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The conference is aimed at dissemination of scientific research results, sharing of experience, improvement of foreign language and cross-cultural communication skills, and establishing of international contacts.

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AGRICULTURE

BOTRYTIS PSEUDOCINEREA AS ONE OF THE CAUSAL AGENTS OF TOMATO GRAY MOLD

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Tomato is an economically important vegetable in Latvia. During the past decade, its import value in Latvia has increased by 50%, reaching 38.97 million euros in 2022; however, the export value has increased by 63%, reaching 13.28 million euros in 2022 [1]. Diseases caused by fungal pathogens, including *Botrytis* spp., are one of the major limiting factors in tomato production due to high yield losses. Two polyphagous species – *Botrytis cinerea* and *B. pseudocinerea* – have been attributed to tomato gray mold in different areas [2]. The aim of the present study was to identify the species of *Botrytis* isolated from tomatoes in Latvia.

Tomato leaves, stems, and fruits with characteristic symptoms of fungal diseases were collected in the central part of Latvia at the beginning and end of intensive tomato production in 2021 and 2022. Fungal strains with characteristics typical of *Botrytis* spp. were obtained by pathogen isolation on potato dextrose agar (PDA) media. Colony morphology was evaluated two weeks after incubation at 20 °C in the dark. Pathogen identification to the genus level was confirmed by sequencing the internal transcribed spacer regions of ribosomal DNA (rDNA ITS). Obtained isolates were identified at the species level by multilocus phylogenies using DNA-dependent RNA polymerase II (RPB2), heat shock protein 60 (HSP60) and glyceraldehyde 3-phosphate dehydrogenase (G3PDH) genomic loci [3].

During the 2021 and 2022 growing seasons, a total of 225 colonies of *Botrytis* were obtained from the symptomatic tomato plant tissue. *B. cinerea* was the dominant species; however, *B. pseudocinerea* was also found in low frequencies on tomatoes in the central part of Latvia. This species was identified as a causal agent of tomato grey mold in high tunnels and greenhouses with a polyethylene film cover. This is the first report of *B. pseudocinerea* on tomatoes in the Baltic region. A wide variation in colony morphology was observed for *B. pseudocinerea.* Obtained colonies were grayish white, grayish brown or brown, producing scarce, powdered, or unevenly fluffy mycelium. For some of the colonies, brownish-yellow pigmentation was observed on PDA media. If sclerotium formation was observed, they were small (≤4 mm) and black, and arranged along the edges of the Petri dish. When planning a disease management system, it must be considered that gray mold of tomatoes in Latvia is attributed to both *B. cinerea* and *B. pseudocinerea*. Further studies are required to evaluate the actual frequencies and occurrence of *B. pseudocinerea* on tomatoes in Latvia.

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References

1. Tomatoes, fresh or chilled: https://eksports.csb.gov.lv/en/years/products-selected/export/2022/TOTAL-II-07-0702/TOTAL (03.04.23)
2. Li N., Zhang J., Yang L., Wu M.D., Li G.Q. First report of *Botrytis pseudocinerea* causing gray mold on tomato (*Lycopersicon esculentum*) in Central China, 2015, *Plant Disease.* Vol. *99*, pp. 283.
3. Bankina B., Stoddard F. L., Kaņeps J., Brauna-Morževska E., Bimšteine G., Neusa-Luca I., Roga A., Fridmanis D. Botrytis four species are associated with chocolate spot disease of faba bean in Latvia, 2021, *Zemdirbyste-Agriculture*, Vol. 108(4), pp. 297–302.

ANALYSIS OF POPULATION STRUCTURE AND INBREEDING IN THE LATVIAN HEAVY WARMBLOOD HORSE POPULATION

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A breeding programme has been developed since 2004 to preserve Latvian heavy warmblood horses (LSB), because the number of these horses is small and the status of the local endangered breed has been granted. Native population conservation is important when thinking about genetic diversity both today and in the future [1]. This study is relevant for those horse breeders who are working on the preservation program of the LSB horses breed in order to more efficiently plan their breeding work. The aim of the study was to analyze the population structure and inbreeding of the LSB horse population. A previously conducted study in Latvia proved that the inbreeding coefficient increases for the Latvian heavy warmblood horse population [2].

The research used the database of the Latvia Horse Breeders Association with the pedigree data of LSB horses. Pedigree data recording started in 1927. For LSB, the reference population included 257 females and 117 males that were alive at the time of data selection. For reference animals of both breeds, as many ancestor generations as possible were considered. The software POPREP was used for the analysis of the population structure and the inbreeding coefficient.

While analyzing the population structure, it was concluded that the number of offspring raised for breeding varied from year to year, and it cannot be claimed that the number decreased rapidly in the last five years. During the last 10 years, the largest number of foals (24 foals) that were raised for breeding was in 2016. In the LSB population, the average age of breeding mares and stallions at the time of foal birth was between 8 and 15 years.

The generation interval, which is longer in horses than in other farm animals, has a major impact on genetic progress. In the LSB population, the average generation interval over the last 10 years was similar for stallions and mares - 8.8 years on average. There are only 5 stallions in the LSB population, who have left between 12 and 18 offspring during their lifetime, the contribution of the other stallions to the production of breeding animals being significantly smaller. The largest number of offspring raised for breeding from one mare was 5 animals.

The pedigree information of the first generation of Latvian heavy warmblood horses, starting from 1985, is 100% known; for the second generation starting from 2003, 100% pedigree information is also known,

The inbreeding coefficient was up to 5% for the majority of animals in the Latvian heavy warmblood horse breed. Higher inbreeding coefficients were observed only in some animals. In the last twenty years when the offsprings were born, out of 374 animals alive, 34 animals have a 0% inbreeding rate; this is 9.09% of all the living population. A majority of animals (320 animals) or 85.56% have an up to 5% inbreeding coefficient. 15 of the studied animals alive have a 6-10% inbreeding coefficient; it is 4.01%. 3 horses have a 11-15% inbreeding coefficient (0.80%). A 16-20% inbreeding coefficient was found in only 1 animal, which is 0.27% of the studied population. Up to 21% is the same situation as for the 16-20%.

In conclusion, the inbreeding coefficient can increase in the LSB population, because related stallions and mares can be used for the production of offspring, since 100% complete pedigree information is known for the 1st and 2nd generation.

References

1 . Latvijas siltasiņu zirgu šķirnes braucamā tipa audzēšanas programma, 2019, Latvijas šķirnes zirgu audzētāju asociācija, p. 41.
2 . Veidemane A., Jonkus D., Paura L., Efektīvās populācijas lielums Latvijas siltasiņu zirgu šķirnes braucamajā tipā, *Līdzsvarota lauksaimniecība 2021, Zinātniski praktiskās konferences tēzes*, 2019, Jelgava: LLU, p. 58.

INFORMATION TECHNOLOGIES

NATURAL LANGUAGE PROCESSING FOR SOFTWARE ERROR DETECHTION: REVIEW

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Although an integrated development environment provides a rich toolset for code search and debugging, junior and expert developers have difficulties while setting up projects which have issues, especially in the case of handover or when passing source code to people who have not worked on that project yet or have just joined the team. Going through all commit messages for a large project in the case of a source code issue can be time consuming and inefficient, whereas a helping hand and information from a co-worker could significantly help in problem solving.

The aim of this research is to find out how natural language processing (NLP), which has already been widely adopted for the source code summarization, code search, clone detection, code refinement, code suggestion and code translation, could help to determine and solve potential issues in the project files. Automatically generated overview (summary) or suggestions for potentially defected files or even automatic issue detection and code refinement could significantly improve developer productivity.

The NLP models known to date use Transformers which calculate the results in a parallel manner using a self-attention mechanism, allowing a model to be trained in a shorter amount of time and with less computational cost comparing with sequential based models. [2][4]

Creating deep learning models that are capable of detecting and potentially fixing bugs is a fundamental task in AI research, as a solution requires human-level understanding of program code and contextual cues from variable names and comments. To exploit the rich structure of the code, including its syntax, data, and control flow, relational transformers and graph neural networks (GNNs) can be used. Little research has already been done in the above-mentioned research area, e.g., BugLab, which is a model developed by Microsoft researchers, was specifically designed to detect and fix software issues by jointly training two models to play a hide-and-seek game where first model introduces the issue and second one tries to find and resolve it. The authors state that computers could be promising bug detectors, although much more work is needed to make such detectors reliable for practical use. [1].

Similarly, the programming model Codex has been tested on generating feedback for the syntax errors which includes the resolved program and a natural language explanation describing the errors and solutions the way a human tutor would give feedback. The challenge the authors face is how to ensure high accuracy in the generated feedback, which is important for correct decision making [3].

Although NLP models are now capable of understanding the source code of programmer's intent, they offer no guarantees about the quality of the suggested code or feedback. This could be a further research area when conducting practical experiments. In addition, graph-based neural networks seem to be a promising area for further research in source code modelling.

References

1. Allamanis M., Jackson-Flux H., & Brockschmidt M., Self-supervised bug detection and repair. *Advances in Neural Information Processing Systems*, 2021, 34, 27865-27876.

2. Delvin J., Chang M. W., Lee K., Toutanova K., BERT: pre-training of deep bidirectional transformers for language understanding. arXiv preprint arXiv:1810.04805, 2018.

3. Phung T., Cambronero J., Gulwani S., Kohn T., Majumdar R., Singla A., & Soares G., Generating high-precision feedback for programming syntax errors using large language models. *arXiv preprint arXiv:2302.04662*, 2023.

4. Vaswani, A., et al., "Attention is all you need.", *Advances in neural information processing systems*, 2017, 30

APPLICATION OF ARTIFICIAL INTELLIGENCE IN THE PROJECT MANAGEMENT

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Nowadays, artificial intelligence (AI) is widely used in project management, especially in risk management and resource forecasting, but there are still tasks that have not been automated with the use of artificial intelligence technology. One of them is employee's allocation for project development or human resource management in projects. The aim of the research is to improve project management by applying artificial intelligence technology.

In 2019, the Project Management Institute conducted the research [1] about the impact of artificial intelligence technology in project management and found that AI usage decreased time for strategic planning (for example, task planning), reducing the number of repetitive tasks. By the possibilities revealed using big data and artificial intelligence in decision-making, companies began to develop rapidly and improve the quality of work they performed. The use of AI technologies in projects also increases the probability of achieving a larger portion of business benefits, including increasing profits and customer satisfaction and reducing costs [1].

In 2022, the creation of a knowledge-based system that predicts an employee's productivity in task completion was documented [2]. Employee productivity depends on age, gender, and skills required for task execution. Knowledge objects are represented as a mathematical relationship between an employee's age, gender, and skills. The created relationship is used to calculate productivity.

In 2022, an artificial intelligence model that predicts project costs was developed using machine learning [3]. Two development stages were documented: training and testing. The test results (calculated task completion time and costs) were compared with the calculation results obtained according to the corresponding mathematical models - in the case of task productivity calculation. it is an earned value management index-based model.

To achieve the aim of the research, an artificial intelligence model was created. The model clusters data about employees and projects required skills and work experience, their impact on an employee's choice for project development. The k-means algorithm was chosen as the artificial intelligence model is trained without an observer, determining the cluster centre that divides employees into four groups: matching by skills, matching by work experience, matching both by work experience and skills, and not matching at all. Before developing the AI model, the author pre-processed the data by cleaning and transforming datasets.

References

1. AI Innovators: Cracking the code on project performance, Project Management Institute: https://www.pmi.org/learning/thought-leadership/pulse/ai-innovators. (26.10.2022)
2. Pabolu V., Shrivastava D., Kulkarni M., Modelling and prediction of worker task performance using a knowledge-based system application, International Journal of Production Economics, 2022, Vol. 254.
3. Inan T., Narbaev T., Hazir O., A Machine learning study to enhance project cost forecasting, IFAC-PapersOnLine, 2022, vol. 55(10), pp.3286-329

REAL-TIME FACIAL EXPRESSION AND GAZE BEHAVIOR ANALYSIS FOR DECEPTION DETECTION

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Deception detection is a difficult task that has important implications for various domains, such as criminal investigations, security, and business. Traditional approaches rely on human judgement, but recent advances in technology have made it possible to use machine learning algorithms to analyze physical cues, such as facial expressions and gaze behavior, to detect deception [1]. This research proposes a novel approach for real-time deception detection that uses nonverbal cues, such as facial expressions and gaze behavior, using machine learning algorithms.

