENTATION OF NATURAL LANGUAGE TEXT COLLECTIONS

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Keywords: Hierarchical topic modeling, spectral clustering, natural language processing, visualization

In the modern digital era, the ever-growing volumes of data require advanced tools for efficient navigation and knowledge extraction. Documents written in human language to be consumed by human readers present an interesting dimension of this problem. Writing a comprehensive literature review is but one example where the need might arise to analyze collections on the merits of hundreds of texts.

Recent advances in natural language processing, particularly the development of Large Language Models (LLMs) allowed to create powerful tools to aid with this kind of tasks. The price of these advancements is the need for high amounts of labeled data, computational resources and specialized skills to train and/or fine-tune the model for the task at hand. Aiming to address the resource-related drawbacks of LLM-based tools, current work presents a natural language processing (NLP) pipeline to detect the potential presence of a topic hierarchy in a collection of human language texts, focusing specifically on full texts of scientific publications.

Three research questions were formulated:

1) How to discover the topic hierarchy in a collection of English texts using unsupervised machine learning methods, given that it was discovered by a human?
2) What model and quality metrics allow to ensure that topics are understandable, insightful about the structure of the collection and share interpretable connections between different levels of the hierarchy?
3) How can the output be visualized and used to explore the hierarchy structure and document similarity along and across the topic hierarchy?

The NLP pipeline was constructed to support an unsupervised, hierarchical topic model. The model was based on the additive regularization architecture proposed by (Chirkova, 2016) and additionally enhanced by introducing a variation of architecture suggested by (Khodorchenko *et al.*, 2020) for increased topic interpretability. It was discovered that the resulting pipeline allows to infer a hierarchy of human-interpretable topics from collections of texts, even without extensive hyperparameter tuning. The resulting model also allowed to generate probabilistic topic-based vector representation for each document at every level of the resulting hierarchy. Such soft clustering results were converted into hard clustering results by calculating pairwise document similarity as Bhattacharyya coefficient through Hellinger distance (HD) (Kitsos and Nisiotis, 2022), and applying the Spectral Clustering (SC) algorithm to the resulting similarity matrix.

In order to allow for exploration of document similarity both for a given level of the hierarchy, and between different levels, two types of visualizations were developed. The first one was based on visualizing HDs between documents by applying Multidimensional Scaling to the HD matrix for documents at a given level. This allowed to construct a scatter plot indicating HD-based document dissimilarity in terms of topic content in a 2-dimensional space. The plot was enhanced by adding connections between "topically-similar" documents, given a HD threshold value. The second one was based on assigning the sequence of SC-generated cluster labels at all levels of the topic hierarchy as attributes of each document in the collection.

This allowed to trace out the relatedness of documents and clusters between the layers of the hierarchy using Sankey plot.

The resulting pipeline coupled with the developed visualization was used to explore a potential topic hierarchy in two custom datasets consisting of 50 open-access scientific publication full texts each. The results suggest that the pipeline can be useful to search for groups of topically-related texts, estimate the degree to which a given collection can be meaningfully represented by a topic hierarchy, and to generate an informative visual topical summary of the collection. Potential applications include creating a collection-based topic map for a self-study process, a literature review or a meta-analysis both in academia and industry.

The research is supervised by Dr.sc.ing., Professor Irina Jackiva.

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RAG REFINED: A DETAILED INVESTIGATION INTO DIVERSE ENHANCEMENT TECHNIQUES

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Keywords: Artificial Intelligence (AI), Large Language Models (LLM), Retrieval Augmented Generation (RAG), generative AI, Machine Learning, Natural Language Processing (NLP)

In the ever-evolving landscape of natural language processing, Retrieval-Augmented Generation (RAG) signifies a pivotal advancement, enhancing the capabilities of Large Language Models (LLMs) through the seamless integration of external knowledge sources—a point underscored by Gao *et al.* (2024). Addressing inherent limitations present in regular LLMs, such as vulnerability to outdated information and the tendency to generate inaccurate "hallucinated" content, RAG emerges as a promising avenue for refining the efficacy of language understanding and generation. Introduced by Lewis *et al*. (2020), RAG signifies a pivotal leap forward in the pursuit of enhancing language models by leveraging the power of retrieval mechanisms.

To comprehensively evaluate and enhance the performance of RAG, this research strategically incorporates diverse datasets, encompassing news articles, the book "The Ballad of Songbirds and Snakes" by Suzanna Collins published 2023, and research articles about RAG obtained from arxiv. The deliberate selection of varied text types aims to shed light on how the RAG system should be optimized for distinct linguistic contexts, considering factors such as complexity, length, and information recency.

In alignment with our exploration, we adopt the CRUD approach (Create, Read, Update, Delete), initially proposed by Truica *et al.* (2015). Within the context of RAG systems, explained by Lyu *et al.* (2024), "Create" involves the creative generation of text, entailing analysis or report creation tailored to the underlying data. "Read" encompasses question-answering tasks, while "Update" involves error correction or hallucination fixation. Finally, "Delete" related to the creation of concise summaries. This framework allows for a structured assessment of RAG's capabilities across different dimensions, facilitating a nuanced understanding of its strengths and areas for improvement.

For the evaluation phase, we leverage Es *et al.* (2023) innovative RAGAS (Retrieval Augmented Generation Assessment) framework, revolutionizing reference-free evaluation of RAG pipelines. RAGAS systematically evaluates crucial quality aspects such as faithfulness, answer relevance, context precision, answer similarity, answer correctness, and context recall. Utilizing an LLM, this automated approach offers a comprehensive overview, particularly focusing on the generation and retrieval components of the RAG system. Notably, for assessing error correction, a new metric is employed, gauging the accuracy of the system's output in correcting mistakes within the given text. This tailored evaluation methodology ensures a thorough examination of RAG's performance across diverse tasks, providing valuable insights for future advancements in retrieval-augmented language models.

In the implementation phase, the study commenced by formulating a set of questions and corresponding ground truths to establish correct answers. The initial investigation focused on assessing the performance of general LLMs, specifically GPT-3.5-Turbo and GPT-4, across

various tasks. Interestingly, GPT-4 did not universally outperform its predecessor, GPT-3.5, highlighting the importance of detailed evaluation in selecting the most suitable model for the given context.

Subsequently, a foundational RAG system was constructed utilizing the langchain framework. The study systematically explored the impact of different parameters on the RAG system's performance, including variations in chunk sizes, overlaps, embedding methods, and top-k values. The research delved into the realm of retrieval methods, experimenting with both sparse methods such as BM25 and dense retrievers utilizing vectors. A hybrid approach, combining both sparse and dense retrievers was used. Also, multi-step approach of creating separate search query and usage of a reranker was also used. The experiments primarily employed GPT-3.5-Turbo, but the most promising configurations were further assessed with GPT-4 to measure their adaptability and effectiveness across different models.

In addition, the study involved minor prompt engineering. Notably, RAG systems demonstrated significant enhancements compared to conventional LLMs, yet the intricacies of each method and dataset necessitated tailored configurations for optimal performance. Particularly challenging was the detection of errors, where the RAG systems faced notable difficulties. This research not only contributes empirical insights into the effectiveness of diverse RAG configurations but also underscores the nuanced nature of system optimization, varying across methodologies and datasets.

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PREDICTIVE ANALYTICS FOR ONLINE CASINO REVENUES IN AUSTRALIA: AN INTEGRATION OF ECONOMIC INDICATORS AND WEATHER DATA

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Keywords: Online casino revenue, economic indicators, predictive modeling, time series analysis, CPI, consumer behavior

This study investigated the interplay between economic indicators, weather conditions, and online slots revenue in Australia's gambling market. In the rapidly growing casino sector, especially with slot games, identifying what influences revenue changes is crucial for shaping strategies and guiding policy decisions (Merchie and Ernst, 2022). The motivation behind this research lies in the need to discern how external economic and environmental factors influence gambling trends, providing a holistic view of the market dynamics.

The aim was to analyse the correlation between Australian economic reports, such as GDP Quarter on Quarter (QoQ), Consumer Price Index (CPI) QoQ, unemployment rates, weather conditions, and the resultant online slots revenue. This was undertaken to predict revenue trends and provide actionable insights for industry stakeholders. The methodology encompassed a comprehensive review of historical economic data, weather patterns, and revenue figures. Advanced statistical techniques and machine learning models, including Multiple Linear Regression and ARIMA/SARIMA, were employed to analyse the data, and forecast future revenue trends (Uppala *et al.*, 2022).

The analysis revealed a significant correlation between economic health indicators and gambling revenue, with GDP and CPI serving as reliable predictors of spending on slots. Unemployment rates presented a nuanced relationship, suggesting variable gambling behaviours in response to economic hardship (Somers *et al.*, 2021). Additionally, weather conditions emerged as a contributing factor to gambling activity, highlighting potential seasonal impacts on consumer behaviour.

In summary, the findings offer a nuanced understanding of the factors influencing online slots revenue, suggesting that economic health and weather conditions are integral to market dynamics. For operators and policymakers, these insights can inform strategic planning and regulatory frameworks, contributing to the sustainable development of the gambling industry. This research enriches the existing literature by integrating weather data, offering a novel perspective on gambling economics.

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DEVELOPMENT OF A MATHEMATICAL MODEL FOR OPTIMIZING BEAD GEOMETRY IN 3D PRINTING OF STRUCTURAL AVIATION COMPONENTS USING WIRE ARC ADDITIVE MANUFACTURING (WAAM)

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Keywords: Wire Arc Additive Manufacturing (WAAM), bead geometry optimization, thin-wall components, additive manufacturing quality control, mathematical modeling in manufacturing

Wire Arc Additive Manufacturing (WAAM) is a way of metal parts production layer by layer using an electric arc and wire as the material. Today WAAM is an important part of the aerospace industry production process because it can create large and complex parts quickly and with less material waste, compared to traditional manufacturing methods like casting and milling. However, making these parts with high quality (dimensions), especially when they have thin walls, using a single pass of the welding torch without moving it back and forth (no weaving), and ensuring they meet design requirements is challenging.

Achieving the target bead geometry – the shape and size of the metal deposited in each layer - is crucial. This process must be precise to ensure that the final product meets the strict specifications required in aerospace and other critical applications. The research aims to focus on WAAM process control during creation of parts with thin walls using a specific approach: a single pass of the welding torch, no weaving (moving the torch back and forth), and using Aluminum 5XXX series material.

Similar to previous studies focused on stainless steel (Oh, 2022), where control of bead geometry at the start and end of the welding process was emphasized, research aims to extend these concepts to the control of bead geometry in stabilized conditions for the production of massive thin-wall parts.

Previous studies (Wang *et al.*, 2022) have shown that the key factors in controlling the shape of the welding bead in WAAM are the Wire Feed Speed (WFS) and the Travel Speed (TS). The balance between these speeds affects how much material is placed along the bead, which is crucial for getting the target shape and size of the bead.

Previous studies (Nilsiam, 2017) have pointed out challenges in keeping the printing process's temperature and bead shape steady. Often, the solution was to stop printing to tweak the settings, which wasn't efficient and could cause uneven results. The study will examine the thermal deformation of the welding bead and its cumulative impact on the whole part dimensions after multiple printed layers print, acknowledging that maintaining consistent temperature and bead shape has been a challenge in previous research.

These gaps in the literature underscore the need for a new approach that can maintain optimal printing conditions continuously without interruption for Aluminum 5XXX series material.

This research explores study on Wire Arc Additive Manufacturing (WAAM), aiming to refine bead geometry for producing thin-wall parts. WAAM builds metal parts layer by layer through a welding process. A key challenge is controlling the bead geometry, essential for the structural integrity and accuracy of thin-wall parts.