Facial expressions play a critical role in detecting deception. Liars often try to control their facial expressions to conceal their true emotions, but they may reveal subtle facial cues that give away their true feelings. These expressions may include a fleeting smile or a slight twitch in the face [2]. Understanding the significance of facial expressions in deception detection can help to make better decisions and avoid wrongful convictions.

Gaze behavior is another important factor in the detection of deception. People who are lying tend to avoid looking someone in the eyes, or they use a lot of eye contact [3]. The behavior of the gaze, such as looking towards the top right corner or left bottom corner, gives away whether the information is taken from visual memory or verbal memory. Understanding the importance of gaze behavior helps with deception detection.

The research shows that real-time facial expression and gaze behavior analysis can be used to detect deception, but there are still some challenges to be overcome. These techniques need to be improved so that they can be used responsibly and effectively in different situations. More research is needed to develop more accurate and comprehensive analysis methods, and to see whether these techniques are effective in real life.

References

1. Monaro M., Maldera S., Scarpazza C., Sartori G., Navarin N., Detecting deception through facial expressions in a dataset of videotaped interviews: A comparison between human judges and machine learning models, *Computers in Human Behav*iour, 2022, Vol. 127, p. 107063, doi: 10.1016/j.chb.2021.107063.
2. Khan W., Crockett K., O'Shea J., Hussain A., and Khan B.M., Deception in the eyes of deceiver: A computer vision and machine learning based automated deception detection, *Expert Systems with Applications*, 2021, Vol.169, p.114341, doi: 10.1016/j.eswa.2020.114341.
3. Mirsadikov A., George J., Can you see me lying? Investigating the role of deception on gaze behavior, *International Journal of Human-Computer Studies*, 2023, vol. 174, p. 103010, doi: 10.1016/j.ijhcs.2023.103010.

ASYNCHRONOUS PROGRAMMING WITH COOPERATIVE MULTITASKING IN MODERN BUSINESS LOGIC OF CRITICAL SYSTEMS

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Asynchronous programming as an event-driven model has been in active research [1] since the 1990s. The main goal in modern applications is efficient utilization of system resources while allowing for the serving of more clients and requests than the more classical processes and threads model can provide. Although Node.js® was not a pioneer project in this field, it is possibly the one which has been most adopted in the industry with a good reputation because of decent performance in a single non-blocking event loop [2]. The industry leans towards cooperative multitasking using various coroutine technologies and conventions, which allow sharing a single operating system thread's execution time among independent business logic task flows. The long-standing problem of all event-driven technologies is so-called "Callback Hell" [3]. The problem has been relatively successfully mitigated by the remarkable async/await programming pattern originally coming with the proprietary Microsoft's C# 4.0 specification update in 2012 and later standardized as ECMA 334 5th edition specification in 2017 [4]. The pattern allows splitting what looks to be a linear business logic into code fragments which get executed with partial ordering in scope of some covert event loop.

As part of his Bachelor work, the author has reassessed the state of affairs in the asynchronous programming field in scope of modern business logic for critical systems. The original non-academic research was conducted back in 2014 and culminated with FutoIn® FTN12 AsyncSteps specification [5] and its reference implementations in various technologies.

This new research effort has identified the same old issues with widespread solutions: a) lack of business flow as an identifiable entity, which limits the ability to manage and reference it like a thread or a process; b) the resulting orphan actively executed code upon cancelation when any results are just discarded; c) the further resulting general resource accounting issues and even Denial-of-Service situations; d) lack of general approach for time limiting of task execution at runtime environment level; e) in some cases outside of ECMAScript (a.k.a. JavaScript) world, problematic debugging; f) latent troubles with loops; g) lack of a real cross-technology solution to seamlessly span asynchronous business logic flow across different types of technologies like C++, ECMAScript, C# and Java for example.

The research shows how FTN12 AsyncSteps still remains relevant and extends that with a low-level binary interface similar to C++ virtual function tables and Java Native Interface.

References

1. Schmidt D., Stal M., Rohnert H., Buschmann F., Pattern-Oriented Software Architecture, Patterns for Concurrent and Networked Objects, Volume 2, John Wiley & Sons, 2000, pp. 22–268.
2. Chhetri N., A Comparative Analysis of Node.js (Server-Side JavaScript), M.S. thesis, St. Cloud State Univ., St. Cloud, MN, USA, 2016.
3. Zamora-Gomez E., Garcıa-Lopez P., Mondejar R., Continuation Complexity: A Callback Hell for Distributed Systems, 2015, Euro-Par 2015 Workshops, pp. 286–298, doi: 10.1007/978-3-319-27308-2_24.
4. Standard ECMA International, C# Language Specification, ECMA-334, 2017, 5th Edition.
5. FutoIn Async API, FutoIn FTN-12, 2014: https://specs.futoin.org/final/preview/ftn12_async_api.html (23.02,2023)

BLUETOOTH LOW ENERGY METHODS FOR DISTANCE ESTIMATION AND CALCULATION

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Along with interior navigation, asset monitoring, and location-based services, Bluetooth Low Energy (BLE) technology has emerged as a potential option for distance measurement, calculation, and placement in a variety of applications. The Received Signal Strength Indicator (RSSI) and Angle of Arrival (AOA) approaches are two of the many methods used for distance estimation utilizing BLE.

The generally used method for determining the separation between BLE devices is RSSI. It utilizes the radio signal strength between the devices to determine the distance. The RSSI method's simplicity and low computing overhead are two of its key benefits. It is a cost-effective choice for distance calculation because it doesn't call for any extra gear or specialized tools. Inaccurate distance estimations might result from RSSI's sensitivity to ambient elements such obstructions, multipath interference, and signal attenuation. Moreover, sophisticated signal processing and calibration methods are needed to increase the accuracy of RSSI-based location.[1]

Another well-liked technique for determining the separation between BLE devices is AOA. It determines the radio signal's angle of arrival between the devices and uses that angle to determine the distance. The excellent accuracy of AOA even in situations with significant multipath interference and obstructions is one of its key benefits. Moreover, signal attenuation has less of an impact on AOA, which can deliver precise distance estimations with less calibration. However, the expense and complexity of AOA are increased by the need for additional antennas and specialized signal processing methods.[2], [3]

In conclusion, RSSI and AOA each have advantages and disadvantages when it comes to estimating distance utilizing BLE technology. While simple and inexpensive, RSSI is subject to environmental influences and needs sophisticated signal processing techniques for precise placement. AOA involves several antennas, is more expensive, and is more complicated than other methods, but it is more accurate and less influenced by ambient conditions. A method's suitability for a given application is determined by the complexity, cost, and degree of precision required.

References

1. Ramirez R., Huang C.-Y., Liao C.-A, Lin P.-T., Lin H.-W., Liang S.-H., A Practice of BLE RSSI Measurement for Indoor Positioning, *Sensors,* 2021, Vol. 21, (15), p. 5181, doi: 10.3390/s21155181.
2. Li C., Zhen J., Chang K., Xu A. Zhu H., Wu J., An Indoor Positioning and Tracking Algorithm Based on Angle-of-Arrival Using a Dual-Channel Array Antenna, *Remote Sensing* (Basel), 2021, Vol. 13, (21), 4301, doi: 10.3390/rs13214301.
3. Lin Q., Son J., Shin H., A self-learning mean optimization filter to improve Bluetooth 5.1 AoA indoor positioning accuracy for ship environments, *Journal of King Saud University - Computer and Information Sciences,* 2023, Vol. 35(3), pp. 59–73, doi: 10.1016/J.JKSUCI.2023.01.019.

INTERACTIVE GIS SOLUTIONS TO SUPPORT MODERN BEEKEEPERS

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Beekeeping is an important part of agriculture, as it supports plant growth through the pollination process as well as providing additional food resources like honey. Human population growth increases demand for food resources. It causes an increase in need of plant production that impacts the demand for pollination. At the same time, today's there are different kinds of challenges in beekeeping related to effectivene management of honeybee colonies and selection of suitable foraging locations [1].

One of significant ways to improve honeybee colony management is an implementation of ICT solutions for remote monitoring in combination with geographic information system (GIS) solutions. Preliminary scientific literature analysis shows that currently there is a deficiency in research related to implementation of GIS solutions for the needs of precision beekeeping [2]. Most existing GIS solutions for beekeeping needs are represented as a static maps that provide information about the situation at a specific period of time. This can be useful to estimate the situation on a global scope, but could be unsuitable for local beekeeping activities due to outdated data over time and local weather conditions. In this case, an improvement could be implementation of the GIS solution based on interactive maps together with data crowdsourcing and real time monitoring of bee colonies.

The authors of this research paper within a Horizon project named Hiveopolis developed an experimental prototype of the interactive map application to explore potential ways of future research and development. Such a solution in concept consists of several functional components that ensure data exchange and update over time provided by available data sources and users of the solution (mainly beekeepers and farmers) [3]. As a result, such a solution could provide a useful set of tools for beekeepers to supervise bee colonies in real time by remote monitoring data and to plan their management activities. At the same time, such a solution could ensure collaboration between beekeepers and farmers of surrounding agricultural lands to improve agricultural activities in general. In the near future, it is important to continue research in this way for new findings.

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References

1. Martínez-López V., Ruiz C., & de la Rúa P., Migratory Beekeeping and Its Influence on the Prevalence and Dispersal of Pathogens to Managed and Wild Bees, *International Journal for Parasitology: Parasites and Wildlife*, 2022, Vol. 18, pp. 184–193: https://doi.org/10.1016/J.IJPPAW.2022.05.004 (23.02,2023)
2. Mutinelli F., Mazzucato M., Barbujani M., Carpana E., di Salvo V., Gardi T., Greco D., Bonizzoni L., Benvenuti M., Casarotto C., Bortolotti L., Costa C., The Italian National Beekeeping Registry (BDNA) as a Tool to Identify Areas Suitable for Controlled Mating of Honey Bees in Italy. *Applied Sciences (Switzerland*), 2021, Vol. 11(11), 5279: https://doi.org/10.3390/APP11115279 (23.02,2023)
3. Kotovs D., Zacepins A. GIS-Based Interactive Map to Improve Scheduling Beekeeping Activities. *MDPI Agriculture* 2023, 13 (3), 669: https://doi.org/10.3390/agriculture13030669 (23.02,2023)

ARTIFICIAL INTELLIGENCE USAGE IN CRYPTOGRAPHY

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Artificial Intelligence (AI) is a field of computer science that focuses on creating machines or software that can perform tasks that typically require human intelligence, such as speech recognition, decision-making, language translation and visual perception. AI is used in a wide range of everyday areas, such as self-driving cars, intelligent personal assistants, medical diagnosis, fraud detection, and much more.

Artificial intelligence is also increasingly being used in the field of cryptography to improve the security of cryptographic systems. Cryptography involves the use of mathematical algorithms and protocols to secure communication and protect data. This is the process of hiding or coding information so that only the person a message was intended for can read it. It has been used to code messages for thousands of years and continues to be used in bank cards, computer passwords, and e-commerce. Cryptography is widely used on the internet to help protect user data and prevent eavesdropping. To ensure secrecy during transmission, many systems use private key cryptography to protect transmitted information. With public-key systems, one can maintain secrecy without a master key or a large number of keys. AI can be used to improve the efficiency and effectiveness of cryptographic systems in several ways.

One of the main areas where AI is used in cryptography is in the development of new cryptographic algorithms. AI can be used to generate and analyse large numbers of possible algorithms, using techniques such as machine learning and genetic algorithms. This can help researchers find new algorithms that are more secure and efficient than existing ones.

AI can also be used to improve the efficiency of existing cryptographic algorithms. For example, AI algorithms can be used to optimize the parameters of an encryption algorithm, making it more efficient and secure. AI can also be used to analyse encrypted data and detect any potential vulnerabilities or weaknesses in the encryption scheme.

Another area where AI is used in cryptography is in the detection of malicious activities. AI can be trained to recognize patterns of behaviour that may indicate an attack on a cryptographic system. This can help to identify and prevent attacks before they can do any damage.

Finally, AI can be used to improve the usability of cryptographic systems. For example, AI can be used to automate the key management process, making it easier for users to securely manage their encryption keys.

Overall, the use of AI in cryptography has the potential to greatly enhance the security and efficiency of cryptographic systems. However, it is important to ensure that these systems are properly designed and tested to ensure that they are secure and reliable.