Research proposes a concept of a mathematical model that enlights dependencies of the deposition process parameters to the expected bead height **(h)** and width **(w)**:

(h, w) = f(TS, WFS, ALC, PDC),

where, major process parameters are:
- **Travel Speed (TS)**: How fast the welding nozzle moves across the material. [m\min],
- **Wire Feed Speed (WFS)**: How quickly the welding wire is fed into the melt pool [m\min] and minor process parameters are:
- **Arc Length Correction (ALC)**: [-10..+10 units], inner hardware tuning coefficient,
- **Pulse Dynamic Correction (PDC)**: [-10..+10 units], inner hardware tuning coefficient.

In the initial experiment, the dimensions of each layer were measured using the MLZL171 scanner. Received the results of the preliminary data processing of the experiment.

The research is supervised by Dr.sc.ing., Professor Aleksandrs Grakovskis.
The experiments for the research were conducted in collaboration with TSI Additive Lab, with Mg. sc. ing. Arseny Kisarev overseeing the work.

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THE DEVELOPMENT OF A MODEL FOR ACCELERATED PRODUCTION OF UAVS IN LATVIA

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Keywords: UAV, Latvia, development, devices

The development of a framework for accelerated production of unmanned aerial vehicles (UAV) in Latvia is significant in various sectors of industry, with the goal of addressing existing challenges. This paper presents solutions to accelerate the UAV manufacturing process in Latvia.

Compared to other countries, Latvia trails behind in UAV development. Nevertheless, unlike military applications, nations such as the United States and China employ UAVs for a variety of purposes, including agricultural, transportation, and leisure activities such as racing (Fedoseeva and Zagvozdkin, 2017). This insight has led to increased research and swift advancement of the Latvian UAV sector. To address these challenges, a comprehensive database has been created to facilitate the selection of unmanned aerial vehicles (UAVs) based on parameters such as battery life, fuel efficiency, materials, size, and functionality (Bondarev and Kirichek, 2016). The aim of the model is to optimize UAV operations and expedite essential services, allowing tasks to be completed three times faster than with traditional methods.

Furthermore, by establishing partnerships with international companies, access to advanced drone technologies and materials is facilitated, accelerating the domestic production process. This contributes to the use of UAVs in Latvia, particularly in agricultural applications, as large fields require efficient management (Tsvetkov and Oznamets, 2020).

Additionally, algorithms for the improvement and innovation of drones will be developed in line with global trends, with UAVs being used in various services ranging from taxi services to window cleaning on skyscrapers, although there are currently few tall buildings in Latvia. However, the agricultural sector provides ample opportunities for the use of drones (Dorogina and Konushina, 2022). Collaborations with other organizations stimulate innovation in unmanned aerial vehicle (UAV) manufacturing.

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DEVELOPMENT OF AN AI FRAMEWORK FOR MONITORING, MAINTENANCE AND MODELING FOR DOMESTIC WASTEWATER TREATMENT BY BIOLOGICAL WASTEWATER TREATMENT PROCESSES

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Keywords: Artificial intelligence, wastewater treatment, Artificial Neural Networks, pollution

Artificial intelligence (AI) has emerged as a rapidly evolving technology with various applications, including wastewater treatment (Malviya and Jaspal, 2021). It simulates human intelligence and complex processes, offering powerful tools for simplifying the management, modeling, and monitoring of wastewater treatment processes (Zhao *et al*., 2020).

Biological wastewater treatment processes encompass a wide range of hydraulic, physical, mechanical, chemical, biochemical, and biological processes to remove dissolved, colloidal, emulsion, and solid contaminants from wastewater. Following treatment, the treated wastewater meets environmental release requirements or undergoes further treatment to achieve drinking water quality and facilitate water reuse.

Wastewater can be categorized into three main types: domestic, industrial, and stormwater (Altowayti *et al.*, 2022). Domestic wastewater, also known as sanitary wastewater, comprises waste from black water (toilet waste containing feces, urine, or toilet paper) and/or gray water (water from sinks, baths, washing machines, etc.) (Bani-Melhem *et al.*, 2017).

While traditional approaches and calculations for domestic wastewater treatment are well-established, the integration of AI offers opportunities for enhanced monitoring, faster response times, and the identification of technological solutions to address changes in wastewater composition and treatment conditions.

The main problems with traditional monitoring of wastewater treatment plants are their reactive nature and lack of proactive measures to prevent problems. System monitoring often focuses on specific parts of the process, potential missing issues, and wasted resources. In addition, it does not effectively use online data for real-time management due to system limitations and reliance on manual control. Furthermore, to effectively tackle these challenges, the matter of employee qualifications must also be taken into account.

AI has historically been applied to monitor the operational efficiency of wastewater treatment facilities, focusing on factors such as efficiency metrics, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and the removal of pollutants like nitrogen, phosphorus, sulfur, and other contaminants (Malviya and Jaspal, 2021). Numerous uses of AI in the realm of wastewater treatment have been devised, encompassing areas such as enhancing treatment plant performance, wastewater modeling, optimizing water treatment processes, implementing control mechanisms, and predicting energy and equipment operations optimization (Imen *et al.*,2023).

The study aims to develop a framework for monitoring, maintaining, and modeling the operation of domestic wastewater treatment plants, with a focus on leveraging AI and mass balance approaches, as well as implementing online data acquisition for enhanced control of the wastewater treatment process. Visual wastewater treatment plant (WWTP) process control and monitoring can also be employed for individual wastewater treatment processes and assessment.

It is also crucial to determine the appropriate level of AI integration based on the size of the treatment facilities, considering that real-time monitoring solutions tend to be relatively costly and, thus, less feasible for small WWTPs.

The main novelties of this study include the integration of AI and mass balance approaches, which enable a more comprehensive understanding of treatment process dynamics and facilitate effective decision-making. Additionally, the utilization of online data acquisition enhances real-time monitoring and control, allowing for adaptive management strategies based on current conditions.

The proposed solution addresses the challenges associated with traditional monitoring and control methods by integrating advanced AI techniques with established mass balance principles. Overall, the proposed approach is a new and practical solution to the problems faced by domestic wastewater treatment plants. Using AI, mass balance methodology, and online data acquisition, the research aims to improve the monitoring, maintenance, and modeling of wastewater treatment processes, leading to more efficient, sustainable, and resilient wastewater management practices.

The research is supervised by Dr.sc.ing., Professor Mihails Savrasovs.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 46-47
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DEVELOPING A MACHINE LEARNING MODEL TO MITIGATE BIAS IN THE FUTURE AI-BASED RECRUITMENT IN PUBLIC SECTOR

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Keywords: Artificial intelligence, human resources, recruitment, machine learning, bias, algorithms

In light of its inherently people-centric nature, human resources might not seem an immediate fit for artificial intelligence. Nevertheless, AI is swiftly becoming integrated into HR functions, particularly evident in recruitment processes. The recruiter's tasks, which are often repetitive, fit well with automation technologies in the recruiting process. This includes tasks like opening requisitions, handling candidate applications, conducting assessments and screenings, all before direct engagement with a recruiter. Johnson *et. al.* (2021) highlight the advantages of AI-based recruitment in enhancing talent acquisition outcomes, particularly during initial screening. The utilization of online application allows candidates to input comprehensive job-related details, which AI-driven software can automatically scan and assess using keywords to determine qualifications. Significantly, the authors emphasize the potential of AI algorithms in making more effective selection decisions by avoiding biases and emotional reactions that may influence traditional decision-making processes. On the other hand, Soleimani *et al.* (2021) emphasize that while AI can aid in decision-making, it is essential to acknowledge that the datasets and algorithms employed in AI systems can be influenced by human biases. Algorithmic bias, particularly rooted in partial historical data, can appear across different dimensions such as gender, race, skin colour, and personality. Ntoutsi *et. al*. (2020) in their research, provided a definition of bias in the context of AI systems. They defined bias as the inclination or prejudice of a decision made by an AI system that favors or discriminates against a person or group, particularly a manner perceived as unfair. According to Jayatilleke (2022), biased machine learning outcomes often stem from using training data that is derived from environments or processes influenced by unconscious biases, leading to models and predictions that perpetuate those biases and result in inequitable outcomes. Newman *et al.* (2019) highlights that need to focus on the decision-making aspect of the human-machine partnership equation, and focus on validating the data, predictive models and prescriptive models delivered to them by machine-learning algorithms.

Considering that the recruitment and selection process in public sector of Latvia is planned to be fully automated, it is crucial to pay attention to potential biases. Therefore, two research questions were formulated: the first one being 'What are the existing biases in the recruitment processes of public sector institutions, both explicit and implicit?' and the second one 'How can biases in the recruitment process be effectively mitigated or eliminated through modeling techniques in future AI-based recruitment systems in the public sector?'. Each institution retains its own organizational culture, decision-making structures, and industry specifications, which impact recruitment policies and introduce unconscious biases in decision-making. There are not only interpersonal biases but also biases within organizations and systems. In the study, comprehensive analytics were conducted on candidates' historical data, revealing that there exists hiring bias, including gender and age bias, in public sector. Data were obtained from institutions within public sector, underwent comprehensive preprocessing, and were subsequently subjected

to a multifaced analytical process. This process encompassed not only traditional statistical analyses but also exploratory data analysis, machine learning modelling, and data mining techniques. The combination of these analytical approaches aimed to uncover patterns, correlations, and insights within the dataset, providing a holistic understanding of the complexities inherent in public sector context. By investigating the biases and factors influencing the current recruitment and selection practices, the main objective of this research is to develop a dataset for future AI-based recruitment, thereby promoting equitable decision-making. It means that the object of the research is the mitigation of biases in the selection process, while the subject of the research is the AI-based model.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 48-49
Transport and Telecommunication Institute, Valērijas Seiles 1, Riga, LV-1019, Latvia

IMPROVEMENT OF MACHINE LEANING ALGORITHMS PERFORMANCE BY DATA SET DIMENSIONALITY REDUCTION USING CELLULAR AUTOMATA

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Keywords: Machine learning, dimensionality reduction, cellular automata

A significant challenge in Machine Learning is dealing with high-dimensional data, which refers to datasets with a large number of features or variables (Dheepak and Vaishali, 2021). Complexity knowns as the "curse of dimensionality," where the performance of Machine Learning algorithms deteriorates as the dimensionality increases, is one of the obstacles that dimensionality reduction is intended to overcome (Sarker, 2021).

There are numerous technics (Reddy *et al.*, 2020) used to perform dimensionality reduction either by selecting only the relevant features or by transforming the original features into a lower-dimensional space. Random sampling is an example of dimensionality reduction that maintains characteristics of data and provides its high internal and external validity. Cross-validation and resampling is another important approach that was considered for splitting the dataset into test and train data for model fitting.

Cellular automata are a dynamical discrete computational system with simple mathematical functions knows as rules that result in complex global behaviour (Bhattacharjee *et al*., 2016). We used one-dimensional elementary cellular automata as a tool for dimensionality reduction for dataset with justified ordering where adjacent observations are interdependent, for example housing prices dynamics in specific region. As the result, cellular automata was used as dropout analogue in neural networks with aim to reduce model overfitting.

Model variables were selected for initial status vector generation and its further transformation to format that is suitable for cellular automata Wolfram code rules application known in cellular automata theory as configuration. Then model iterated through all possible cellular automata Wolfram code 256 rules and various epochs variations were applied. For simplified Python coding amphichiral rules which are the same as their mirrored rule also were used as variables for model fitting.

Model performance was compared with benchmark results after standard dimensionality reduction technics used for the same dataset. It was concluded that some of applied cellular automata rules can be used as alternative methods for dimensionality reduction for datasets with interdependent values.