References

1. What is artificial intelligence (AI): https://www.ibm.com/topics/artificial-intelligence (10.04.2023)
2. What is Cryptography?: https://www.fortinet.com/resources/cyberglossary/what-is-cryptography (10.04.2023)
3. Artificial Intelligence and Cryptography: An Intersection: https://www.simplifaing.com/2022/06/24/artificial-intelligence-and-cryptography-an-intersection/ (10.04.2023)
4. Artificial Intelligence and Cryptography: a Match Made in Heaven?: https://hariharan09.medium.com/artificial-intelligence-and-cryptography-a-match-made-in-heaven-e29e5bfc7789 (10.04.2023)

RESEARCH OF OTDR APPLICATIONS

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An Optical Time Domain Reflectometer (OTDR) can detect, locate, and measure all the functions of (splices, connectors, bending, etc.), and report the location of each event with accuracy ranges from 4 cm to 40 meters. An OTDR uses the possibility of a RADAR and be can considered a one dimensional RADAR. Utilizing OTDR, a full report of losses and intelligent occasions (connectors and mechanical splices) fixing to the separation or land data of an optical fiber interface can be achieved [1].
OTDR makes use of the small signals that travel back the fiber. Even by backscattering or by reflection comparing their power levels and arrival time with its sent signals, it can generate a highly accurate report of what events are on a fiber link. The attenuation dead zone (ADZ) is characterized as the distance, typically for a solitary "decent" connector intelligent occasion, between the pulse's rising edges and the backscatter level's 0.5 dB deviation from a fit to a straight line. The backscatter level refers to the tilting line on the trace that produces the fiber attenuation measurement. Under ideal conditions, this dead zone data frequently gets provided. In order to offer a sign of the separation adhering to an interface at which a precise losses measurement may be done, the ADZ determination is made. This idea could work to measure the loss using the length of the dead zone singles [1, 2].
The OTDR monitors loss at a connector or splice between the two markers as well as separation to the occasion. The two markers are moved such that they are roughly the same distance apart from the splice's focus point in order to assess splice loss. As can be seen, the instrument resolution and clamour cause the trace to appear less sharp, so the splice won't look as clean as this. The OTDR will calculate the loss in decibels (dB) between the two markers and display it in dB [3].
The main aim of the research was to use the different setup connection of OTDR and to perform several experiments to find the parameter in which get minimum insertion loss in the distance and compare the analysis the output value.

References

1. Laferriere J., Lietaert G., Taws R., Wolszczak S., Reference Guide to Fiber Optic Testing, Vol. 1, JDSU, France, 2011, p 172.
2. Thevenaz L., Advanced fiber optics, EPFL Press, New York, 2011, p.300.
3. Jeunhomme L.B., Single-mode fiber optics, Routlege, New York, 1996, pp 9-29.

SOFTWARE AS SERVICE WITH CONTAINER-BASED ARCHITECTURE

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With the development of cloud computing technology, Software as a Service (SaaS) has become a popular delivery mode for enterprise applications. Because of this, SaaS providers continually seek to improve the cost-efficiency, scalability, and dependability of these services. In the SaaS model, a cloud provider hosts programs and makes them accessible to end users via the internet. A single instance of the SaaS application can run on the host servers and be used to serve each subscribing client or cloud tenant. SaaS applications and services often employ a multi-tenant approach, with all clients, or tenants, using the same version and configuration of the application. Because of this, the main goal that providers of SaaS applications strive towards is the optimization of cost-efficiency. [1]

There currently exist several tactics that seek to resolve these issues. These tactics include cloud deployment, which uses a Platform as a Service (PaaS) approach that addresses the issue of scalability. The second tactic utilizes an Infrastructure as a Service (IaaS) strategy, which provides necessary computing, storage, and networking resources on demand on a pay-as-you-go basis. The third tactic is the hybrid tactic, which combines several different approaches in order to make overall improvements to the applications. In addition to the previously described strategies, the cost-effectiveness, adaptability, and flexibility of cloud-native services may all be increased with the aid of container technologies like Docker and Kubernetes. [2], [3]

Our review aims at exploring current technological trends in the area of container-based multi-tenant architecture for SaaS applications in order to analyze potential risks and weaknesses. In addition to this, we also analyze the strengths, benefits, and overall potential of container-based architecture for SaaS applications.

Our analysis indicates that multi-tenant container-based architecture for SaaS has a lot of potential, and this approach addresses most of the issues, especially in terms of improving the cost-efficiency of multi-tenant SaaS applications. We also conclude that the most effective container orchestration technology is Kubernetes.

References

1. Truyen E., et.al., Towards a container-based architecture for multi-tenant SaaS applications, *Proceedings of the 15th International Workshop on Adaptive and Reflective Middleware*; 2016; pp.1-6.
2. Wang Y., et al., Container-based performance isolation for multi-tenant SaaS applications in Micro-service Architecture, *Journal of Physics*, 2020, Vol. 1486 (5), 052032.
3. Xing Liang Wu, Container Technology and Its Market, 2021.

ANALYSIS OF TECHNIQUES FOR OPTICAL CHARACTER RECOGNITION

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Digitization in the current day and age is crucial. We have technologies like digital twins which are used for running multiple simulation with real life information [1], 3D environment scans which could digitize real life objects and which could be later used for games or movies, and document digitization which is more relevant for day-to-day use. To digitize a document, it is necessary to first recognize characters; one of the ways to do this is OCR (optical character recognition). Several techniques/ways to assist with character recognition or make it more reliable were considered.

Usually, images were taken of vehicle license plates in different conditions. To make recognition easier, the image was corrected to be greyscale instead, which makes images smaller and process itself easier. Image segmentation using contrast is used to determine license plate location, then text recognition happens using the binarization method [2]. A deblurring technique with VBF algorithms was used to improve image quality (in terms of characters being sharper) which in turn, could yield up to 65% improvements for character recognition [3].

Several techniques like zoning algorithm, projection profile, histogram of gradients, and a combination of those were used to see which provides highest accuracy with best result being 94.43% [4].

In conclusion, it is possible to combine techniques like converting an image into greyscale and deblurring it, using higher resolution camera for taking images, while keeping in mind that increasing the distance from object increases chance of blur or loosing details. When detecting features, it is possible to get the best results with using histogram of gradients combined with projection for extracting features and support vector machine for classification.

References

1. What is a digital twin? | IBM: https://www.ibm.com/topics/what-is-a-digital-twin (10.03.2023).
2. Tote A., Pardeshi S., Patange A., Automatic number plate detection using TensorFlow in Indian scenario: An optical character recognition approach, Mater Today Proc, 2023, vol. 72, pp.1073–1078, Jan. 2023, doi: 10.1016/J.MATPR.2022.09.165.
3. Zabaldo A., Ueda J., Camera trajectory optimization for maximizing optical character recognition on static scenes with text, *IFAC-PapersOnLine*, 2021, vol. 54(20), pp. 801–806, Jan. 2021, doi: 10.1016/J.IFACOL.2021.11.270.
4. Phangtriastu M., Harefa J., Tanoto D., Comparison between neural network and support vector machine in optical character recognition, *Procedia Comput Sci*, 2017, vol. 116, pp. 351–357, Jan. 2017, doi: 10.1016/J.PROCS.2017.10.061

AIR QUALITY IN COMPUTER LABORATORIES: CO2 SENSOR SOLUTIONS

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Indoor air quality is an important aspect in maintaining a healthy and productive work environment, especially in rooms where groups of people spend a large amount of time. Carbon dioxide (CO2) is one of the main indicators of indoor air quality, as it is a by-product of human breathing, and CO2 levels in a classroom can easily spike to concentrations above 2000pmm in a single lesson [1] which is well above the maximum recommended concentration of 1000ppm. Without periodic ventilation, while the CO2 level decreases slightly during breaks, it stays above the 1000ppm threshold during the day [2]. Measuring CO2 levels in indoor environments is, therefore, an important part of ensuring good air quality. For this purpose, single-board computers such as the Raspberry Pi and microcontrollers such as the Arduino NANO and Arduino Uno have gained attention as a low-cost and efficient way to incorporate sensors into projects due to their ease of use, low power consumption, versatility, and part accessibility.

The aim of the research was to develop a system for measuring CO2 levels in a naturally ventilated classroom using both Arduino and Raspberry Pi platforms, and to investigate the relationship between CO2 levels, sensor placement, ventilation rates, and occupancy levels. The project also aimed to test different types of CO2 sensors and measure CO2 levels in different parts of the room during full occupancy, as well as use multiple sensors of each type to see how much they deviated from each other in the same room next to each other.

Multiple monitoring systems on both platforms were made to accommodate different CO2 sensors. For each sensor model, at least two systems were created to measure the deviation between the sensors and to compare it to the sensors' specifications. Sensors were placed in different parts of the classroom. A web application was developed to display and visualize the data from each sensor in a graph using JavaScript libraries.

The study found that during lectures and practical assignments, the level of CO2 in the room increased above the recommended maximum concentration of 1000ppm even when the classroom was at half occupancy and it is required to ventilate the room every 45 minutes to let the CO2 concentration decrease to a healthy level.

In conclusion, this study successfully developed multiple affordable systems for measuring CO2 levels in a naturally ventilated classroom using both Arduino and Raspberry Pi platforms. The study also found that ventilation plays a crucial role in maintaining healthy indoor air quality. The comparison of multiple sensors of each type showed that there were some differences in their measurements, but these were generally within the manufacturers' specifications.

References

1. Griffiths M., Eftekhari, Mahroo. Control of CO2 in a naturally ventilated classroom. *Energy and Buildings*, 2008, 40(4), pp.556-560.
2. Kviesis A., et al. Development of classroom microclimate monitoring system. *Engineering for Rural Development*, 2017, 16, pp.719-724.
3. Balasubramaniyan C., Manivannan D., Iot enabled air quality monitoring system (AQMS) using raspberry Pi. *Indian Journal of Science and Technology,* 2016, 9(39), pp.1-6.

FINGERPRINT BASED VOTING PROJECT

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The Fingerprint Based Voting Project is an innovative application that utilizes an individual's unique fingerprint pattern to verify their identity. Since each person has a distinct fingerprint pattern, this system allows for easy and efficient verification of voters. Through the use of fingerprints, users can be identified with great accuracy, and the system permits them to cast their vote electronically. Additionally, the system allows the administrator to attach candidate names and photos for voters to choose from, as well as register voters by verifying their identity through proof of identification. Once the election is over, the system automatically deletes the number of candidates attached to it. The user is permitted to vote only once, and the system ensures that the same voter does not vote for multiple candidates. The system offers a login module, registration module, fingerprint verification module, new candidate module, and result module. The user and admin can log in by entering their id and password, while the verified user can vote for their preferred candidate only once.

The system also permits the administrator to add any number of candidates when a new election is declared, and users can view the election results through the election id. However, a disadvantage of the system is that if a voter's finger pattern is damaged, the system may not be able to identify the user accurately. The system can be applied in a variety of contexts where elections are taking place. The software requirements include Windows XP or Windows 7 (ultimate, enterprise), SQL 2008, and Visual Studio 2010, while the hardware components required include a processor-i3, hard disk-5 GB, and memory-1GB RAM.

The fingerprint based voting project is used to identify the individual through his finger pattern. This system allows the person to vote for their candidate for only one time. It does not allow voter to vote a second time. The administrator can also add the names of candidates so that voters can easily vote them and register the voter’s proof of identity. A voter can also check the result when election is over. Therefore, this system is also called a modern technique of voting.

Reference

1. Fingerprint election voting system project, Nevon Projects: https://nevonprojects.com/fingerprint-voting-system-project-2/ (29.03.2023.)
2. Fingerprint based voting system, JP Infotech. https://jpinfotech.org/fingerprint-based-voting-system/ (29.03.2023.)
3. Dahal D., Electronic fingerprint voting system, *Theseus*: https://www.theseus.fi/bitstream/handle/10024/267354/dahal_dibya.pdf (29.03.2023.)

EGG FERTILITY DETECTTION IN HATCHERY USING ARTIFICIAL INTELLIGENCY

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Artificial intelligence (AI) has been used to speed up processes in fields such as agriculture, animal husbandry, medicine, education. In the field of poultry, breeding with AI can control not only the bird's weight, welfare, and water and feed consumption at the farm, but also control processes at the hatcheries. Most of the breeding industries have a major problem in detecting ideal eggs with embryos from infertile eggs. For example, Nasiri et al. (2020) [1] used a deep learning computational vision method for egg classification in their research. They were able to implement an egg sorting system based on the modified architecture of VGG16, the trained model being based on intact, bloody, and broken eggs (break, crack or hole in the egg shell), with an overall average accuracy of 94.84%. Their method cannot be used to detect an embryo in the egg, but at least can sort and removed broken eggs.

In Saifullah et al. (2022) research work [2], egg fertility detection was done by the Support Vector Machine (SVM) method using the second-order statistical feature extraction based on the Gray-Level Co-occurrence Matrix (GLCM) approach. They were able to classify two types of fertile and infertile by taking 100 egg samples; with the SVM-GLCM approach, it is possible to detect fertile and infertile eggs with a success rate of 98.20%. SVM-GLCM method might take a while to perform the task. The egg candling method in the Reis and Soares (1993) research work [3] was used, and the authors concluded that candling has no effect on hatchability and chick quality, but it is difficult to establish for a large number of eggs and requires a lot of resources.

Our research study will be to prepare a set of methods such as k-nearest neighbours (KNN), which is much faster than SVM in simulating intelligence on an electronic device so that it can tell us with an acceptable percentage of accuracy whether an egg is fertile or not.

References

1. Nasiri A., Omid M., Taheri-Garavand A., An automatic sorting system for unwashed eggs using deep learning, *Journal of Food Engineering*, 2020, Vol. 283, p.110036, doi: 10.1016/j.jfoodeng.2020.110036.
2. Saifullah S., Drężewski R., Non-Destructive Egg Fertility Detection in Incubation Using SVM Classifier Based on GLCM Parameters, *Procedia Computer Science*, 2022, Vol. 207, pp. 3254–3263, doi: 10.1016/j.procs.2022.09.383.
3. Reis M. L. H., Soares M. C., The Effect of Candling on the Hatchability of Eggs from Broiler Breeder Hens, *Journal of Applied Poultry Research*, 1993, Vol. 2(2), pp. 142–146, doi: 10.1093/japr/2.2.142.

DEVELOPMENT OF A WEB APPLICATION FOR NECTAR PLANT POLLINATION SERVICES

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Pollination plays a crucial role in the production of nectar crops. Proper pollination can increase multiple seed quality metrics such as quantity, quality, and oil production. Seeds obtained from properly pollinated crops are heavier and exhibit a higher germination rate. Pollination also significantly influences the visual and physical quality metrics of crops, including weight, colour, taste, and firmness. Hand pollination and insect pollination are the most beneficial methods of pollination. [1-3]. Human activity, pollution and climate change reduces the number of natural pollinators [4]; therefore, pollination services may be necessary.

In Latvia, there are no available dedicated pollination services, web systems or mobile apps that would enable beekeepers to rent or provide their bees to farmers for pollination of nectar crops.

Pollination services could be provided using a web application. In this application, users (farmers) could request pollination services by providing general information, such as an email address, location of the field, start and end dates for the pollination, and the number of bee colonies they require. Meanwhile, beekeepers could register their company and colony information on the platform. They can also specify important details such as the maximum delivery distance, delivery fees, minimum number of hives required for delivery, and the minimum rental duration for the hives. Once a new pollination request is submitted, the web application will automatically calculate the most cost-effective delivery options to the user's location from the nearest active beekeeper’s locations. If additional colonies are required, the application can include multiple beekeepers in the contract to ensure efficient and effective pollination services. To effectively manage beekeeper companies and contracts, the application would need to have administrative control.

Within this work, a prototype of the web application is developed using such technologies as Laravel, WordPress and Linux.

References

1. Amro A. M., Pollinators and pollination effects on three canola (Brassica napus L.) cultivars: A case study in Upper Egypt, *J King Saud Univ Sci*, 2021, Vol. 33(1), doi: 10.1016/j.jksus.2020.101240.
2. Wietzke A., *et al.*, Insect pollination as a key factor for strawberry physiology and marketable fruit quality, *Agriculture, Ecosystems & Environ*, 2018, Vol. 258, pp.197–204, doi: 10.1016/j.agee.2018.01.036.
3. Burns K. L. W., Stanley D. A., The importance and value of insect pollination to apples: A regional case study of key cultivars, *Agriculture, Ecosystems & Environment*, 2022, Vol. 331, doi: 10.1016/j.agee.2022.107911.
4. LeBuhn G., Vargas Luna J, Pollinator decline: what do we know about the drivers of solitary bee declines?, *Current Opinion in Insect Science*, 2021, Vol. 46. Elsevier Inc., pp. 106–111, doi: 10.1016/j.cois.2021.05.004.

TEACHING METHODS FOR CHILDREN IN A MOBILE APPLICATION

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The topic of the present research is teaching methods for children using mobile applications. Mobile technology is growing, and the percentage of kids who used smartphones is increasing each year. This growth encourages developers to build educational apps to help kids learn to write letters, numbers, and animals in a fun way. Mobile applications are created for writing, which replaces paper with a device's screen (e.g., mobile, tablet, etc.). This procedure also replaces a human trainer for teaching the learner and is mostly based on tracing.

Augmented reality is combination of the real and virtual world. One can effectively learn through the flawless convergence of real and virtual surroundings. Changing the position and alignment of the virtual object means this technology can make higher current educational environments and improved learning opportunities for students [1].

Handwriting recognition (HWR) has entered wide interest in the exploration community in recent times due to the increased demand of recognition operations for bettered human-computer interaction, and different approaches have been exploited for HWR. One approach, grounded on computer vision, uses cameras and scanners dealing with cutlet stir discovery and cutlet stroke recognition. To upgrade recognition delicacy, deep literacy algorithms were applied and attained satisfactory performance [2].

With deep learning (DL), convolution neural networks (CNNs) have exposed an important capability to identify handwritten characters of different languages. A neural network with perfect presentation generally needs a good modification of CNN hyperparameters and a good choice of applied optimization algorithms [3].

Latvia, while perhaps competitive in this area, needs to evolve and develop the use of newer technologies and the interactions between them. It would be very useful to do deeper research on this theme.

References

1. Opu M. N. I., Islam M. R. Kabir , M. A., Hossain M. S., Islam M. M., Learn2Write: Augmented Reality and Machine Learning-Based Mobile App to Learn Writing, *Computers*, 2022, Vol. 11(1), doi: 10.3390/computers11010004.
2. Zhang H., et al., A Wearable Real-Time Character Recognition System Based on Edge Computing-Enabled Deep Learning for Air-Writing, *Journal of Sensors*, 2022, Vol 5, (1-12), doi: 10.1155/2022/8507706.
3. Wagaa N., Kallel H., Mellouli N., Improved Arabic Alphabet Characters Classification Using Convolutional Neural Networks (CNN), *Computational Intelligence and Neuroscience*, 2022, Article ID 9965426, doi: 10.1155/2022/9965426.

FORESTRY

SOIL AND SUBSTRATE IN FOREST TREE NURSERIES

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Soil or substrate is needed for every plant's survival, growth and development; it is one of the most important components in plants life. Specific species' survival possibilities and their growth and development, in certain conditions, is dependent on soil/substrate physical and chemical properties. Chemical properties can be improved by using fertilizers, but physical properties can be improved by soil management. The purpose of this research is to determine different kinds of fertilizers that could be or are already used in forest tree nurseries and to research how important sustainable soil management is in tree nurseries.

Plants generally grow best when planted in fertile, well-drained soils. In tree nurseries, good conditions and nutrients are constantly provided to plants so they could become healthy and strong. To provide these conditions, inorganic fertilizers and peat moss are being used. Unfortunately, these resources have become less plentiful and costly, while the demand for tree seedlings has increased. Thus, alternative sources of organic matter and plant nutrients are being searched for. Such alternative could be composted sewage sludge mixed with woodchips, which produces an organic material similar to garden compost. The mixture is a good source of organic matter, which is rich in trace elements and other nutrients. This way, plants could be provided with everything they need to grow and develop, while saving both money and nature resources [1].

The University of Guelph in Canada has been conducting research dealing with environmentally friendly and sustainable nursery production practices with emphasis on container production. For the past 20 years, they have been trying to find a way to use farm, industrial and consumer waste by-products as amendments in nursery substrates. The research has evaluated hundreds of potting mixes derived from individual or combined, raw or composted waste by-products, such as turkey litter compost, paper mill sludge, municipal waste compost, and even pulverized glass. Most of them provided excellent container-growth media, which means that different by-products can be used to create organic matter that could be used in tree nurseries [2].

Soil and substrate properties and availability are as important as soil health is. Soil management, especially in tree nurseries, due to lack of foundational resources, needs to be a priority. Even tree nursery producers agree that a need for resources to support cover crop usage and comprehensive soil testing plays an important part in improving tree performance [3].

References

1. Gouin F. R., Walker J. M., Deciduous tree seedling response to nursery soil amended with composted sewage sludge, *HortScience*, American Society for Horticultural Science, 1977, Vol. 12 (1), pp. 45-47.
2. Chong C., Experiences with wastes and composts in nursery substrates, *HortTechnology,* 2005, Vol. 15(4), pp. 739-747.
3. McGrayh D., Plummer R., Williams C., McGlynn B., Soil health and management matters: A survey of field tree nursery producers, *Journal of environmental management,* 2023, Vol. 331, 8 pp.

THE USE OF BIOGAS DIGESTATE AND WOOD ASH MIXTURE FOR THE FERTILIZATION OF SCOTS PINE *PINUS SYLVESTRIS* L.

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Trees and plants receive the necessary moisture and nutrients for growth from the soil [2]. Today, solid fuel boilers and biogas stations are used more often for energy and heat production, where by-products, such as wood ash and digestate, are obtained. Wood ash and digestate contain several plant nutrients: macroelements potassium (K) and phosphorus (P), microelements calcium (Ca), magnesium (Mg), manganese (Mn), sulfur (S), iron (Fe), aluminum (Al) and others [1]. These elements contained in these two components can return to the forest stand nutrients necessary for tree growth that may have been lost after logging or other forestry activities [1]; therefore, wood ash and biogas digestate can be a useful soil amendment to improve tree growth conditions and increase their radial growth [3].

The study was conducted in two *Myrtillosa mel*. forests located in Jelgava Forest district and managed by the Forest Research Station. Both stands were fertilized with ash and digestate mixture of four different dosage groups (according to the mass ratio ash:digestate 1:1; 2:1; 3:1; 4:1) in the autumn of 2020 and in the spring of 2021. The spring and autumn control groups were also created. The mixture was prepared by the Latvia State Forest Research Institute "Silava". The mixture was spread over the strip created by the milled-watered disc plow, in which pine saplings were planted. In one area, 3 replications were created for each fertilization option, creating 60 1x1m plots and creating a total of 120 plots in the whole area. After two growing seasons, pine height and crown width (4 radii) measurements were made. In addition, vegetation assessment was carried out in two areas.

A total of 83 vascular plant species were identified in the vegetation assessment. Compared to the control group, there was a decrease in the number of species which can be explained by the dominance of one or more species in the plant after the use of fertilizers, but it can be observed only in the variant with the highest proportion of ash, which was 4:1. Fertilization proportion and fertilization time did not significantly affect tree heights and crown width after two growing seasons.

In order to better assess the effect of fertilization on the growth parameters of conifers, it is necessary to carry out measurements for a longer time period after soil amendment.

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References

1. Kārkliņa I., Lazdiņa D., About wood ash, 2020: https://www.zemeunvalsts.lv/par-koksnes-pelniem (06.03.2023.)
2. Lee E-P., Han Y-S., Lee S-I., Cho K-T., Park J-H., You Y-H., Effect of nutrient and moisture on the growth and reproduction of *Epilobium hirsutum* L., an endangered plant. *Journal of Ecology and Environment*, 2017, Vol. 41, pp. 281-289.
3. Pitman R.M., Wood ash use in forestry – a review of the environmental impacts. *Forestry: An International Journal of Forest Research*, 2006, Vol. 7, Issue 5, pp.563-588.

NON-NATIVE WOODY PLANT SPECIES DISTRIBUTION IN SUBURBAN FORESTS OF LATVIA

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Throughout many decades, there has been a controversial topic in forestry about non-native woody plants and their distribution in forests as well as the effects they have on neighbouring native species in sensitive ecosystems, such as changing the balance of nutrients or lowering the level of biodiversity in some cases. This research aims to explore the dispersion of *Sambucus racemosa L.*, *Sambucus nigra L.*, *Acer negundo L.*, and *Amelanchier spicata (Lam.) K.Koch* in Latvian suburban forests as well as ways to successfully manage the growing spread of these woody plants.