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The research is supervised by Dr.sc.ing. Professor Dmitry Pavlyuk.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 50-51
Transport and Telecommunication Institute, Valērijas Seiles 1, Riga, LV-1019, Latvia

EVALUATION OF MICROCONTROLLERS EFFICIENCY FOR DEVELOPING AN INDUSTRIAL MINI ROBOT CONTROL SYSTEM

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Keywords: Minirobot, microcontroller, performance calculation, robot arm

Mini robot manipulators, due to their small size, allow for the creation of entire manufacturing lines in confined spaces (Tsujiuchi *et al.*, 2009). This presents opportunities for businesses to engage in low-volume production and the development of prototypes requiring high precision and the ability to adapt processes to minor details. These mini robot manipulators undoubtedly have their benefits, but they also come with several limitations. The main requirement for the low-level control system of a mini robot arm in solving kinematic problems (Khatib *et. al.*, 1997) in real-time is minimal dimensions.

When developing a control system considering these requirements, it's important to choose a microcontroller (MC) with high efficiency. The problem of evaluating the efficiency of a microcontroller is as follows:

- microcontrollers vary significantly within the same family, and models from different manufacturers have different architectures.
- difficult to assess the efficiency of a MC for solving kinematic tasks using only the technical specifications provided by the MC manufacturers.

The aim of the research was to assess the effectiveness of various general-purpose MC in completing inverse and forward kinematics (Huang *et al.*, 2011) tasks in real-time. The efficiency evaluation was based on the microcontroller's performance, which was defined as the normalized number of mathematical expressions executed by the microcontroller per second. The clock speed of the MC was used as the normalizing value.

For the research, microcontrollers from "STMicroelectronics", "Raspberry PI Foundation", and "Espressif Systems" were selected: ESP32 (Cameron, 2020), ESP8266, STM32G431 (STM, 2023), RP2040 (Bell, 2022), ATmega328p (Dunbar, 2020).

As a result of analyzing the kinematic task, a list of complex mathematical expressions was created, which are difficult to calculate using any microcontroller because they require a significant number of MC core computations. This has a negative impact on both the overall control speed and the performance of individual components.

The microcontrollers were selected for their general-purpose capabilities, which include a range of clock frequencies and architectural features. Additionally, the potential for future scalability and application in various management areas was a significant factor in selecting microcontrollers for the research project (Doboli & Currie, 2010).

To obtain the values of the time intervals required to execute a mathematical expression, an algorithm was developed to measure the duration of mathematical expression calculations. A set of programs for microcontrollers was implemented in C/C++ and MicroPython languages.

As a result of testing the microcontrollers, the following results were obtained:

- Estimates of the calculation durations for the selected expressions for each MC;
- The values of the expressions calculated per second for each expression and each MC;
- Normalized values of the expressions calculated per second for each expression and each MC.

Conclusions:

- The power function requires the maximum time for computation by any MC, with the ESP32 providing the shortest computation time at 3.120 microseconds;
- The ESP32 and STM32G431 microcontrollers provide the highest number of thousands of calculated expressions per second, with 12,961 and 19,476 respectively.
- The normalized values of expressions calculated per second are highest for the same microcontrollers, ESP32 and STM32G431: 54.007 and 114.565 thousand expressions per second per 1 MHz, respectively.
- The STM32G431 microcontroller is the most preferred for implementing a tactical level control system for a mini robot arm.
- Controller ESP32 with 240 MHz clock frequency is not an absolute leader.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 52-53
Transport and Telecommunication Institute, Valērijas Seiles 1, Riga, LV-1019, Latvia

VIBRATION ANALYSIS-BASED FAULT DIAGNOSIS OF ELECTRIC MOTOR-POWERED MACHINES USING CONVOLUTIONAL NEURAL NETWORKS

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Keywords: Defect diagnosis, machine learning techniques, signal processing techniques, power tools, condition monitoring

This paper explores the field of vibration analysis-based Convolutional Neural Network (CNN) defect diagnostics in electric motor-powered equipment. The focus of machine health monitoring is vibration signals, which have clear benefits for fault identification. The goal is to use these signals to determine a drilling machine's operational status with accuracy (Li *et al*., 2017).

Examining machine vibration patterns is known as vibration analysis, and it can reveal important information about mechanical defects (Wang *et al*., 2018).

This technique is essential for industrial applications since it may identify a variety of problems, such as misalignment, unbalance, and bearing wear (Zhao *et al*., 2019).

Modern machine-learning techniques will be applied to the detailed analysis of vibration data to classify the drilling machine's operational state. Among the techniques used include Convolutional Neural Networks (CNNs), Support Vector Machines (SVM), Random Forests, and Decision Trees (Chen *et al*., 2020).

This study differs from previous studies in that it monitors tool wear in electric motor-powered devices instead of bearing and motor failures. In contrast to earlier research, which focused mostly on identifying mechanical defects in the machine components, this study investigates the critical factor of tool wear, which has an immediate impact on both product quality and machining performance.

Vibration signals obtained from sensors installed on the machine tool are analyzed using 1D and 2D CNN architectures in the suggested methodology. To capture dynamic changes in tool wear over time, temporal vibration data is processed using a 1D CNN, on the other hand, spectrograms produced from the vibration signals are processed by the 2D CNN to extract spatial features, which results in a comprehensive representation of tool wear patterns throughout various frequency bands.

The research will add to the growing body of knowledge regarding the faults in machines driven by electric motors that have the potential to seriously reduce production efficiency and create safety risks. Since vibration analysis records the system's dynamic response to emerging problems, it provides a useful method for fault diagnostics in this equipment. The use of convolutional neural networks (CNNs) for vibration-based fault diagnostics in electric motor-powered machinery is examined in this paper.

The research is supervised by Ph.D., Professor Emmanuel Alejandro Merchán.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 54-55
Transport and Telecommunication Institute, Valērijas Seiles 1, Riga, LV-1019, Latvia

APPLICATION OF TIME SERIES ALGORITHMS FOR CONTAINER IMBALANCE FORECASTING USING EVENT DATA

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Keywords: Container, empty container, repositioning, container imbalance, forecasting, prediction, estimation, model

According to "Forecasting empty container volumes" (Diaz, 2011) since 1998, 20% of all containers handled by ports have been empty containers. Based on public information from TransportGeography.org (Rodrigue *et al*., 2020) around 56% on container life span is idle and empty repositioning which is a lot compared to only 16% of ocean transit and 16% of terminal operations. The 'active' part of container live span when the revenue related events happen is only 38%. Increasing that part will help container shippers to fulfil a transportation demand with less containers and related to that maintenance and repositioning costs.

Container demand has yearly seasonality, which is visible from shipping data, however the container event data provide more detailed view on average 'container journey' and could be used for evaluating a container activity levels in different destination to adjust the empty repositioning forecasts. Also, container event data allows us to evaluate demand for different types of containers, like reefers or open tops for example. Using that information could help to avoid unnecessary repositioning and save money as a result. Time series algorithms like ARIMA are frequently used for forecasting data with seasonality and multiple related time variables, so evaluation of time series algorithms for container imbalance forecasting is a practical part of planned research.

Container imbalance is a global problem of container shipping caused by import/export imbalance between countries and regions. Because of that empty containers are moved to more demanding regions (where export of goods is higher than import). Moving an empty container creates costs but does not bring any revenues to a shipper. Forecasting the required number of containers in a region will help to optimize the empty container repositioning and avoid unnecessary costs while fulfilling the container demand in a region. The research goal is to find a way how equipment event data could be used for container imbalance forecasting with time series algorithms.

There are two main parts of the research. The first one is State of the Art on Empty Container Repositioning (ECR) forecasting methods and approaches. The second part is an application of time-series methods for forecasting container imbalance, experiments with real data and attempts to develop a novel data-driven framework using event data. The second part followed by discussion section with critical evaluation of received results and comparison with established in research community methods application on same scenarios.

The findings of this research are a contribution to the development of a data-driven framework for container imbalance forecasting, enabling stakeholders in the shipping industry to make informed decisions regarding container distribution and repositioning strategies. By reducing the reliance on manual forecasting methods and leveraging the power of data analytics, the framework has the potential to enhance operational efficiency, minimize unnecessary repositioning costs associated with empty container movements.

The research is supervised by Dr.sc.ing., Professor Dmitry Pavlyuk.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 56-57
Transport and Telecommunication Institute, Valērijas Seiles 1, Riga, LV-1019, Latvia

REAL-TIME LANE DETECTION AND TRACKING FOR AUTONOMOUS VEHICLE CONTROL

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Keywords: Lane, detection, tracking, vehicle, control, autonomous

Lane detection is a computer vision technique used primarily in the field of autonomous vehicles and advanced driver assistance systems (ADAS). It involves identifying and locating lane boundaries on a road or highway from images or video streams captured by onboard cameras (Al Noman *et al.,* 2023). The task is to accurately locate and track the lane markings in real-time, even in challenging conditions. However, real-time lane detection is a daunting task and is an essential component in the control of autonomous vehicle.

Creating a robust lane detection system presents several hurdles. Some of the challenges in real-time lane detection and tracking for autonomous vehicle control include:

1. Highly random traffic properties and road constraints necessitate the integration of multiple perception sensors at the sensor level, along with system and algorithm level integration to design robust lane detection systems (Xie *et al.* 2023).
2. Complex road geometries such as clothoid roads are less investigated, characterized by their curvature that changes gradually along the length, pose significant challenges for detection algorithms, as traditional methods often focus on straight or uniformly curved roads. Additionally, challenging weather conditions, vision (camera) quality, unclear line-markings, and unpaved roads pose significant challenges (Waykole *et. al.*, 2021).
3. Occlusion due to overtaking vehicles, high-speed, high illumination effects, and the use of custom-based datasets for model testing further compound the complexity of real-time lane detection and tracking (Aamir *et al.* 2021).

Addressing these challenges by ensuring robustness to varying conditions and adaptability to different road types is paramount for the efficient control of an autonomous vehicle, leveraging computer vision techniques to accurately detect and track lanes in real-time, thereby contributing to improved safety through the Advanced Driver Assistance System (ADAS) and enabling path planning and trajectory control. Moreover, lane-changing decisions based on accurate information of surrounding vehicles can optimize traffic flow throughput (Li *et al.* 2023).

Literature has shown that various methodologies, including geometric modeling, traditional methods, deep learning, and machine learning, are some of the studies currently employed for this purpose. This study, however, employs the traditional method of edge detection using 4 edge detectors and proposes the integration of deep learning techniques with traditional edge detection methods for real-time lane detection. Since deep learning algorithms, such as convolutional neural networks (CNNs), have demonstrated remarkable capabilities in learning complex features directly from raw data, making them well-suited for lane detection tasks.

By leveraging deep learning, the proposed system will aim to improve the accuracy and robustness of the edge-based lane detection in challenging environments. Steps that were employed for the edge detection are grouped into 3 steps which are:

1. Image smoothing stage: This initial step focuses on noise reduction by filtering the image. As demonstrated in (Likhith *et al.,* 2021), this process aims to enhance the performance of the edge detector by improving the quality of the image.

2. Detection stage: In this stage, the algorithm extracts all potential edge points from the smoothed image. These points serve as candidates for becoming actual edge points. Edge localization stage: This critical step involves the refinement of candidate edge points to identify the true members of the set of points forming an edge. Only those points that genuinely contribute to defining an edge are selected during this process.

In conclusion, the findings suggest that data obtained from lane detection using various edge detectors can be utilized to develop a multi-edge-detector system integrated with deep learning. This integrated system would analyze the road scene and dynamically select the most appropriate edge detector for the current lane scene, thereby enhancing the accuracy and adaptability of lane detection in various driving conditions.