Red elderberry (*Sambucus racemosa)* is a deciduous shrub that was imported into Latvian territory as a decorative woody plant. It has become a popular garden woody plant; however, it escaped containment and quickly naturalized due to its form or reproduction using both seeds and offshoots. Compared to other woody plant species, *Sambucus racemosa* is one of the least problematic; it poses only minimal threats to the suburban forest environment, which are affected by other larger factors such as climate change. If the climate becomes warmer, the red elderberry will be able to spread more efficiently, thickening the shrub layer in forests. Therefore, there are minimal or no special removal measures for the red elderberry. The black elderberry (*Sambucus nigra*) is a tall deciduous shrub that is widely cultivated for its decorative, nutritious, and medicinal purposes. In Latvia, its population is stable and it is usually found in suburban forests or abandoned plantations. Similarly to the red elderberry, it does not pose a significant threat to the environment. It will only become a problem if the climate becomes warmer. For now, there are not many control measures. The ash-leaved maple (*Acer negundo*) is a medium-sized tree. It is native to North America and was introduced as a decorative park tree. *Acer negundo* can easily survive in dry and poor ecosystems and thrive in wetter forest areas. As a preventative measure, it is encouraged not to plant the ash-leaved maple. Dwarf serviceberry (*Amelanchier spicata*) is originally native to North America, and it was also cultivated in Europe as a decorative shrub, as well as a food source. The shrub can withstand very low temperatures and can incredibly adapt to a wide range of different soil pH levels. The influence of *Amelanchier spicata* is more noticeable in comparison to the other mentioned shrubs because it drastically changes the balance of nutrients in the soil and the distribution of light in forests. The dwarf serviceberry is considered a possible threat to the surrounding ecosystem, so measures have been taken to minimize its spread, such as cutting the shrubs during spring and summer as well as using chemical agents to destroy the shrub entirely. This shrub is widely found in most of Latvia and also the forests surrounding Riga and other cities [1].

These woody plants commonly surround cities, especially the suburban forests of Riga. This is most likely due to the various abiotic factors the environment is affected by, such as pollution, human activity, eutrophication, etc. [2].

In conclusion, all the above-mentioned plants have been brought into Latvian territory as decorative woody plants; however, these plants possess the ability to spread far and quickly. By far out of all these common and semi-common non-native woody plants, Amelanchier spicata causes the most damage to the environment and economics.

References

1. Fact articles – Invasive PLANT species: https://www.daba.gov.lv/lv/invazivas-sugas#faktu-lapas-invazivas-augu-sugas (24.02.2023.)
2. Emsis I., Rīgas pilsētas meži un to apsaimniekošana (Riga suburban forests and their management). Rīga, LatZTIZPI, 1980, pp. 37- 46.

FOREST NURSERY PESTS

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This research focuses on different types of forest nursery pests and their effect on saplings and seedlings. The aim of this research is to examine different forest nursery pests, to see how they affect saplings and seedlings, and understand how these pests are controlled. The work inspects pests from *Aphididae*, *Noctuidae, Elateridae* and *Scarabaeidae* families; in addition, other pests are mentioned.

The description of pests, their lifestyle, appearance and how they affect the trees was based on the material "Meža aizsardzība un apsardzība, 1.daļa: Meža entomoloģija" (in English: Forest protection and damage prevention, Part 1: Forest Entomology) [2]. Another source of information "Diagnosis and control of cutworm damage on conifer seedlings in nursery seedbeds" [1] examines specific pests and their control, describes cutworm identification, the damage they cause, and how they could be controlled in conifer nursery beds. The monitoring and control of specific pests are found in the articles that describe the research on pest monitoring and control, such as wireworm control in the article "Control methods and monitoring of *Agriotes* wireworms (*Coleoptera: Elateridae*)" [3].

During the research, we found that most tree pests can become forest nursery pests, andcan be detrimental in forest nurseries, because saplings and seedlings are young and small; therefore, pests that are not a big threat to mature trees in forests may kill small trees in nurseries. All pests that are included in the research are well known pests both in forests and forest nurseriesbut, because they do not cause a lot of harm to fully grown trees, they are frequently not paid sufficient attention to; therefore, if not controlled, these pests may have dangerous breakouts which may become destructive to forest nurseries.

References

1. Palmer M.A., Nicholls T.H., Diagnosis and control of cutworm damage on conifer seedlings in nursery seedbeds, *Tree Planter's Notes*, 1983, Vol. 34, No. 2, pp. 20-21.
2. Miezīte O., Meža aizsardzība un apsardzība, 1.daļa Meža entomoloģija, Student association "Šalkone", Jelgava, 2015, 163 pp.
3. Ritter C., Richter E., Control methods and monitoring of Agriotes wireworms (Coleoptera: Elateridae), *Journal of Plant Diseases and Protection*, 2013, Vol. 120 (1), pp. 4-15.

RESEARCH OF BIRCH TREE (*BETULA SPP.*) DISEASES IN NURSERIES

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When planning to grow birch trees, it is important to be aware of common diseases affecting them. Not all diseases may be deadly, but they can have a negative effect on appearance of the tree. If a disease is left untreated, it can significantly reduce the lifespan of the tree, so regular care is essential to avoid it. The purpose of this research is to find out about diseases in nurseries and how to cure them.

The research was performed for the company "Latvia's State Forests" and the plywood company "Latvijas Finieris". Birch samples having the most obvious symptoms were collected, and their diseases were diagnosed around tree nurseries in Latvia while doing the survey of plantation. Based on the obtained results in 2016, an artificial infection experiment was conducted with the aim to test five most symptomatic birches' pathogenicity of fungal species commonly found in seedlings, causing the wilting of birch tops and forming of necrosis on the trunk [1].

The same conditions that increase nursery production of seedlings (high densities, irrigation, fertilization, and herbicides) may also favour pathogenic fungi. The use of good quality seed, sterilized containers, pest-free growth substrate together with proper irrigation, ventilation, fertilization, and removal of weeds all prevent the entry or survival of pathogens causing damping-off, grey mold, root dieback and perhaps stem lesions. There is a disease like birch rust that needs chemical control every summer. Knowledge of the life cycle of pathogens and the conditions leading to plant diseases guarantees correct pest control [2].

Birch rust causes early defoliation, which weakens and retards the hardening of birch seedlings. Infected seedlings also grow less well than healthy ones after planting. The severity of birch rust varies among years, so the need for control varies each year. The disease caused by *Phytophthora cactorum* causes stem and root collar lesions. Nursery hygiene is important in controlling the disease [3]; all dead plant debris from the growing areas need to be removed to prevent pathogen survival in the soil, and containers are also placed on an insulating cloth which is spread on the ground (floor) that prevents direct contact between the bottom of containers and the underlying soil.

References

1. Brūna L., Šmits A., Bērza jaunaudžu un stādmateriāla audzēšanas problemātika, Salaspils, 2017, 17 pp.
2. Lilja A., Poteri M., Petäistö R.-L., Rikala R., Kurkela T., Kasanen R., Fungal Diseases in Forest Nurseries in Finland, Silva Fennica, 2010, 44 (3) pp. 525-545.
3. Lilja A., Sutherland J.R., Poteri M. Mohanan C., Diseases and Insects in Forest Nurseries, Helsinki, 2005, pp. 22-23.

THE IMPACT OF CLIMATIC CONDITIONS ON *TAXUS BACCATA* L. IN SLITERE NATIONAL PARK

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Climate change is known to bring difficulties in a lot of industries, including forestry. Inseparable from forestry is environmental protection, which is even more influenced because of the need of specific conditions for endangered species in order to thrive.

One of the species that is and will be even more endangered in Europe and in Latvia is common yew (*Taxus baccata* L.). It is a native evergreen, non-resinous, poisonous, long-lived and shade tolerant coniferous tree. In Latvia, it grows on North-East borderland of its natural range. It is believed that yew is a relict of the Atlantic flora. The long evolution period indicates that common yew is an ecologically plastic species: it has the ability to adapt to different growing conditions including light, moisture and natural disturbances. Nevertheless, the distribution of the common yew is limited by climatic and edaphic factors.

Although common yew is an endangered and protected species in Latvia, it is widely distributed in few places. One of these places is Slitere National park, where the autochthon stands growing in different forest site types are complemented with anthropogenically formed plantations. In Slitere, stands of common yew are distributed in various geological structures – moraine, a bluff of the Baltic Ice Lake and abrasion-accumulation low land. Each of the geologically unlike sites are ideal to analyse favourable micro-climatic and other conditions.

A precise way to analyse the climatic impact on common yew is by using tree core samples. There is little research analysing yew growth increase because of the specifics of wood qualities: yew has a hard, dense wood; often the trunk of the tree is unsymmetrical, and it is common that there are several trunks grown together. Natural disturbances and unsuitable climate can cause uneven and missing tree rings, which makes it difficult to determine the age of the tree and to perform cross-dating.

References

1. Galvin S., Potito A., Hickey K., Evaluating the dendroclimatological potential of Taxus baccata (yew) in southwest Ireland, *Dendrochronologia*, 2014, 32(2), pp. 144-152.
2. Moir A. K., The dendrochronological potential of modern yew (Taxus baccata) with special reference to yew from Hampton Court Palace, UK, *New Phytologist*, 1999, *144*(3), pp. 479–488.
3. Preston C. D., Hill M. O., The geographical relationships of British and Irish vascular plants, *Botanical Journal of the Linnean Society*, 1997, Vol. 124.
4. Riekstiņš I., Laiviņš M., Ogu īves izplatība un tās saistība ar klimatiskajiem un edafiskajiem faktoriem, *Jaunākais Mežsaimniecībā*, 1984, *26*, pp. 29.–32.
5. Thomas P. A., Garcia-Martí X., Response of European yews to climate change: A review. *Forest Systems*, 2015, Vol. 24(3), p.3.
6. Thomas P. A., Polwart A., Taxus baccata L., *Journal of Ecology*, 2003, Vol. 91(3), pp.489-524.

WIND EFFECT ON SPRUCE (*PICEA ABIES*, (L.) H. KARST.) STANDS

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Wind is an essential abiotic factor which is explained as the movement of air masses affected by the difference in atmospheric pressures. It contributes to the natural regeneration of forests by ensuring the spread of seeds through bird airwings or airfluffs, but the wind has also a negative impact on tree species and forest stands [1].

It is well known that strong winds can cause windfall when trees are dumped along with roots, and windbreaks can result in a tree trunk being broken. Windbreaks are more common in medium-aged crops, where the annual rings are wide and loose, which results in insufficient mechanical strength. On the other hand, in older stands where the annual rings become narrower and more mechanically durable, the root system of trees has often been damaged by decay, which is why such stands suffer most often from windfalls [1].

In the climatic conditions of Latvia, spruce is one of the most endangered species of windbreaks and windfalls due to the shallow root system. Cyclonic winds, whirlwinds and storms outside the tropical zone are considered significant sources of risk. The effect of these risk factors depends on the sensitivity of the trees: the dimensions and shape of trees, the size of the root system, and changes in the forest caused by forestry activities. Wind-damaged forests are immunologically unstable, especially spruce stands. Damaged or dead wood is an environment suitable for forest pests and diseases that can increase their spread, so it is recommended to remove wind-affected trees during the logging process [3].

Scientists' predictions suggest that climate in Latvia may become even windier in the near future. It is not only the frequency of winds that is of concern, but also their strength and wind speed; therefore, the risk of windfalls and windbreaks will increase. Also, the future forestry importance of spruce (*Picea abies*, (L.) H. Karst.) has gradually declined in central and western Europe over the last decades due to the deterioration of growing conditions caused by climate change. The most significant factors for mitigating the risk of wind damage include lower planting thickness, fewer thinning times, grooming of young stands and a target diameter as a key felling criterion known as targeted forestry [4],[2].

References

1. Dreimanis A., Mežsaimniecības pamati. Jelgava, 2016, 22.,76.pp.
2. How climate change affects Latvia's forests: https://www.lvm.lv/en/news/5624-how-climate-change-affects-latvia-s-forests (17.03.2023.)
3. Jansons Ā., Meža apsaimniekošana klimata izmaiņu kontekstā: https://edu.lu.lv/pluginfile.php/150706/mod_resource/content/1/Klimatas%20izmainas%20un%20mezu%20apsaimniekosana.pdf (17.03.2023.)
4. Krišāns O., Parastās egles (Picea abies) vēja noturības izmaiņas sakņu trupes un stumbra mizas bojājumu ietekmē: https://www.llu.lv/lv/raksts/2020-12-30/promocijas-darbu-aizstavejis-oskars-krisans (17.03.2023.)