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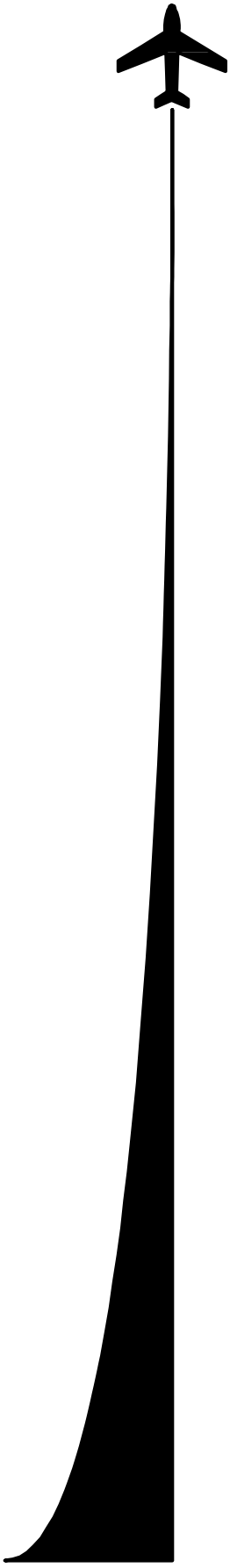

Session 2

Transport and Logistics

Transports un loģistika

RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 60-61
Transport and Telecommunication Institute, Valērijas Seiles 1, Riga, LV-1019, Latvia

SCOPE 3 GREENHOUSE GAS EMISSIONS ACCOUNTING AND REPORTING FRAMEWORK FOR AN AIRLINE COMPANY

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Keywords: Scope 3 emissions, GHG Protocol, framework, airline company

In the context of sustainability, many organizations want to understand the impact of climate change on their operations, products, and the entire value chain. Greenhouse gas emission accounting and reporting provides the baseline data needed to implement an effective sustainability and cost reduction strategy (ghgprotocol.org, 2023). The contents of Scopes 1, 2, and 3 are described in the international standard for greenhouse gas accounting and reporting (further – GHG) Protocol. Scope 3 emissions result from the use of assets that are not owned or controlled by the reporting entity; but that the reporting entity indirectly influences in its value chain (wri.org, 2011). For example, emission Scope 3 for aviation companies includes the GHG emissions associated with all raw materials purchased to provide services and all emissions associated with the use of equipment during its useful lifetime. The search for opportunities to reduce costs that do not relate to the airline's operating activities but have an indirect impact on its value creation process makes the companies follow this standard by developing their own rules or framework of its practical application at the corporate governance level. It should also be noted that the developed Scope 3 greenhouse gas emissions protocol identifies 15 emission categories, although not every category is relevant to the organization. Finally, the Scope 3 reporting is currently voluntary. However, global financial markets are forcing listed companies to report on Scope 3 emissions now, seeing this as a best practice disclosure. The above-mentioned circumstances have determined the relevance of this research topic for the national Latvian airline company AirBaltic Corporation.

The research aims to design accounting and reporting framework for the airline company to begin assessing Scope 3 emissions and develop recommendations for this purpose. To achieve the aim different research questions are developed: 1) Do aviation companies currently report GHG emissions and how do they do it. 2) What are the challenges of accounting and reporting Scope 3 emissions practice. 3) What are the main categories of Scope 3 emissions for an airline company in the context of its value chain. 4) How can the practice of accounting and reporting Scope 3 GHG emissions in AirBaltic Corporation be performed.

Research results are achieved by applying various research methods such as literature review, in- depth analysis of legislative and regulatory documents, descriptive statistics of total carbon emissions, case study analysis, including the current state of accounting and reporting practices in the airline industry and highlights the need for new methods.

The framework for Scope 3 GHG emissions developed by the author is methodological basis and practical guide, which could help the airline company to move towards more sustainable methods and innovative technologies for measuring GHG emissions that align its strategy with sustainable development goals and quantify the potential impact of Scope 3 emissions across the company’s value chain.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 62
Transport and Telecommunication Institute, Valērijas Seiles 1, Riga, LV-1019, Latvia

RESEARCH OF SMART AND AUTOMATISED SOLUTIONS IN WAREHOUSE LOGISTICS

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Keywords: Warehouse automatization, pick by voice, automated guided vehicle, automated storage and retrieval system, automated warehouse, semi-automated warehouse

This study explores smart and automated solutions in warehouse logistics, focusing on the increasing trend towards automation in material handling systems and warehouses, particularly driven by the growth of ecommerce fulfilment centres. The study delves into the various technologies such as Pick by Voice, Automated Guided Vehicle, Automated Storage and Retrieval System, and the transition from manual warehouses to automated and semi-automated warehouses.

The research examines the challenges and advantages of automation in warehouse operations, emphasizing the importance of integrating physical handling systems and information handling systems for optimal efficiency. Special attention is given to the critical aspect of order picking, highlighting the impact of inefficient manual labour on warehouse productivity.

Furthermore, the study discusses the significance of high speed and accuracy in modern warehouse operations and the role of automation technologies in enhancing productivity and reducing errors in picking processes. The implementation of technologies like pick-by-light, pick-by-voice, and other virtual displays is explored in detail, showcasing their benefits in improving hands-free working environments and increasing overall warehouse productivity.

In addition, the study addresses the advantages and disadvantages of automation in warehouse operations, emphasizing the need for proper integration, design, and standardization to ensure the reliability and effectiveness of automated solutions.

RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 63-64
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ESTIMATING GENERALISED TRANSPORT COSTS OF ROAD FREIGHT TRANSPORTATION IN THE BALTIC SEA REGION

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Keywords: Freight logistics, cost models, transport rates, Baltic countries

Transport costs play a crucial role in shaping the economic landscape of the Baltic Sea region, influencing trade patterns, industrial location, and regional development. Recognizing the limitations of traditional metrics focused on physical distance and travel time, this thesis seeks to estimate transport costs using the Generalised Transport Costs (GTC) framework. This approach is grounded in the pioneering work of Nichols (1975), which expanded the definition of transport costs to include distance and time accessibility variables, setting a new standard for transport cost estimation in the literature.

Combes and Lafourcade (2005) employed this approach for delivering precise cost estimates for French employment areas, and their work has been complemented by Hanssen et al. (2012) who factored intermodal transport solutions into GTC estimations. Zofío *et al.* (2014) advanced the methodology by applying index numbers to discern the influence of economic and infrastructure factors on Spain's transport costs.

To enhance this literature, this study introduces a unique dataset (Persyn *et al.*, 2019) that estimates the GTC across all pairs of the 268 EU regions, by analysing trips between numerous centroids within each Nomenclature of Territorial Units for Statistics (NUTS)-2 region to account for the spatial distribution of the population and by leveraging a digitalized network from OpenStreetMap, which ensures that current road conditions are accurately reflected.

The study's research methodology begins with an analytical review of GTC definitions, focusing on the formulations by Zofío *et al*. (2020), to ensure their compatibility with our Baltic Sea region focus. The next step involves a detailed examination of the European Commission's database to select the most impactful variables affecting regional transport costs, such as geodesic and road distances, travel times, fuel consumption, labour costs, tolls, and other overheads like taxes and vignettes. In the subsequent phase of the research, we undertake a comparison, juxtaposing the Generalised Transport Costs (GTCs) calculated through our methodology against the values established in the database. This validation stage is designed to fulfil two key objectives: firstly, to authenticate the accuracy of our GTC calculations; and secondly, to discover the distinct transport cost determinants that are uniquely characteristic of the Baltic countries.

In conclusion, this thesis intends to significantly enhance the understanding of road freight transport costs in Baltic Sea Region. By employing a recognized methodology and a robust dataset, this analysis aims to bridge the theoretical and empirical worlds, offering a valuable tool for both policymakers and the logistics sector, from regional authorities to logistics companies operating within Latvia.

The research is supervised by Mg.sc.ing., PhD(c) Francesco Maria Turno.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 65-66
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CUSTOMER SATISFACTION IN INFORMATION PROVISION IN BUS AND COACH TERMINALS

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Keywords: Transport terminals, services, information, visualization, signage

The actuality of this research lies in the significance of changing the mobility traditions toward public transport usage and requires considering various aspects of the customer experience in public transport services. Transport terminals are an asset to an area as they may act as catalysts for more active use of public transport. However, poorly planned, and sited terminals may generate problems as well as passengers deteriorating.

Transport terminals are important transport infrastructure elements, especially in the context of urban mobility and the need for efficient interchange facilities. Their role is to allow passengers to switch from one route or mode to another and while larger transport hubs are designed to offer travelers a variety of business and retail opportunities, the core design of the terminals should focus on transport transfers (Monzon and Ciommo, 2016). Accurate, valid, and timely information enhances the level of users' convenience and improves the efficient operation of the whole transport system (Grotenhuis, 2007). Yatskiv *et al.* (2019) investigate and assess the information provision level of four interchanges in Riga, Latvia including the Riga International Coach Terminal. Riga International Coach Terminal, which is an important interchange in Baltic Countries that supports intermodal trips, including international, national, and urban connections.

The goal of the research is to gain insights into the effectiveness of information visualization in bus and coach terminals and contribute to enhancing the overall passenger experience during journeys. The author is reviewing existing literature on information visualization in transport terminals and studies, or best practices related to improving passenger experiences through effective information design.

Transport signage as a method of information visualization plays a crucial role in facilitating efficient and effective movement within transport terminals, especially at interchange facilities. Clear and well- designed signage is essential for guiding passengers, providing information, and enhancing the overall user experience. For instance, Clear Wayfinding assists passengers in navigating through the terminal to find their desired routes, modes of transportation, exits, and facilities. Very important also is signage placement, because it is necessary to consider the visibility of signage from various vantage points, strategically place signage at eye level and in locations where passengers can easily see and follow directions without causing congestion.

The research questions are based on the goal and include:

- What are the key challenges faced by passengers in navigating the terminal?
- What specific elements of information provision contribute most to customer satisfaction?
- How effective is the current information visualization in facilitating passenger transfers at the Riga International Coach Terminal?

The author uses the following research methods for it: (1) user surveys to gather feedback from passengers on their experience with information visualization (2) experts' interviews for insights; (3) observations for understanding how passengers interact with existing information displays.

The research is supervised by Dr.sc.ing., Professor Irina Yatskiv.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 67-68
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DEVELOPMENT OF TRUCKING SERVICES IN NIGERIA (PROBLEMS & PERSPECTIVES)

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Keywords: Trucking, transportation, technology, infrastructure, safety

In response to Africa's surging commercial activities, this study delves into the current state of trucking services, identifying challenges and opportunities for development with the major focus on Nigeria which is undeniably the commercial hub of Sub Sahara Africa and arguably the largest market in Africa with a population of over 220 million (World Bank, 2022). The trucking industry, a linchpin in the supply chain, faces hurdles like poor infrastructure, lack of data, and, more. Despite these challenges, prospects arise from the AfCFTA (African Free Continental Free Trade Area) and technological advancements (AfCfTa, 2024). The study aims to analyze and propose recommendations for the trucking sector's enhancement, considering factors like structure, infrastructure, regulations, market dynamics, and technology adoption and if all of these are put in place in Nigeria, some of ECOWAS (Economic Community of West African States) neighbors like Togo, Benin Republic, Niger Republic, Ghana and others also benefit directly or indirectly from efficient trucking services in Nigeria as cross boarder trucking becomes more reliable. A secondary aim explores and compares Africa's traditional trucking practices and a trucking system that leverages technology to enhance efficiency and service delivery. Objectives encompass assessing the industry's current state, identifying challenges, evaluating technology's impact, exploring collaborations, analyzing environmental sustainability, studying global best practices, and proposing strategic recommendations. The study utilizes both quantitative and qualitative data. Quantitative data, emphasizing primary sources, aims to understand the industry's current state. Qualitative data, from reports and journals, complements quantitative findings. Convenience sampling and desk research gather data, emphasizing online sources. Descriptive and inferential statistics analyze quantitative data, while thematic analysis interprets qualitative data. This study provides a comprehensive understanding of Africa's trucking industry, emphasizing challenges, opportunities, and strategic recommendations. Rooted in a theoretical framework, the analysis uncovers a dynamic landscape influenced by infrastructure, regulations, market dynamics, and technology. Identified challenges include poor infrastructure and security concerns, countered by potentials in technology adoption and collaboration. Recommendations focus on infrastructure enhancement, regulatory strengthening, and environmental sustainability. The study highlights collaborative potentials within Africa's trucking business and advocates for policymakers and industry stakeholders to foster a resilient, efficient, and sustainable trucking ecosystem. The journey toward a seamless border crossing and robust intra-African trade requires a thriving trucking sector which in itself requires continuous collaboration, adaptability, and innovation.