SEED CHARACTERISTICS, GERMINATION AND INITIAL GROWTH

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Seed germination is the process in which the seed receives adequate hydration to sprout a radicle through its seed coat. The germination potential of seeds can be influenced by a number or factors ranging from characteristics of the seed like color, size and shape, to various biochemical and physiological mechanisms such as water uptake, use of stored nutrients within the seed itself and the activation of enzymes. An important factor is not only the speed of seed germination, but also the delay of this process. Seed dormancy and its molecular factors allow the seed to delay its germination until a period where conditions are optimal for its survival. This delay is used in the process of storing seeds while not critically diminishing its germination potential [1].

While seed germination is dependent on the seed's plasticity and province, it does not mean that it is capable of enduring all biotic and abiotic factors. These factors are important to consider when trying to lessen the spread of invasive species whose plasticity properties are high, since each species has a biotic or abiotic factor that significantly affects its growth and spread. A major factor that affects seed germination is the soil, and its physical and chemical composition.

Temperature is another factor that affects seed germination, maturation and further early life growth process. The effect of short-term exposure to extreme temperatures have been studied and heat resistance of *Pinus Sylvestris* and *Pinus halepensis* seeds has been documented. Seeds have been exposed to temperatures ranging from 70 to 150°C to ascertain the effect of forest fires on seed germination [2].

Bud phenology affects further life of the tree, since buds develop new leaves, create new shoots or develop into flowers. However, bud damage can also cause trauma to the tree, further reducing its annual shoot growth. Initial growth and allocation of growth can be largely affected by the neighboring flora of trees, and a competition for nutrients and light can occur [3].

To sum up, many factors influence seed germination and initial growth of trees as well as their effect on the development of healthy and productive plants.

References

1. Finkelstein R., Reeves W., Ariizumi T., Steber C., Molecular Aspects of Seed Dormancy, *Annual Review of Plant Biology*, 2008, Vol 59, pp.387-415.
2. Núñez M.R., Calvo L., Effect of high temperatures on seed germination of *Pinus sylvestris* and *Pinus halepensis*, *Forest Ecology and Management*, 2000, Vol.131 (1-3), pp.183-190.
3. Nilsson U., Gemmel P., Changes in growth and allocation of growth in young *Pinus sylvestris* and *Picea abies* due to competition, *Scandinavian Journal of Forest Research*, 1993, 8 (1-4), pp. 213-222, DOI: 10.1080/02827589309382771.

ROLE OF THE LONG NIGHT SYSTEM IN FOREST TREE NURSERIES

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Photoperiodism is the physiological reaction of organisms to the changing length of night or dark period. It is the inherent mechanism in plants that lets them know when to start or stop growing. Since trees are long-living organisms and the yearly increment is relatively small, it can be very benificial to exploit these properties of the plant. This is why the "long night system" is useful. In their first years, some tree species stop their growth completely in the middle of the summer and continue only at the start of fall, when nights get longer and days shorter. So in order to get two years of increment in one, some tree nurseries simulate the begining of fall by covering the planted trees with a special dark cover material for three weeks at a specific time in the day. The trees assume it is fall and start growing. This method not only creates larger plants of a higher quality, improved root system and more resistance to external threats like frost, but also larger in height and has a mature stem that is better for growth in the forest.

As it turns out, not all tree species react the same to extended light. Some plants like the Black spruce can grow relatively easy with even countinuous (24 hour a day) illumination. But some (white spruce) suffer and can barely gain any growth [2]. And as a result, this can be a deciding factor weather a species benefits from the long night system.

To implement the long night system ,it is neccesary to know the origin of the seeds that are being planted. Lattitude is a determining factor for each plants photoperiod lenght, so it must be taken in high regard [1]. It was found that trees which sprouted earlier in the year also have a naturally shorter biological night. So in the long night , the artifical darkening needs to happen later.

In some countries like Sweden, the long night system has been mostly automated. It is possible to calculate the optimal length of time for each species from different provenances for the implementation of the short day and then add timers to change the environement to fit each plantation. With added treatment practices like subjecting the plants to very warm days and cold nights in the long night system, they also appear to develop a tolerance to cold and frost.

In conclusion, the long night system prepares new seedlings for the forest environment, where they can be threatened if they are not strong enough. The long night system helps to get a two-year-old seedlings in one season, thus reducing overall growth time and risks.

References

1. Partanen J., Dependence of photoperiodic response of growth cessation on the stage of development in Picea abies and Betula pendula seedlings*; Finnish Forest Research Institute, Punkaharju Research Station.*, 2003, 148pp.
2. Fraser D. A., Growth of spruce seedlings under long photoperiods; *Forest Research Branch*, 1962, 18pp.
3. Wallin E., Floistad I. S., Grans D., Lindstorm A., Short day treatment of Norway spruce - stops height growth and promotes the development of freezing tolerance, *SLU, The School for Forest Management*, 2021, 5pp.

STORAGE AND SALE OF PLANTING MATERIAL

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Poor physiological and health quality of seeds has particularly serious effects on seed germination and subsequent growth, and often these result from incorrect seed storage. If a seed has not been stored in the right conditions, or it has been stored for too long, it will probably be of poor physiological or health quality. Accordingly, this also has a negative impact on the marketing of seedlings. There are several categories of seed storage and the average value depends on the species and, particularly, to which seed storage category it belongs. Recalcitrant or intermediate seeds are required to be stored for more than a few days, otherwise they should not be offered for sale. Orthodox seeds can be stored at low temperature for many years or even without important decline in health or physiological quality after drying. But in any case, seed merchants are recommended to carry out germination test before offering the seeds for sale [1].

Tree seedlings in containers, such as polyethylene bags, are generally ready to plant out when they are 20-30 centimetres tall. The size of 20-30 centimetres is sufficient to withstand transport, handling and transplanting. There are several rules for successful seedling transport; for example, during transportation, planting material or seedlings should always be placed in proper conditions and they should not be placed one above the other on the floor of the transporting vehicle, containers, etc. to avoid damage [2].

Beetles can attack stored seeds and constitute a major cause of serious post-harvest crop losses. It is possible to find a solution to deal with it without chemical pesticides - ash can offer an effective way to protect stored seeds against storage beetles, if it is applied in large quantities. For small quantities of seeds, ash could be a cheap and safe alternative for chemical pesticides [3].

We can distinguish several categories of seed storage. Duration and conditions of storage depend on these categories. The sale of planting material is also affected by the size of the seedlings and their quality, which must be taken into account when transporting them. The quality of seedling storage can also be affected by pests, so solutions should be sought.

References

1. Bande, Chiputwa et.al. Design and management principles for people and the environment, Indonesia, Kenya 2022, pp. 98-99: https://www.cifor-icraf.org/publications/pdf/books/Agroforestry-primer.pdf (28.03.2023.)
2. Handa A.K., Dhyani S.K., Rizvi J., Guidelines to Produce Quality Planting Material of Agroforestry Species, India, 2019, 21 pp.: http://apps.worldagroforestry.org/downloads/Publications/PDFS/B19030.pdf (28.03.2023.)
3. Boeke S.J., van Loon J.J.A., van Huis A., Kossou D.K., Dicke M., The use of plant material to protect stored leguminous seeds against seed beetles: a review, the Netherlands 2001, pp. 5-8: https://library.wur.nl/WebQuery/wurpubs/fulltext/282994 (28.03.2023.)

FOOD SCIENCE

REFINED AND UNREFINED OIL OXIDIZABILITY

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Oils of plant origin are a great source of unsaturated fatty acids, which have been shown to reduce the risk of cardiovascular disease and are even critical to human health in carrying out important physiological processes, such as forming cell membranes, promoting the development of nervous tissue, absorbing fat-soluble vitamins, etc. [1, 2]. In addition, large quantities of oils are produced worldwide every year, and many quality criteria are established with production to assure customers that the oil is safe for consumption [3]. For example, Commission Regulation (EEC) No. 2568/91 establishes certain criteria for different types of olive oils based on their characteristics such as acidity, peroxide value, etc [4]. Since oils with a high content of polyunsaturated fatty acids are particularly susceptible to auto- and photo-oxidation, peroxides and free radicals are formed, which pose a great danger to human health [5]. Precisely for this reason, the oil is given a lot of attention.

In the study, the oxidability of 5 oils of vegetable origin (unrefined hemp seed oil, refined rapeseed oil, refined olive pomace oil, refined olive oil, and unrefined *Extra Virgin* olive oil) was analysed by placing the oil samples in a thermostat at 60.00±0.10 °C and determining the peroxide value after 0, 2, 24, 48, 72, 144, and 312 hours.

The aim of the study was to understand the oxidation dynamics of the oils studied and to find out which of the oils is least susceptible to oxidation processes.

Oxidation dynamics can vary greatly in oils, which is largely influenced by chemical composition and extraction method. According to this study, unrefined hemp seed oil has the highest peroxide value, while the lowest peroxide value is found in refined olive oil. The trend in the increase of the peroxide value can be used to assess how quickly the oil deteriorates and how much attention should be paid to storage conditions, duration of use after opening, and cooking methods. Strong dynamics were observed for unrefined hemp seed oil, medium-strong for refined rapeseed and olive pomace oil, and weak for refined olive oil and unrefined *Extra Virgin* olive oil.

References

1. Abedi E., Sahari M. A., Long-chain polyunsaturated fatty acid sources and evaluation of their nutritional and functional properties. Food Science & Nutrition, 2014, 2(5), pp.443-463.
2. Nagy K., Tiuca I.-D., Importance of fatty acids in physiopathology of human body, Fatty Acids, ed. by Angel Catala, Intech Open, 2017: https://doi.org/10.5772/67407 (29.03.2023.)
3. Olive Oil Production by Country 2022: https://worldpopulationreview.com/country-rankings/olive-oil-production-by-country (29.03.2023.)
4. Commission Regulation (EEC) No. 2568/91 of 11 July 1991 on the characteristics of olive oil and olive-residue oil and on the relevant methods of analysis: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01991R2568-20151016&from=EN (29.03.2023.)
5. Ramana K. V., Srivastava S., Singhal S. S., Lipid peroxidation products in human health and disease. *Oxidative Medicine and Cellular Longevity*, 2013, 583438: https://doi.org/10.1155/2013/583438 (29.03.2023.)

RESEARCH OF FERMENTED CARROT JUICE PRODUCTION

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One of the most consumed vegetable juices is carrot juice (*Daucus carota L.*), which is a rich source of natural b-carotene. Lactofermentation, which uses lactic acid bacteria as starter cultures, can produce fermented vegetable juice. The lactofermented carrot juice is pleasant in taste, is microbiologically safe, and can have high innutrition value. Due to the fact that carrot juice has low acidity and a high concentration of bacteria that can spoil food and form spores, it is challenging to preserve [1].
According to the previous research, probiotic foods should contain at least 10^6 to 10^7CFUml^{-1}of probiotic bacteria at the moment of ingestion in order to provide the most health advantages [2].
The aim of the master thesis is to improve the fermentation and post-treatment process of carrot juice to ensure the quality of the product. In this study, carrot juice (with and without anadditional1% NaCl) was pasteurized and refrigerated. The fermentation of carrot juice was set up by using starter culture *Lactobacillus plantarum* Harvest LB-2, the fermentation time 17–18 h, temperature 27 – 30°C. In this study, on the 4th day of fermentation, using lactic acid bacteria, the count of the bacteria varied between 22 x 10^6 CFUml^{-1} and 23 x 10^6 CFUml^{-1}; however, on the 30th day, it varied from 111 x 10^6 CFUml^{-1} to 137 x10^6CFUml^{-1}.
As regards sensory properties, better results were found in the samples of fermented carrot juice with an additional 1% NaCl than in the samples without salt, as well as higher growth of lactic acid bacteria. After 24 hours, the formation of organic acids during the fermentation of carrot juice caused a rapid decrease in pH from 6.65 to 4.56, but an increase from 0.09% to 0.14%. was observed in titratable acidity. Moreover, the pH of fermented juice below 4.1 negatively affected the taste of the product. Due to changes in the cell structure, the ability to extract carotenoids increased. The highest increase in total carotenes 3.67 mg100g^{-1} was found on the 8thday of juice fermentation. As the acidity increased, the carotene level decreased from 3.67 (8th day) to 0.76 mg100g^{-1} on the 22nd day.
The fermentation of fruit and vegetable juices with lactic acid bacteria improves the sensory properties and nutritional value of the products and extends the shelf life by 6 months at a low storage temperature from +2 to +8 °C [3,4].

References

1. Demi L., Savas K., Acar J., The effects of different initial lactobacillus plantarum concentrations on some properties of fermented carrot juice. *Journal of Food Processing and Preservation*, 2006, pp. 352–363, DOI: 10.1111/j.1745-4549.2006.00070.x
2. Shah N. P., Functional cultures and health benefits. *International Dairy Journal*, 2007, Vol. 17(11), pp.1262–1277, https://doi.org/10.1016/j.idairyj.2007.01.014
3. Muhialdin B. J., Kadum H., Meor Hussin A. S., Metabolomics profiling of fermented cantaloupe juice and the potential application to extend the shelf life of fresh cantaloupe juice for six months at 8 °C. *Food Control*, 2021, 120, 107555. DOI: 10.1016/j.foodcont.2020.107555
4. Neffe-skoci K., Rzepkowska A., Szydłowska A. Trends and possibilities of the use of probiotics in food production, *Alternative and Replacement Foods*, Ed. by Holban A.M., Grumezescu A.M., 2018, pp. 65–94. DOI: 10.1016/B978-0-12-811446-9/00003-4

POSSIBILITIES OF STEVIA APPLICATION FOR MANUFACTURING OF PRODUCTS FOR PATIENTS WITH DIABETES

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In order to lower the glycaemic index, fructose is often used in food production instead of simple sugar, which does not cause the sugar level in the blood to rise rapidly. Increased consumption of fructose leads to weight gain and obesity. Therefore, other alternatives are being sought that allow lowering the glycaemic index in products without affecting the human system. The aim of the research is to evaluate the scientific studies on stevia as a fructose substitute and its positive and negative aspects in food production.

Stevia is a non-alcoholic sweetener of natural origin. Stevia glycosides are contained in the stevia composition, which impart a sweet taste. The highest sweetening effect is provided by stevioside and rebaudiose A, which are most commonly used in food production [1]. Stevioside accounts for 5-10% of the total dry weight, while rebaudiose A accounts for 2 4% [2]. As a sweetener, stevia is heat stable up to 200°C, acid stable, and non-fermentable, which makes it suitable overall for the production of various food products.

Stevia is safe for sugar diabetics. It does not increase sugar levels in the blood, and it also promotes insulin secretion. Stevia is characterised by antibacterial and antioxidant effects, which is why it is widely used in pharmacy. Unlike artificial sweeteners, stevia has no side effects on the human organism [3]. The composition of stevia contains various minerals, such as calcium, phosphorus, sodium, potassium, iron, magnesium, and zinc [4].

Stevia can be used for manufacturing different food products and drinks to preserve the sweet taste of products decreasing at the same time their glycaemic index. Stevia can give a certain bitter aftertaste to food products. To decrease it, different strategies have been developed. Microencapsulation is one of the strategies. Using spray-drying techniques inulin and maltodextrin are used as encapsulating substances, improving thereby product taste. To conceal stevia's bitter aftertaste in commercially available products, other artificial sweeteners such as polyols, vegetable glycerine, fructo-oligosaccharides, dextrose, and even sucrose are used [5]. The bitter aftertaste of stevia is well masked by the addition of a natural sweetener called thaumatin. It also improves the overall product taste.

Research confirms that stevia is a good fructose alternative in making products for patients with sugar diabetes. It has numerous therapeutic properties as well as a high sweetening effect.

References

1. González C. et al., Main properties of steviol glycosides and their potential in the food industry: A review, 2014, *Fruits*, 69(2), pp. 127–141.
2. Swiader K. et al., Plants as a source of natural high-intensity sweeteners: A review, *Journal of Applied Botany and Food Quality*, 2019, 92(September), pp. 160–171.
3. Goyal S.K., Samsher, Goyal, R.K., Stevia (Stevia rebaudiana) a bio-sweetener: A review, *International Journal of Food Sciences and Nutrition*, 2010, 61(1), pp. 1–10.
4. Gasmalla M.A.A., Yang R. Hua X., Stevia rebaudiana Bertoni: An alternative Sugar Replacer and Its Application in Food Industry, *Food Engineering Reviews*, 2014, 6(4), pp. 150–162.
5. Ahmad J. et al., Stevia rebaudiana Bertoni: an updated review of its health benefits, industrial applications and safety, *Trends in Food Science and Technology*, 2020, 100(April), pp. 177–189.

SURVIVAL OF LACTIC ACID BACTERIA GROWN IN ORGANIC AND CONVENTIONAL MILK IN THE HUMAN GASTROINTESTINAL MODEL

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Organic milk is considered more nutritious and beneficial to health because it is produced without hormones and antibiotics and is environmentally friendly [1]. Organically fermented dairy products have the added health benefit of providing consumers with lactic acid bacteria (LAB). LAB can help restore the gut microbiota and prevent the proliferation of harmful bacteria by adhering to and colonizing the intestinal mucosa [2,3]. The aim of this study is to find out how efficient organic and conventional milk are as a substrate for the growth of LAB and how the origin of the milk affects the survival of LAB *in vitro* digestion processes.

Organic and conventional milk samples with a fat content of 2% were used for the study. The chemical composition of the milk was analysed using MilkoScan Mars ™ (Foss, Denmark). Milk samples were pasteurized at 90°C for 15 minutes and then cooled to 43°C. Samples were inoculated with YoFlex Acidifix culture (Chr. Hansen, Denmark) and fermented at 43°C to a pH of 4.4-4.6. The fermented samples were cooled and matured for 10-12 hours at 6 °C.

The survival of LAB in the fermented samples during the digestion process simulated by the gastrointestinal tract model Labfors 5 (INFORS HT, Switzerland) was investigated. The gastric and intestinal phases lasted 120 minutes each. The acids, bases, digestive enzymes, and bile salts were added accordingly. After the gastric and intestinal phases, samples were collected and plated on MRS agar for *L. bulgaricus* and on M17 media for the cultivation of *S. thermophilus*. *L. bulgaricus* was cultured at 37 °C for 48 hours under anaerobic conditions, and *S. thermophilus* was cultured at 42 °C for 72 hours.

The result showed that the survival rate of L. bulgaricus in the intestinal phase was increased in both organic and conventional milk.

The result showed that there has been an increased survival rate of *L. bulgaricus* in both organic and conventional milk in the intestinal phase. But the number of CFU in the intestinal phase is 1-fold higher in organic milk than in conventional milk. The survival rate of *S. thermophilus* has been negatively influenced by conventional milk and the survival rate is lesser than that of the gastric phase. We concluded that organic milk is a better substrate for growth and adaptation of LAB in the intestinal phase. Moreover, *L. bulgaricus* was in the range of 6-7 $\log_{10}$ CFU ml^{-1}, required for the LAB grow and multiply in the intestine to provide a healthy gut to the consumer.

References

1. Selcuk Z., Muruz H., Organic milk versus conventional milk as functional milk. *Turkish Journal of Agriculture - Food Science and Technology*, 2018, 6(3), 273. https://doi.org/10.24925/turjaf.v6i3.273-277.1631
2. Lakstina J., Ciprovica I., Majore K., In vitro testing of lactic acid bacteria from commercial yoghurts. *Rural Sustainability Research*, 2022, 47(342), pp.32–36. https://doi.org/10.2478/plua-2022-0005
3. Naissinger da Silva M., Tagliapietra B. L., Flores V. do A., & Pereira dos Santos Richards, N. S. (2021). In vitro test to evaluate survival in the gastrointestinal tract of commercial probiotics. *Current Research in Food Science, 4*(March), 320–325. https://doi.org/10.1016/j.crfs.2021.04.006

THE EFFECT OF COCONUT FIBRES ON LACTIC ACID BACTERIA GROWTH DURING THE MILK FERMENTATION

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Probiotics are non-pathogenic microorganisms that can improve human health and prevent certain diseases such as cardiovascular disease and cancer when administered in sufficient amounts [1]. Coconut fibres support the growth and survival of probiotics in fermented products [2]. The aim of the research is to evaluate the effect of coconut fibres on the growth dynamics of lactic acid bacteria during milk fermentation.

Milk with a fat content of 2.0% was used for the research. The composition of the milk was analysed using Milkoscan Mars (Foss, Denmark). 1% coconut fibre (made from coconut shell fibre) was added to one of the milk samples (hereafter experimental sample) before pasteurisation. The other samples were pasteurised at 95°C within 5 minutes. Starter YF-L811 (Chr. Hansen, Denmark) was added to the samples after cooling the pasteurised milk to 43 °C. The samples were fermented at 43 °C to the isoelectric point of casein at pH 4.4 to 4.6. The fermented samples were cooled and matured within 12 hours at 4-6 °C. The colony forming units (CFU) of lactic acid bacteria were tested in the fermented milk samples. M17 agar medium was used for the cultivation of *Streptococcus thermophilus*, and MRS agar medium was used for *Lactobacillus delbrueckii ssp. bulgaricus*. *L. bulgaricus* was cultured at 37 °C for 48 hours under anaerobic conditions and *S. thermophilus* was cultured at 42 °C for 48 hours under aerobic conditions in lab-scale incubators.

As a result, the CFU of *L. bulgaricus* in the control sample was 3.96×10^{6} CFU g^{-1} and in the experimental sample was 8.69×10^{6} CFU g^{-1}. The CFU of *S. thermophilus* in the control sample was 1.71×10^{7} CFU g^{-1} and in the experimental sample was $1.40\times10^{7-}$ CFU g^{-1}. The study shows that the addition of coconut fibre can promote the growth of *L. bulgaricus*. In addition, the coconut fibres support the survival of probiotics in the fermented milk.

References

1. Song M., Park S., Lee H., Min B., Jung S., Park S., Kim E., Oh S., Effect of *Lactobacillus acidophilus* NS1 on Plasma Cholesterol Levels in Diet-Induced Obese Mice, *Journal of Dairy Science*, 2015, pp.1492–1501: https://doi.org/10.3168/jds.2014-8586 (16.02.2023.)
2. Hanafi F. N. A., Kamaruding N. A., Shaharuddin S., Influence of Coconut Residue Dietary Fiber on Physicochemical, Probiotic (*Lactobacillus plantarum* ATCC 8014) Survivability and Sensory Attributes of Probiotic Ice Cream. *LWT - Food Science and Technology*, 2022, Vol. 154, 112725: https://doi.org/10.1016/j.lwt.2021.112725 (16.02.2023.)

PHYSICAL PARAMETER CHANGES IN PINE CONE JAMS DURING STORAGE

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Pinecones *(Pinus sylvestris L.)* can be considered as a relatively new raw material for food production [1]. Pinecones as forest products are traditionally used in pinecone syrups for medicinal treatment of colds, coughs, and to strengthen the immune system. The aim of this study was to produce different pinecone jams and compare their physical parameters during storage.

There were three different pinecone jams: pinecone jam without added sugar mixed with apple juice, pinecone jam with added brown sugar, and pinecone jam with added white sugar. The pH was measured with a pH metre according to the method of [2], and the titratable acidity was determined according to the method [3] with minor changes. Soluble solids were determined according to the method ISO 2173:2002. Microbiological examination was performed according to the method [4]. The samples were stored at room temperature for four months. For each test, 10 g of the samples were used. In addition, sensory analysis was performed according to the method with minor modifications [4].

According to the results, the pH for jam without sugar was 3.19 - 3.60, with a significant difference found during storage ($p < 0.05$), but the pH for jam with white sugar was 3.50 - 3.52 ($p > 0.05$), jam with brown sugar was slightly higher 3.62 - 3.84 ($p < 0.05$). Soluble solids differed between all jam samples: for jam without added sugar they were 45.6-67.1 ($p < 0.05$), for jam with white sugar they were 46.4-47.9 ($p > 0.05$) and for jam with brown sugar they were 43.7-45.5 ($p > 0.05$). It was found that during storage the pH and soluble solids of the samples decreased. Titratable acidity after malic acid in sugar-free jam was 0.29-0.51% ($p < 0.05$), but in jams with added sugar it was measured after citric acid and the result was 0.05-0.07 ($p > 0.05$) in jam with white sugar and 0.04-0.06% ($p > 0.05$) in jam with brown sugar. It was found that the titratable acidity of the samples increased during storage. Overall, microbiological control of the jams showed no evidence of microbiological spoilage or contamination before and during storage. According to the sensory evaluation, the most intense pine aroma was found in jam without sugar, but the most intense taste was found in pine jam with white sugar. In terms of overall popularity, evaluators preferred the pinecone jam with brown sugar. In conclusion, pinecones, as a forest product, can potentially be used for food production, such as jams. However, an in-depth analysis of the biochemical composition would be required to test this hypothesis.