The research also analyses some of the key transport and road unions in Nigeria like the Road Transport Employees Association of Nigeria (RTEAN), The National Truck Owners Association of Nigeria (NARTO) and The National Union of Road Transport Workers (NURTW) which according to ITF (International Transport Workers Federation) has almost 2 million members (NURTW, 2024) and as of this moment not associated with the IRU but chose to be an affiliate of (ITF) to protect the interests and future of transport workers in Nigeria.

The research is supervised by Ph.D., Assistant Professor Berdymyrat Ovezmyradov.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 69-70
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USE OF GREEN VEHICLE IN GREEN LOGISTICS IN INDIA

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Keywords: Green vehicle, green logistics, environmental and firm performance

Since electric cars (EVs) produce substantially fewer greenhouse gases than conventional vehicles, utilizing EVs for green logistics has several advantages. The environment and human health are seriously threatened by greenhouse gases, which include carbon dioxide, methane, and nitrous oxide. They also contribute to global warming and climate change. Once can lessen the consequences of climate change and carbon footprint by making the switch to electric vehicles (Alanazi, 2023)**.** By lowering carbon emissions, electric vehicles in logistics support environmental sustainability. They require less maintenance and, thanks to their energy efficiency, lower operating expenses. Their adoption is sometimes accompanied by government incentives, which further encourage cost savings (Hawkins, 2012). In general, incorporating electric cars improves logistics management's financial viability and environmental responsibility. The ability to save money on gasoline is another advantage of employing EVs for green logistics. One of the biggest costs for logistics companies is fuel, which is also taxable and subject to price changes (Shivanna, 2022).Conversely, electricity — which is more affordable and reliable than fossil fuels — is the energy source used by electric vehicles. Additionally, EVs use less energy to travel farther than conventional cars because they are more energy-efficient than them. Using EVs for green logistics can also increase firm's operational flexibility and efficiency, which is the third benefit. Since EVs have fewer moving components than traditional cars, they require less maintenance and repair (Aizebeokhai, 2009). Additionally, EVs are quieter and more vibration-free than traditional cars, which can enhance driver comfort and safety while lowering noise pollution. Moreover, EVs can travel through places that are off-limits to conventional cars, like residential neighborhoods, metropolitan centers, and low-emission zones (Tie, 2013). This might help logistic firms stand out from the competition and provide firm's clients with speedier, more convenient delivery options (Günther, 2015). Therefore, the main aim of this study to explore the impact of use of electric vehicles on environmental and firm performance of logistic firms. Quantitative method will be used. Data will be collected from face to face surveys. The collected data will be analyzed by using Regression analysis by using SPSS software.

The research is supervised by Dr.sc.ing., Associate Professor Genadijs Gromovs.

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IMPROVEMENT OF LOGISTICS SECTOR IN UZBEKISTAN THROUGH INTEGRATION OF SMART TECHNOLOGIES

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Keywords: Logistics, Uzbekistan, smart technology integration, improvement of efficiency

A class of technical systems referred to as "smart technology" or "smart-tech" is intended to function independently with a little assistance by users (Matthew *et al.*, 2019). In other words, smart technologies use data science, machine learning, and artificial intelligence to provide systems or devices with cognitive awareness with assistance of communication and information technologies, such as Blockchain and the Internet of Things (Choi and Wang, 2021).

Indeed, the integration of smart technologies has played an important role in revolutionizing of many areas across different kind of industries including such as: healthcare, manufacturing retail, agriculture, education, urban planning, financial service as well as transportation and logistics (Choi and Wang, 2021).

As well the study shows that logistics sector has become one of the leading industries alongside microbiology and genetic technology. Additionally, the logistics sector accounts for a sizeable amount of the GDP in both Europe and the United States. Furthermore, since Asia continues establishing itself as a major international trading hub and since a global trade volume approaches 27 trillion dollars, the logistics industry is expanding at a faster rate than before (Sezer and Abasiz, 2017).

Moreover, the author analyses successful real-life cases of integration of smart technologies in the logistics sector in other countries. As an example, DHL started operating test smart warehouses in Germany, the Netherlands and Poland. The organization has achieved notable success as a result of these measures, which have not only improved the operational efficiency but also enabled operational data visualization (Wang, 2021).

In this article the author has described the current situation and challenges of Uzbekistan's logistics sector and highlighted its potential to benefit from smart technology integration. As a nation whose economy is growing quickly, Uzbekistan is actively trying to strengthen its logistics industry in order to promote the increase of trade and the building of infrastructure. Smart technology adoption in logistics is considered to be an effective way to boost the sector's productivity and competitiveness (Sze, 2009).

Moreover, according to (Allaberdiev *et al*., 2023) there are several challenges that include but are not limited to inadequate infrastructure, inefficient customs procedures, and limited access to financing which negatively impact the country economy.

Furthermore, challenges can be divided into two parts, such as external: being double landlocked, transportation infrastructure, fuel price, lack of knowledge about the benefits of supply chain, and, internal, which is a reliance on human labor, lack of internal communication, absence of reverse logistics and lack of customer segmentation (Abdurakhmonov, 2018).

Considering all these factors, the author formulates research questions as how integration of smart technologies can impact the challenges of logistics industry of Uzbekistan? And, what benefits for society and the economy could be a result of their implementation?

Moreover, the author formulated the aim as to assess the feasibility and potential benefits of integrating smart technologies into Uzbekistan's logistics industry, as well as to identify and

address the barriers to adoption, with the ultimate goal of increasing productivity, competitiveness, and economic growth in the sector.

To achieve the aim, the author will use literature review, data collection (conducting interviews and survey among logistics experts, companies and potential users of smart technologies).

At the end the author provides conclusions and suggestions to improve logistics sector of Uzbekistan by implementing Smart technologies.

The research is supervised by Ph.D., Assistant Professor Berdymyrat Ovezmyradov.

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DEVELOPMENT OF "GREEN LOGISTICS" STRATEGY AND JUSTIFICATION OF ITS CHOICE FOR ENSURING SUSTAINABILITY IN A MEDIUM-SIZED COURIER COMPANY

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Keywords: Sustainability, last-mile delivery, alternative fuels, electric vehicles, transport, decarbonization

The need for thinking about impact on the future in order to meet public expectations and to stay competent in the modern market makes companies around the world search for ways to operate more sustainably. In business the term sustainability reflects the tendency of companies to carry out economic activity and receive profit for it in the short term, without contributing to the creation of worse conditions for themselves and the rest of society in the future (Bansal, 2014; Chladek, 2019; Chungyalpa, 2021). This paper offers an analysis of existing solutions to minimize greenhouse gas emissions and improve sustainability in a medium-sized courier delivery company. The research is aimed towards a company based in Latvia. However, the results may be used by other businesses in theBaltic region or even used as a reference material by the ones that are located anywhere else in the world.

This paper produces an analysis of the Latvia-based courier delivery company DPD Latvija to determine its possibilities and evaluate sustainable solutions that it has implemented already. The acquired results are used to compose a realistic strategy of investments and other actions which improves sustainable solutions already used by the company and implements new ones.

The main topics covered by the research are the most impactful ones and include switching to electric vehicles, usage of alternative fuels such as CNG, biodiesel and hydrogen cell, and outsourcing (Etukudoh, 2024; Holtschulte, 2022; Kostukova, 2023; Larsen, 2023; Srivastava *et al*., 2021). There are several more topics covered in the research that can be used to improve a company's sustainability and increase its contribution to decarbonization.

The produced recommendations can ensure the company effectively invests into implementation of sustainable solutions that will lower the amount of greenhouse gas emissions and potentially attract new customers. The additional value is that the recommendations can also be followed or used as a base for creating a new strategy by any company that operates in the same field and has similar assets.

The research is supervised by Mg.oec., Aleksandrs Kotļars.

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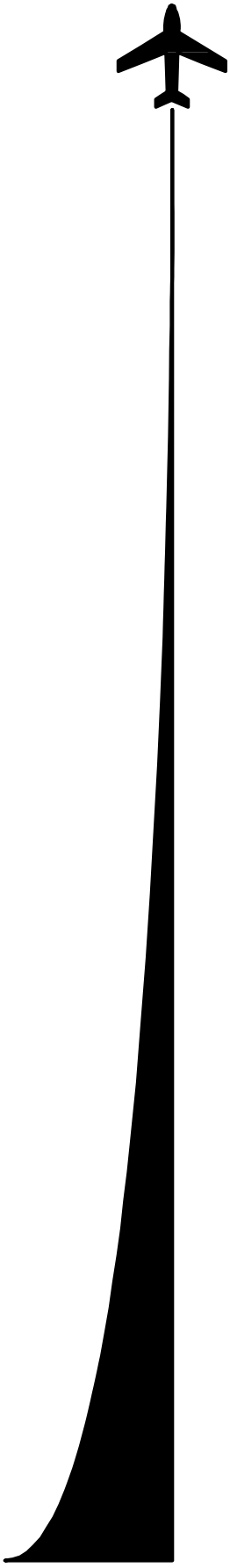

Session 3

Market: Research, Projects, Technologies and Problems of the Modern Economy and Business

Tirgus: pētījumi, projekti, tehnoloģijas un mūsdienu ekonomikas un biznesa problēmas

RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 76
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IMPACT OF REAL-TIME CUSTOMER COMMUNICATION ON E-COMMERCE SUCCESS

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Keywords: Digital business, E-commerce, customer communication, ICTs, AI

It is crucial for e-commerce companies to keep up with current trends in the field. Their success in this highly competitive area depends on several factors. One of them is efficient communication between e-commerce firms and their customers; how well a business communicates with consumers is crucial in the context of delivering a good customer experience, since modern customers always wait for an immediate response. Due to the use of ICTs information can now be transmitted instantly across huge geographical spaces. Real-time customer communication – that is online communication letting users to interact and exchange information in the real-time mode – is becoming vital to accomplish a competitive advantage.

The main aim of the study is to explore how real-time customer communication impacts the success of e-commerce companies. Research objectives are the following: to examine different real-time communication channels; to discuss the advantages of using an Omnichannel communication strategy in e-commerce. The object of the study is real-time communication in e-commerce, and the subject of the study is digital channels employed for real-time customer communication.

The data was collected through a survey among e-commerce business owners/managers. An original questionnaire was developed by the authors based on a thorough analysis of existing research on the given topic. Up-to-date works and specialized literature dedicated to the use of digital channels employed for real-time customer communication were reviewed. For testing the hypotheses IBM SPSS 26TH version was used.

Among the findings was the evident realization that prompt customer communication plays a major role in the company's growth and reputation. While some businesses use cutting-edge AI-based solutions, others have turned to social media as a quick way to communicate with their customers. Customers who appreciate prompt communication return to the same platform, which is highly beneficial for repeat business and customer retention.

The research is supervised by Dr.sc. administr., Professor Yulia Stukalina.

RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 77-78
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ROLE OF SOCIAL MEDIA FOR BOOSTING ECOTOURISM

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Keywords: Social media, ecotourism, India

India stands out as a remarkable eco-tourist destination globally, owing to its rich natural diversity. From the deserts of Rajasthan to the forests of Cherrapunji, from the Himalayas to the beaches in the South, India has established itself as a top choice for ecotourism. The core of ecotourism lies in creating value for tourists through nature exploration, local agricultural activities, adventure sports, indigenous cuisines, cultural arts, community development volunteering, and mental/spiritual rejuvenation. These engagements have the potential to prolong tourists' stays and increase tourism expenditure, while simultaneously reducing environmental impact (The Financial Express, 2022).

In 2019, India has experienced important moment in its approach to ecotourism with the introduction of the Concept Note on Ecotourism Certification Standards (NCCF, 2019), that was created in order to become a catalyst for various governmental ministries to align and consolidate their efforts towards fostering ecotourism in the country and basically was aiming to bring together multiple ministries. Later in 2022, a milestone in India's approach to ecotourism was reached with the introduction of the National Strategy for Ecotourism. (Ministry of Tourism Government of India, 2022) that can be stated as an important shift as ecotourism transitioned from being a focused practice mainly limited to certification standards and regulatory frameworks to a broader national-level strategy that was aiming to cover multifaceted aspects of tourism promotion such as marketing, and targeted campaigns, strategies applied, and consequently, unlike previous initiatives that primarily concentrated on setting certification standards and regulations. As a result, this National Strategy for Ecotourism (Ministry of Tourism Government of India, 2022) created a road map that not only addressed certification and rules but also incorporated robust plans for marketing and promotional activities and created the more robust movement towards a national-level strategy for ecotourism, including marketing and promotional efforts which was targeting to finally elevate the profile of ecotourism destinations, position India as a global leader in sustainable tourism and attract a diverse range of tourists.

Narain & Kumar (2022) argue that along with these strategies there is also important proof that promotion started to be one of the most important aspects being targeted by the government and present the case of the establishment of the Ecotourism Society of India by the Indian government, that included a 13-member group dedicated to promoting and facilitating ecotourism, as well as contributing to the development of regulations. Thus, by leveraging social media effectively, India can position itself as ecotourism destination on the global map.

The research aim is to assess the impact of social media on boosting ecotourism in India. The subject of the research is impact of social media on improving the attractiveness of ecotourism in India. The object of the research is ecotourism in India. The research questions are as follows:

1. What theoretical concepts and theories are applicable in the study context?
2. What trends and issues are associated with the ecotourism in India?
3. What is the impact of social media on ecotourism attractiveness in India?
4. What recommendations can be provided for the managers involved in ecotourism, which are aimed at improving the attractiveness of ecotourism by means of social media?

The research employs both qualitative and quantitative methods. Qualitative methods include 1) detailed analysis of the scientific literature and scholarly works on the topics of social media and their impact on promotion of tourism worldwide, including ecotourism; 2) expert interviews with the managers of travel companies involved in ecotourism. Quantitative methods include 1) collecting statistics of the tourism sector in India focusing on the ecotourism as the primary topic of the research, and its further analysis; 2) a survey among customers of the tourism companies in India.

The anticipated results lie within the theoretical and practical significance of this research. Research will contribute to theoretical assessments by analyzing the dynamics between social media and tourism promotion, specifically within the context of ecotourism in India and via the review of existing scientific papers and the evaluation of various models, will aim to identify and assess key factors influencing the effectiveness of social media in tourism promotion. By doing so, author seeks to fill existing gaps in theoretical analysis, presenting more in deep understanding of the mechanisms through which social media can be used to promote ecotourism. The study also provides insights for tourism stakeholders involved in the Indian tourism industry.

The research is supervised by Dr.sc. administr., Professor Yulia Stukalina.

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DIGITAL FINANCE AND ECONOMIC GROWTH OF A COUNTRY

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Keywords: Digital economy, digital finance, innovations

Digital technologies, traditionally referred to as information and communications technologies (ICT), have the potential to significantly reduce information asymmetry and change the role of digital financial development as a catalyst for economic growth. Digital finance was born from the combination of traditional finance and digital technologies. Digital finance has the potential to compensate for the shortcomings of traditional financial services through innovative financial products.

It is necessary to analyze the impact of digital finance on the economic growth of a country. Thus, the main research question is formulated as follows: “How does digital finance affect economic growth”? To answer this question, the authors main objective is to show the effects of digital finance on economic growth.

The study methodology includes an in-depth analysis of theoretical sources and research papers on digital finance issues. More specifically, exploiting the economic literature on the link between digital finance and economic growth and then analyzing the literature on digital finance and its impact on economic growth.

The use of secondary data provided by the World Bank's Global Fintech database on a sample of Central African countries for the year 2021 will be used. These sample countries of the central African region include Cameroon, Chad, the Central African Republic, Democratic Republic of Congo, Equatorial Guinea, Republic of Congo and Gabon.

The research results demonstrate that digital financial development plays a major role in supporting a country's economic growth and that ICT tends to strengthen this role. Therefore, the rapid development of innovations in the ICT sector due to the advent of technologies such as Internet of Things, AI, 5G have given birth to a new concept which is that of digital finance. The research results also show that digital finance is an important driver of economic growth, as it facilitates access to financing for small businesses and is also a source of productivity growth. The main limitation of this research lies in the measurement of digital finance, which remains a fairly new concept. However, as part of this work, the author used the World Bank database “DatabankWide” by selecting variables relating to the use of digital technology in the financial sector.

The research is supervised by Dr.sc. administr., Professor Yulia Stukalina.

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MANAGING INVESTMENT IN HUMAN CAPITAL IN A CHANGING ENVIRONMENT

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Keywords: Human capital, investment, development, changing environment, competition

The modern company faces numerous challenges that are constantly changing and evolving with the rapidly changing business world. One of the key challenges is to remain competitive in the face of rapid technological development. Companies must constantly adapt to new technologies and innovations to keep up with competitors and remain in the market.

Another significant challenge is attracting and retaining talented employees. In an intensely competitive environment, companies must offer attractive working conditions, develop career opportunities and create the right corporate culture to attract the best talent and retain them in the long term. (Boudreau, 2019)

Research goal: development of an algorithm of actions for the process of organizing investments in human capital in a rapidly changing environment to improve the competitiveness and sustainable development of telecommunications companies.

Research tasks:

- to determine the external environment factors influencing the human capital needs of modern companies;
- analyze the current human capital needs of Latvian telecommunication companies;
- to formulate proposals on how to improve human capital management processes for Latvian telecommunication companies.

Human capital is the set of skills, knowledge, experience, abilities and competencies possessed by a company's employees. This resource is a key asset for any enterprise, since the quality and professionalism of the staff directly affects the success of the business.

Research object: Latvian telecommunication services market.

Research subject: human capital management practices in Latvian telecommunication companies. The role of human capital for a company cannot be overestimated, since it directly affects its ability to achieve its goals and ensure sustainable growth.

Managing human capital investments in a changing environment is a complex task that requires flexibility, strategic thinking and the ability to adapt to change. In a rapidly changing business environment, companies must continually rethink their approaches to human capital management to effectively utilize their resources and ensure competitiveness (Walsh, 2021).

The conducted research allowed the author to formulate the key steps in introducing the practice of managing investments in human capital for Latvian telecommunication companies.

The first step in managing human capital investments is to analyze the company's needs and goals. It is necessary to determine what specific skills, knowledge and qualifications are required to achieve the company's strategic goals in the current and future periods.

The company must then develop an action plan for investing in human capital development. This plan may include various activities such as employee training and development, motivation and reward programs, improving work conditions and corporate culture, and developing leadership and management skills.

It is also important to take into account changes in the external environment, such as technological innovations, changes in legislation and regulation, demographic changes, etc. These

factors can affect the company's needs for human capital and require corresponding adjustments in the strategy for managing this resource.

Continuous monitoring and evaluation of the effectiveness of investments in human capital are also important aspects of management. The company must monitor the results of its programs and initiatives and conduct regular reviews to assess their impact on the business and adjust its strategy accordingly.

Finally, it is important to emphasize the importance of culture and leadership in successful human capital management. Company leaders must act as role models and inspirations for their employees, creating an environment of mutual respect, trust and support that helps maximize each employee's potential and improve overall company performance.

The research is supervised by Mg.oec. Oksana Skorobogatova.

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Transport and Telecommunication Institute, Valērijas Seiles 1, Riga, LV-1019, Latvia

DODD-FRANK REGULATION RISK MANAGEMENT IN BANKING INDUSTRY

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Keywords: Dodd-Frank Act, banking industry, trading market, risk management

The Dodd-Frank (DFA) regulation has influence on any bank or other financial institution which have transactions with the US residents or companies. The DFA regulation was signed in 2010 after the crisis in 2008 (Wilmarth, 2011); it is still in place up to today, but there were many different changes due to the market changes. According to Baily *et al*., (2017) the main goal of Dodd-Frank Act "was to increase the financial stability and prevent future devastation from financial crises." If any European bank has the operations with another bank which is established under the laws of the US, it is mandatory to be compliant with all rules stated in Dodd- Frank regulation, since the violation of the rules can be a subject for the penalty. It is crucial for banks to understand which rules can raise the biggest risks, as then there can be specific risk mitigation plan created based on the identified risks.

The *research aim* is to create risk matrix with identified risks under the influence of the Dodd-Frank regulation of trading market in banking industry. The *object of the study* is risks environment in banking industry. The *subject of the study* is Dodd-Frank regulation on trading market.

The following *hypotheses* are formulated:

H1: The timeliness rules have the biggest impact on banking risks on trading markets.

H2: The reporting requirement rules have the biggest impact on banking risks on trading markets.

H3: The verification rules have the biggest impact on banking risks on trading markets. Within the study the following methodologies are planned to be used:

- Systematic literature review;
- Case studies with examples of violation of regulation, possible fines in banking sector;
- Risk matrix methodology;
- Statistical analysis.

The study has the following limitations:

- Study is conducted in Latvia only; the results may differ for other countries.
- The latest changes within Dodd-Frank act regulation were used, not taking into consideration historical rules.
- Case studies used in study are limited with timeframe from 2022 to 2024.

The findings of the research will identify the risks with high impact on the banks and decrease the likelihood of threats and vulnerabilities of the banks.

The research is supervised by Dr. oec., Professor Jeļena Popova.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 84-85
Transport and Telecommunication Institute, Valērijas Seiles 1, Riga, LV-1019, Latvia

AI-DRIVEN DIGITAL TRANSFORMATION: CHALLENGES AND OPPORTUNITIES FOR ORGANIZATIONS

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Keywords: Artificial intelligence, challenges, digital transformation, opportunities, technology

The integration of Artificial Intelligence (AI) in business digital transformation has emerged as a transformative force, impacting organizations. However, this integration poses challenges, including technological complexities, organizational resistance, data quality issues, ethical dilemmas, and regulatory compliance.

As Davenport and Ronanki (2018) emphasize, organizations must navigate the intricate landscape of AI implementation, ensuring seamless integration across diverse platforms. These complexities may include compatibility issues, data interoperability, and the need for specialized infrastructure. Organizational resistance and cultural obstacles are significant factors that influence the success of adopting AI technology. Employee resistance, job displacement fears, and lack of comprehension might hinder growth. Lepri *et al.* (2018) highlight the importance of fostering a culture of adaptability and continuous learning to overcome resistance. Ethical considerations are crucial, particularly when AI-driven judgements have an influence on human lives. Therefore, ensuring fairness, transparency, and accountability is essential. Floridi *et. al.* (2018) stress the need for rigorous data governance and ethical considerations in AI development. AI-driven digital transformation offers immense opportunities such as enhancing efficiency, fostering innovation, and providing a competitive edge. McKinsey and Company (2021) accentuate that AI-driven efficiency gains can significantly impact an organization's bottom line. Technological complexities emerge as organizations seek to integrate AI into their existing systems. These complexities span from compatibility issues, data interoperability, and the need for specialized infrastructure. Addressing these challenges requires strategic planning, investment in robust platforms, and collaboration between IT and business units. Organizational culture plays an important role in determining the success of AI adoption. Resistance from employees, fear of job displacement, and a lack of understanding can hinder progress. Organizations must foster a culture that embraces change, encourages learning, and promotes AI literacy. They must navigate the fine line between innovation and ethical boundaries. Regulatory frameworks must evolve to keep pace with AI advancements, ensuring compliance while fostering creativity. From predictive analytics optimizing supply chains to personalized customer experiences powered by machine learning, organizations can harness AI strategically.

This paper aims to explore the challenges and opportunities in organizations from the convergence of AI and digital transformation. The research objectives include the following: 1) to examine how organizations implement AI into their digital transformation initiatives; 2) to explore how AI-based solutions may boost efficiency, stimulate creativity, and provide a competitive edge.

The object of the research is the AI-driven digital transformation within organizations. The subject of the research is the challenges and opportunities that arise from integrating AI into organizational processes, including technological, cultural, ethical, and regulatory aspects. The methodology includes a qualitative study exploring AI-driven digital transformation challenges and opportunities faced by modern entrepreneurs. Data is gathered through interviews with

business leaders with experience in AI-driven digital transformation, conducted in person or via video conferencing and recorded with participant consent. Thematic analysis is used to identify patterns and themes in interviews, forming categories to guide and assess progress and impact of AI initiatives. The results are expected to provide insights into the realm of AI-driven digital transformations, equipping organizations with practical recommendations. By comprehending the challenges and seizing opportunities, these insights empower organizations to navigate the dynamic landscape successfully. This comprehensive analysis would foster a fundamental understanding of challenges and opportunities for organizations when integrating Artificial Intelligence into Digital Transformation initiatives.

The research is supervised by Dr.sc. administr., Professor Yulia Stukalina.

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Transport and Telecommunication Institute, Valērijas Seiles 1, Riga, LV-1019, Latvia

BUILDING A SUCCESSFUL BUSINESS AFTER COMPLETING A BUSINESS INCUBATOR PROGRAM: SUCCESS FACTORS AND CHALLENGES

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Keywords: Start-up, change, business incubator, competition, success factors

Modern business is characterized by a number of features that reflect changes in the economic, technological and sociocultural environment. First, the rapid pace of change is one of the main features of modern business. Technological innovation, changes in consumer demand, and geopolitical shifts require companies to quickly respond and adapt to new conditions. (Gudgeirsson, 2023)

Globalization also plays an important role in modern business. Companies face increased competition in the global market, as well as access to new markets and opportunities to expand their business beyond national borders. (Colwell, 2019)

Young entrepreneurs are inspired by many factors that motivate them to start a business. Firstly, many of them experience a desire for self-realization and independence. They want to create something of their own, be masters of their time and resources, and realize their ideas.

Secondly, the modern economic environment provides young entrepreneurs with a wide range of opportunities. With the development of technology and the spread of the Internet, new markets and segments are emerging where young companies can successfully compete. This creates a favorable environment for starting new projects.

In addition, young entrepreneurs often see business as an opportunity to realize their ideas and participate in social change. They strive to create new products or services that can improve people's lives or solve existing problems.

The goal of the study is to use the example of the “BuSee” project to show what challenges the innovative project faced during and after participating in IDEAHUB incubator. And demonstrate project canvas

Business incubators play a key role in the development of start-ups and new businesses. They provide not only the space and equipment, but also the expert support needed to start a successful business. In incubators, startups have access to consultants on various aspects of the business, which helps them avoid common pitfalls and use their resources effectively. In addition, business incubators create opportunities to exchange experiences and establish connections with other entrepreneurs, investors and partners.

The results of the study allowed the author to identify several key success factors for an innovation project after completion of the business incubator program. One of these factors is the quality of the project’s business model. The study found that successful projects have a clearly defined business model that can ensure profitability and sustainability of the business in the long term.

It should also be noted that the project team is a key factor. The author of the study notes that having a highly qualified and motivated team that can work effectively in conditions of rapid change and uncertainty significantly increases the chances of project success.

The results obtained seem useful for entrepreneurs and investors when making decisions on further support and development of projects.

The research is supervised by Mg.oec., Oksana Skorobogatova.

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Transport and Telecommunication Institute, Valērijas Seiles 1, Riga, LV-1019, Latvia

USE OF ARTIFICIAL INTELLIGENCE IN HUMAN RESOURCE MANAGEMENT

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Keywords: Digital economy, human resource management, artificial intelligence (AI)

The integration of Artificial Intelligence (AI) into Human Resource Management processes presents an evolving domain of exploration and practical application. The potential benefits of AI integration in HRM are substantial, including process optimization, decision-making enhancement, enriched employee experiences, and data-driven insights. The widespread adoption of (AI) technologies presents the potential for significant transformations in products, innovation processes, business models, and the fundamental nature of business activities within industrial ecosystems that embrace the principles of digital transformation (Iansiti & Lakhani, 2020).

This research situates itself within a contextual framework that recognizes the evolving landscape of HRM. The *research aim* is to develop guidelines for effective use of AI in Human Resource Management. The *subject of the research* is AI-based solutions in Human Resource Management (HRM). The *object of the research* is Human Resource Management processes in an enterprise.

The following *research questions* are addressed:

1. What is the role of AI in HRM?
2. What HRM processes in corporations can be improved by implementing AI-based solutions?
3. What are current best practices for integrating AI-based solutions into HRM?
4. What are the attitudes of employees and HR managers towards the use of AI in HRM, and what factors may influence their perceptions?
5. How can AI be effectively and ethically implemented for managing HR in a corporation?

A multifaceted research approach is planned to scrutinize the effective utilization of AI in HRM:

- Literature review for providing a comprehensive understanding of the current state of knowledge, including best practices and ethical considerations related to AI in HRM.
- Case Studies for examining best practices of integrating AI-based solutions into HRM processes of different types of enterprises.
- Surveys for gathering data on employees' perceptions of using AI in HRM, the effectiveness of AI-based technologies, and potential benefits and drawbacks.
- Interviews with HR professionals and industry experts to gain a deeper understanding of the use of AI in HRM, ethical considerations, and potential implementation challenges.

The findings of the study would provide insights into how AI can be effectively and ethically incorporated into HRM practices, potentially leading to more efficient and effective HR processes. The findings could also inform organizational decision-making around the implementation of AI in HRM.

The research is supervised by Dr.sc. administer., Professor Yulia Stukalina.

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CREATING INNOVATIVE SOLUTIONS FOR HR MANAGEMENT IN THE CONTEXT OF CHANGES IN THE LATVIAN LABOR MARKET

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Keywords: Personnel management, employee competencies, work organization, decision making, Latvian labor market

Employees are the main asset of any company and their effective organization, motivation and development greatly influence the overall success of the enterprise. Therefore, human resource management helps a company achieve its goals through the optimal use of the talents and skills of its employees.

Human resource management plays a key role in the successful functioning of any organization, regardless of its size and type of activity. Proper selection of personnel, their professional training and incentives to develop skills and competencies help the company to be competitive in a rapidly changing business world (Tuckwood, 2020).

Purpose of the study: to develop proposals for the Latvian company “Locale” that can improve personnel policy.

As part of the study, an analysis of current trends and challenges faced by companies in the Latvian labor market was carried out, and potential opportunities for introducing innovative approaches in personnel management were identified.

Innovative solutions in personnel management are manifested in various aspects, ranging from the use of advanced technologies to the introduction of innovative methods of organizing work and motivating employees. One of the key areas of innovation in HR is the use and analysis of big data to make decisions, optimize recruitment processes, measure performance and forecast staffing needs.

Innovations in HR management are also associated with the development of flexible forms of work organization, such as remote work, flexible schedules and the use of modern technologies to ensure effective interaction and coordination of distributed teams (Mitchell, 2022).

It should be noted that successful implementation of HR innovation requires not only technical expertise, but also the ability to create a supportive culture in the organization in which employees perceive change as an opportunity for personal and professional growth, rather than as a threat.

Well-organized personnel management contributes to the creation of a healthy and stable organization that can adapt to changes in the external environment, overcome difficulties and develop successfully in the long-term.

The research is supervised by Mg.oec., Oksana Skorobogatova.

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DEVELOPMENT OF MARKETING STRATEGY FOR BUSINESS EXPANSION IN OIL AND GAS INDUSTRY

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Keywords: Marketing strategy, business expansion, oil and gas industry

Contemporary world has witnessed dramatic changes in the geopolitical landscape that have expanded international trade (Cateora *et al.*, 2019). The oil and gas industry are a critical sector that fuels global economic growth, drives technological advancements, and meets the energy demands of nations worldwide. However, with increasing competition, evolving market dynamics, and shifts in consumer preference, companies within the oil and gas sector are continually challenged to innovate and expand business.

The aim of this study is to develop the main components for an oil company's business expansion marketing strategy. The aim of the study is to be achieved by solving the following tasks:

1) What are the main trends in the development of the oil and gas market?
2) Assess the level of competition in the oil and gas market to identify the strengths and weaknesses of the company under study and determine the competitive advantage.
3) Segment consumers and determine the target audience.
4) Develop a price quotation, emphasizing factors such as reliability, efficiency, sustainability, and cost-effectiveness.
5) Identify channels for marketing communications and information dissemination.
6) Identify the factors that form a strong brand.
7) Develop a comprehensive marketing mix based on integration of all components of marketing mix.

The results of the study are based on the explore and generalization of economic literature and scientific publications, analysis of world statistics, as well as marketing research, which helped to identify the main trends in market development, peculiarities of consumer behavior and competitive analysis. Developing a marketing strategy is aimed at stimulating company growth, increasing brand awareness, and establishing long-term customer relationships.

The development of a marketing strategy tailored to the unique challenges and opportunities of the oil and gas industry is essential for driving business expansion and success. By conducting thorough market analysis, understanding customer needs, and implementing targeted marketing initiatives, companies can position themselves for growth, innovation, and sustained competitiveness in the dynamic oil and gas marketplace.

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Session 4

Modern Technologies of Education

Mūsdienu izglītības tehnoloģijas

RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 92-94
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BASIC TEACHER KIT FOR DEVELOPING LECTURES USING ARTIFICIAL INTELLIGENCE

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Keywords: Lecture content, prompt engineering, xml and pptx code generation, quiz generation

The active process of digitalization of higher education, as well as the whole of society, has presented new challenges to the education system in general, and to higher education. A new vision of the next-generation university has emerged, which was described in (Kabashkin, 2023). The first reviews of the situation in the field of application of AI in higher education have already been published (Crompton, 2023). The transition to a new education system does not imply abandoning the methods of classical higher education pedagogy conducting lectures. The emergence of new computer technologies makes it possible to significantly modernize the process of preparing and delivering lectures (AI Tools, 2023). In this work, we will consider only one aspect of this problem - preparing a new lecture.

Developing a new lecture by a teacher is a labor-intensive creative process that requires not only teaching experience but also the use of modern computer technologies. The emergence of generative artificial intelligence has opened new opportunities for educators here.

Let's consider the basic needs of a teacher when creating a new lecture, which can mainly be satisfied by the free online service ChsatGPT3.5 from OpenAI.

Let's set the following tasks:

1. Determine the content of the lecture on the topic given by the teacher and select appropriate literary sources (educational materials).
2. Prepare a lecture presentation.
3. Prepare additional reading materials on the topic of the lecture.
4. Develop questions for self-assessment of students' knowledge on this topic.

In solving all these problems, a significant contribution can be made by the free version of generative artificial intelligence ChatGPT3.5, which we will focus on in the examples. In addition, we use Python's IDLE Shell to execute the AI-designed program. We will load the material into LMS Moodle using the Moodle platform itself. We will also use the standard Windows program - the Notepad text editor.

We communicate with generative AI by writing prompts (prompt engineering). We remind you that all results obtained in response to a request must be double-checked to exclude "hallucinations"!

For example, a request to create a draft lecture content on a given topic might look like this:

```
Create a draft lecture content on the topic of Software Architecture
Types for university third-year Computer Science students.
```

Next, it is advisable to carry out an iterative process to develop a draft presentation for the lecture. To do this, you can offer prompts of the following type:

```
Please advise a set of 30 slides for the presentation for the
lecture developed.
Can you develop more content for the slide 15?
```

Once you have the initial content of your slide deck to your satisfaction, it makes sense to save it in a text file, such as MyPresentation.txt (using the Notepad.exe editor). We will convert this file into pptx presentation format for subsequent refinement using the Power Point application.

To do this, we will ask ChatGPT3.5 to write a Python program to encode the prepared slide descriptions into pptx format. To do this, we use a prompt, for example:

```
Create Python code for generating pptx file with developed presentation slides from Slide 1 to Slide 30.
```

Then we will create an empty text file, for example, using the Notepad editor, with a .py extension (for example, PPTX_generation_code.py), where we will copy the AI-generated code with the content of the presentation being developed.

If the presentation is large, then ChatGPT3.5 may not generate code for all presentation slides in one request. This is due to limitations on the buffer size for a one-time request.

Then the request can be repeated several times with a prompt of this type, for example:

```
Generate code for slides from Slide 3 to Slide 5.
```

The resulting code must be manually added to the appropriate place in the PPTX_generation_code.py file.

This technique can be repeated many times!

Afterward, you can proceed to generate the presentation itself in PPTX format. To do this, you will need to install Python with the ***python-pptx*** library. You can install it via pip:

```
pip install python-pptx
```

NOTE! Do not forget to check PATH check box during Python installation.

When all the prepared slides are encoded and placed in a file in Python (.py), then place this file (in our example it is PPTX_generation_code.py) in the desired directory, launch the IDLShel Python environment, open your .py file, and execute it. As a result, a presentation file in PPTX format will be created in the same directory.

Thus, you have received an excellent presentation template that can easily be supplemented with pictures and diagrams found on the Internet using, for example, Copilot AI in the Edge browser.

All we have to do is prepare Quiz to test students' knowledge on the topic of the lecture. To do this, we ask ChatGPT3.5 to generate 10 MCQ questions with 4 options and correct answers on the topic of this lecture.

If a request to generate questions about a lecture takes place in one session, then there is no need to insert the lecture content into the prompt. If the session is new, then the topic and content of the lecture should be indicated at least briefly.

For example, a request might look like this:

```
Generate 10 MCQ questions with 4 options and correct answers on the topic of the lecture "Layered Architecture".
```

We recommend saving the resulting AI response text in the Quiz.txt file.

The next step is to encode this quiz in XML format for Moodle and then upload it to the LMS question bank.

To do this, prepare a prompt with the following content:

```
Please code the following MCQ Quiz in xml format for Moodle XML for uploading: <Please put here questions generated by AI from the file Quiz.txt>
```

Place the answer received from the AI in a file named Quiz.xml.

If in one request the AI generates only part of the question code, then you need to repeat requests of the following type several times:

```
Could you generate the next 5 questions from the list by following
the same format?
```

Such a request must be repeated as many times as necessary, and the received answers must be manually inserted into the Quiz.xml file in the appropriate place and saved.

To post the received quiz in LMS Moodle, you first need to place the generated questions in the Question Bank. This can be done in the main menu of the bite administration: Edit Setting, More, Question Bank, Import. There you need to select the Moodle XML format, the file name (in our case it will be Quiz.xml), and import it.

After this, you need to create an empty quiz in the right place in the course, and in the question editing mode, add the generated questions from the Question Bank.

The presented experimental material shows that a university teacher, with significant help from AI, can create basic materials on the topic of a lecture (lecture notes, presentation, and questions to test knowledge) within 2-3 hours or faster.

Thus, we can recommend the use of the popular AI option ChatGPT 3.5 in combination with traditional tools of digital educational technologies as an effective means of creating teaching materials for modern lectures. The main advantage of this approach is the flexibility in the development of individual elements of teaching materials for their prompt updating. As a result, this makes it possible to significantly reduce the unproductive labor costs of university teachers.

In conclusion, it can be argued that large language models (LLM) can play not only the role of a consultant in various areas of university education but also actively participate in the development of teaching materials for the educational process, preserving the teacher's resources for creative activity.

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RESEARCH and TECHNOLOGY – STEP into the FUTURE, 2024, Vol. 19, No. 1, 95-96
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ARTIFICIAL INTELLIGENCE USING IN THE EDUCATION PROCESS AT RIGA PURVCIEMS SECONDARY SCHOOL

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Keywords: Artificial intelligence, application of artificial intelligence in education, impact of AI on student motivation in classes

Artificial Intelligence (AI) refers to the capability of systems to accurately interpret external data and simulate human-like behaviors, such as rational decision-making, cognitive agility, strategic foresight, and inventive thinking. With the help of AI, technical systems are able to evaluate their surroundings, utilize acquired information, and resolve issues with a certain level of autonomy in order to achieve specific goals (Eiropas Parlaments, 2020).

AI systems are capable of exhibiting behavior by analyzing the impact of previous actions and working autonomously. The use of AI can influence the improvement of the quality of education by being used as an individual consultant to help create students' training programs, and to quickly find and structure the necessary information (eLearning Industry, 2023). The main goal of this study is to research the areas of AI application and to examine how the application of AI in education will affect students' work motivation in the period from 27.11.2023 to 22.02.2024. First, surveys were created for teachers and students to understand their readiness to use AI in the school's educational process.

The participants of this survey include 18 school teachers and 61 students from grades 10 to 12.

Analyzing the responses to the survey questions, it was concluded that 72.2% of teachers see the potential of using AI in education, and 66.7% of them would like to use it. The most popular and well-known AI program among teachers is ChatGPT, but some teachers have experience with chatbots, Gamma.app, and the Magic School application.

Among the students, all respondents answered that they know what AI is, and 86.9% indicated that they are aware of its potential use as a tool in education. The most widespread and popular AI program among students is ChatGPT, as absolutely all respondents know about it and almost all of them have used it. 91.8% of students said they would like to use AI systems for learning, and 68.9% of respondents would recommend introducing it into the curriculum.

Together with the school's programming teacher, tasks were developed for programming lessons, where solving them with the help of artificial intelligence was allowed. During the experimental lesson in programming with the use of AI, a total of 71 students participated in the lesson, including: 23 students from class 10a, 18 students from class 10b, and 30 students from class 11a.

After the experiment, students were surveyed about changes in their learning motivation level due to the use of artificial intelligence in classes. The majority of students noted that they have little experience in using AI and about 60% have been using it for no longer than a year. Considering the survey results, it can be understood that 47.8% of the class 10a students, 72.2% of the surveyed class 10b students, and 66.7% of the class 11a students believe that their motivation for work in programming classes has increased by using artificial intelligence. Some students expressed the opinion that AI is convenient to use and its application makes their work easier.

The use of AI only increased interest in students who were actively and partially interested in programming. For students who were not interested in learning programming the use of AI had almost no impact. This could be due to the following reasons:

1. Students need to consider questions for generating code with the help of artificial intelligence, which also requires knowledge of programming basics.
2. After obtaining commands generated by artificial intelligence, they had to be used in the provided website template, which also assumes the existence of knowledge of programming basics.

Students and the majority of teachers have a positive attitude towards the use of AI in the learning process. AI can ease the work of teachers and shorten the time required for preparing materials and assignments. As a result of the experiment, recommendations were made for the use of artificial intelligence in the learning process.

Recommendations for the use of AI in the education process include (UNESCO, 2023):

1. Get to know artificial intelligence: Understand the basic principles and capabilities of AI before using it in the educational process.
2. Integrate AI in content creation: Use AI to create personalized content offerings that cater to each individual student, helping to adapt the learning experience and address learning differences.
3. Be informed about ethics and privacy considerations: Before using AI, ensure an understanding of the ethical and privacy implications of data processing and usage, adhering to appropriate security standards for student data protection.

Artificial intelligence is a tool, not a goal in itself. To achieve the best results, it must be integrated into the learning process thoughtfully and with clear objectives.

The research is supervised by Mg. paed., Svetlana Lisova, Programming Teacher, Riga Purvciems Secondary School, and consulted by Dr.sc.ing., Professor Boriss Misnevs, Transport and Telecommunication Institute, TSI.

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EVALUATE THE EFFECTIVENESS OF PERSONNEL TRAINING SYSTEMS IN ORGANIZATIONS

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Keywords: Training system, personnel of organization, evaluation methods, employee competencies

Personnel training plays a pivotal role in enhancing organizational performance and achieving strategic objectives. Evaluating the effectiveness of staff training is a comprehensive procedure for analyzing the knowledge gained, skills acquired, and the overall development of employees. It helps to understand whether financial investments justify themselves. With the help of evaluation methods, it is possible to analyze how much the efficiency of the employee has increased, competencies, and level of professionalism have improved. Accordingly, you will be able to predict the rationality of further investments. Any thorough need assessment phase must address three key areas: The organization, the job, and the individual. Organizational assessment considers the proposed training within the context of the rest of the organization. An important is whether the proposed training will be compatible with the organization's mission and strategy, goals, and culture (Goldstein and Ford, 2002).

Evaluation is also needed as modern universities do not cope with the demands of business. There is a clear lag of educational programs of higher and secondary educational institutions from the constantly changing requirements of companies, rapidly increasing market expectations. It so happens that a specialist comes to production with outdated knowledge that is unsuitable for effective growth and development of the company. Accordingly, the employer is forced to invest in training. Each program needs to be assessed at this first level to help improve the model for future use. On top of that, the participants' responses are essential for determining how invested they will be in learning at the next level. Even though an optimistic reaction does not ensure learning, an unfavorable one makes it less likely that the user will pay attention to the training (Kirkpatrick & Kirkpatrick, 2006).

The study focuses on analysis of personnel training within the context of "Regional Jet" Enterprise, aiming to investigate the intricacies of its training system and formulate recommendations for system enhancement. Additionally, the study aims to assess the effectiveness of the existing training system within "Regional Jet" as a case study.

The subject of the study likely extends beyond just managing the personnel training system within the "Regional Jet" enterprise, but rather encompasses a generalized personnel training system within organizations at large.

To achieve this goal, the following objectives were established:

- To explore theoretical aspects of personnel training systems in modern enterprises, with a focus on the concept of a learning organization.
- To analyze and evaluate the effectiveness of the existing personnel training system within "Regional Jet" as a representative example of a modern organization.
- To develop recommendations for the introduction of a program aimed at enhancing the personnel training system and improving its management within the enterprise.

The research allows obtaining valuable information about the personnel training system at "Regional Jet" and has brought valuable insights into modern personnel training practices within the organization. The analysis of theoretical aspects and the evaluation of the existing training

system have provided a comprehensive understanding of the strengths and weaknesses of the current approach. Based on these results, recommendations have been formulated to change the program aimed at improving the personnel training system and enhancing its management at "Regional Jet." These recommendations enable HR managers and specialists in human resources management from other organizations to pay attention to the peculiarities of enhancing staff competence and to optimize personnel training practices, fostering continuous improvement within the organization.

The research is supervised by Dr.psych., Associate Professor Išgalejs Išmuhametovs.

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