References

1. Ramay M.S., Yalcin S., Effects of supplemental pine needles powder (Pinus brutia) on growth performance, breast meat composition, and antioxidant status in broilers fed linseed oil-based diets, *Poultry Science*, 2020, Vol. 99(1), pp. 479-486, https://doi.org/10.3382/ps/pez542
2. Buck R.P., Rondinin S., Covington A.K., Baucke F.G.K., Brett C.M.A., Camões M.F., Milton M.J.T., Mussini T., Naumann R., Pratt K.W., Spitzer R., Wilson G.S., Measurement of pH. Definition, Standards, and Procedures. *Pure and Applied Chemistry*, 2002, *74*, 2169-2200. https://kuscholarworks.ku.edu/handle/1808/8412 (20.02.2023.)
3. Vicentini-Polette C.M., Belé, J.S.A.H.S., Borges, M.T.M.R., Spoto, M.H.F., Verruma-Bernardi, M.R. (2019). Physicochemical and sensorial characterization of commercial sugarcane syrups. *Revista de Ciências Agrárias*, 42(3): 808-816. DOI: https://doi.org/10.19084/rca.17279
4. Jyske T., Järvenpää E., Kunnas S., Sarjala T., Raitanen J. E., Mäki M., Pastell H., Korpinen R., Kaseva J., Tupasela T., Sprouts and Needles of Norway Spruce (*Picea abies* (L.) Karst.) as Nordic Specialty-Consumer Acceptance, Stability of Nutrients, and Bioactivities during Storage. *Molecules (Basel, Switzerland)*, 2002, *25*(18), 4187. https://doi.org/10.3390/molecules25184187

NUTRITION'S IMPACT ON MENTAL HEALTH

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In recent years, the number of studies on the influence of diet on mental health has increased. This is because nutrition is one of the factors, along with pharmacotherapy and psychotherapy, that can improve or worsen patients' overall symptoms. Moreover, meta-analyses show that the mortality rate in the population with mental disorders is twice as high as in the population without mental disorders [1]. Prospective cohort studies have shown that depression is associated with a 31% increased risk of myocardial infarction and a 36% increased risk of coronary death compared with people without depression [2]. Therefore, the aim of this study is to evaluate scientific articles on the impact of diet on mental health and the restriction of nutrients in the diet of patients with mental disorders.

Studies show that an unhealthy diet contributes to the deterioration of mental status and leads to obesity, cardiovascular disease, and type II diabetes [3]. Nutrient deficiencies observed in patients with psychiatric disorders include omega-3 fatty acids, B-group vitamins, and inadequate consumption of plant products such as vegetables, fruits, and legumes [4]. Meta-analyses and cross-sectional studies show that decreased serum folic acid levels are associated with schizophrenia. Serum levels of vitamin B6 were significantly lower in people with schizophrenia. Studies have shown that zinc levels, which have anti-inflammatory and neuroprotective effects, are reduced in patients with depression. In depression, low serum zinc levels contribute to the reduction of polyunsaturated fatty acids (especially omega-3 fatty acids), which play an important role in reducing the risk of psychiatric disorders [5]. Experimental studies show that essential amino acids such as serine, lysine, glycine, and tryptophan reduce symptoms of psychiatric disorders [6].

Studies confirm that in the diet of patients with mental disorders should imclude certain nutrients that can positively affect the treatment process.

References

1. Walker E. R., McGee R. E., Druss B. G., Mortality in mental disorders and global disease burden implications: a systematic review and meta-analysis. *JAMA Psychiatry*, 2015, *72*(4), pp. 334–341.
2. Wu Q., Kling J. M., Depression and the risk of myocardial infarction and coronary death. *Medicine (United States)*, 2016, *95*(6).
3. Teasdale S. B., Ward P. B., Samaras K., Firth J., Stubbs B., Tripodi E., Burrows T. L., Dietary intake of people with severe mental illness: systematic review and meta-analysis. *The British Journal of Psychiatry*, 2019, 214(5), pp. 251–259.
4. Altomare R., Damiano G., Palumbo V. D., Buscemi S., Spinelli G., Cacciabaudo F., Lo Monte G., Maffongelli A., Fazzotta S., Gulotta E., Gulotta L., Altomare S., Maione C., Attilio I., Lo, M., Feeding the brain: the importance of nutrients for brain functions and health. *Nutrition*, 2017, 19, pp. 243–247.
5. Lange K. W., Omega-3 fatty acids and mental health. *In Global Health Journal*, 2020, Vol. 4, (1), pp. 18–30.
6. Aucoin M., Lachance L., Cooley K., Kidd S., Diet and psychosis: A scoping review. *Neuropsychobiology*, 2020, Vol.79(1), pp. 20–42.

VETERINARY MEDICINE

GANGLION CELL ASSESSMENT OF THE OESOPHAGUS IN DOGS WITH POLYNEUROPATHY

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Polyneuropathy (PN) is an inherited or acquired neurological disorder, which is generally attributed to the dysfunction of various peripheral nerves due to denervation and reduced nerve conduction velocity of the affected nerves. The main manifestation in patients with polyneuropathy is the development of megaoesophagus, which leads to digestion disorders, cachexia, aspirating pneumonia and possibly animal death due to loss of oesophageal contraction. The contraction of the oesophageal musculature is controlled and mediated through various ganglion cells located in the myenteric plexus of the oesophagus. The goal of this study was to establish the number of ganglion cells in healthy canine oesophagi and in oesophagi of dogs with PN, which can help to describe the disease pathogenesis.

The study was carried out from 2014 to 2023 at the Latvia University of Life Sciences and Technologies and the Latvian reference laboratory BIOR. Necropsy was conducted for 23 dog carcases. Samples of oesophagi from frozen (n=5) and unfrozen (n=5) canine carcases without gastroenteritis as well as neurological, metabolic or muscular disorders and oesophageal samples of frozen dog carcases with PN (n=13) were collected and evaluated by characterization of macroscopical alterations and quantity of ganglion cells. For each carcass, the entire oesophagus was cut into three segments (cranial, middle and caudal segment) and fixated in 10% formalin. Subsequently, each segment was cut into three approximately 1.5 mm transverse slices, equating to nine slices per sample. For oesophageal samples of dogs with PN, each segment was cut into one transverse slice, equating to 3 slices per sample. Each tissue slice has been stained using haematoxylin-eosin and covered by a coverslip to acquire a permanent histological slide. A total of 129 slides were evaluated by light microscopy.

The following results were obtained: oesophagi unaffected by PN were without macroscopical alterations, while oesophagi from the dogs with PN presented with marked oesophageal dilation (100%), loss of wall thickness (50%) and feed residues in the oesophageal lumen (83.3%). PN-unaffected oesophagi undergoing freezing lost 28.6% of ganglion cells, while oesophagi from dogs with PN lost 60.0% of ganglion cells.

In conclusion, the distribution of ganglion cells was uniform along the entire length of the oesophagus for each group of dogs. However, dogs with PN have a significant loss of ganglion cell in the oesophagus, which effects all segments of the oesophagus equally.

References

1. Jahns H., Vernau K.M., Nolan C.M., O'Neill E.J., Shiel R.E., Shelton G.D., Polyneuropathy in young Siberian huskies caused by degenerative and inflammatory diseases. Veterinary Pathology, 2020, Vol. 57 (5), pp. 666-674.
2. Tilley L.P., Smith Jr F.W.K., Blackwell's five-minute veterinary consult: canine and feline. Sixth edition. Wiley Blackwell, Iowa, 2016, 1088 pp.
3. Tsuboi M., Uchida K., Ide T., Ogawa M., Inagaki T., Tamura S., Saito M., Chambers J.K., Nakayama H., Pathological Features of Polyneuropathy in Three Dogs. Journal of Veterinary Medical Science, 2013, Vol. 75 (3), pp. 327-335.

EFFECTS OF COLOSTRUM QUALITY ON CALF HEALTH IN FIRST MONTH OF LIFE

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Both calf morbidity and mortality, mainly caused by a weak immune system, later result in serious economic losses due to lower productivity and reproductive performance of dairy cows. The function of colostrum is to stimulate and regulate the growth and development of the calf's body and promote the development of the endocrine and immune systems. Colostrum should be fed immediately after the birth of the calf, as absorption of immunoglobulins is most effective in the first 2 to 6 hours. It is the most important factor related to calf survival and health status in the first months of life. [1, 2, 3].

The aim of the study is to find out correlation between the quality of colostrum, blood total protein level in calves and the incidence of neonatal diseases in the first month of life. In the summer of 2022, a study was conducted in the Vidzeme region in two different herds of dairy cows with different morbidity rates of neonates. The tasks of the study were to measure the level of immunoglobulins in colostrum and to find out the total protein level in the blood of calves at the age of 24 hours using different methods, to follow their health performance in the first month after birth, and to perform statistical analysis of the data using the Stata 17.0 (StataCorp) program.

There was no significant difference in welfare between the study herds, but there was different incidence of disease. In each herd, one blood serum and two plasma samples were taken from *v. jugularis* from each of 10 female calves at 24 hours of age. Total protein concentration in serum and plasma samples was determined by Brix and clinical refractometer, and the level of colostrum immunoglobulins was determined by Brix refractometer.

Results.

In both herds, a significant correlation is observed between the quality of colostrum and the level of total protein in the blood serum ($r = 0,71$; $p<0,05$) and plasma ($r = 0,74$; $p<0,05$) - when calves consume higher quality colostrum, the level of total protein in the blood was higher. According to the correlation diagram, it can be established that the total protein in the blood will not always increase when the animal is receiving higher quality colostrum. The relationship between calves' immunity and their health indicators within one month after birth is closely related to changes in the total protein level in settled blood plasma. In clinically healthy calves, the total protein level is statistically higher than in ill calves.

To conclude, there is no correlation between the consumption of high-quality colostrum and the frequency of illness in calves in the first month of life. Multifactorial managemental problems associated with holding, feeding, hygiene mistakes and herd's pathogens lead to greater risk of illness in the first month after the birth. Total protein level in the serum and plasma at 24 hours of age is not a useful predictor of the calf health performance, but if total protein concentration in the blood is higher, then incidence of diseases is lower in the first month of life.

References

1. Hurley W.L., Theil P.K., Perspectives on immunoglobulins in colostrum and milk. *Dairy Nutrients.* 2011, Vol. 3 (4), pp. 442-474.
2. McGrath B.A., Fox P.F., McSweeney P.L.H., Kelly A.L., Composition and properties of bovine colostrum: a review. *Dairy Science & Technology,* 2015, Vol. 96, pp. 133-158.
3. Soufleri A., Banos G., Panousis N., Fletouris D., Arsenos G., Kougjioumtzis A., Valergakis G.E, 2021, Evaluation of Factors Affecting Colostrum Quality and Quantity in Holstein Dairy Cattle. *Animals,* Vol.11 (7), 2005 pp.

BRAIN LOBES VOLUME MEASUREMENTS IN DOGS WITH IDIOPATHIC EPILEPSY AND STATUS EPILEPTICUS CONDITION BY USE MAGNETIC RESONANCE IMAGING

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Idiopathic epilepsy (IE) is the diagnosis in dogs that have seizures but do not have any structural changes in brain, or secondary metabolic changes. Some IE patients belong to a group with status epilepticus (SE) or cluster seizures (CS). Based on the International Veterinary Epilepsy Task Force, magnetic resonance imaging (MRI) should be performed to exclude structural changes in brain of patient with seizures [1]. There are no specific changes for IE patients in MRI, so prognostic indicators still need to be studied [2]. SE or CS are serious neurological emergencies and major risk factors for euthanasia and spontaneous death. Some studies indicate that about all IE patients without treatment have a risk for SE or CS condition; therefore, prognostic factors would help to prevent and avoid serious condition of the patient [3].

Within the experimental research, 21 dogs with IE and SE or CS were examined (an experimental group) and 14 dogs belonged to the control group that underwent brain MRI. Using 0,4 Tesla APERTO Lucent Open system MRI machine (Fujifilm, Minato City, Tokyo, Japan) T2W transverse images available in all dogs were evaluated. Six forebrain lobes (frontal, parietal, temporal, thalamus, hippocampus, piriform) were measured and statistically evaluated.

The volume of the frontal lobe of the brain was varied among all subjects - from 7.75 ± 0.55 cm3 to 19.38 ± 0.55 cm3. The average volume of the frontal lobe of subjects with idiopathic epilepsy is 12.95 ± 0.71 cm3, while the mean frontal lobe is 16.86 ± 0.34 cm3 in clinically healthy subjects of the control group. A statistically significant difference ($p<0.001$) was obtained when comparing dogs with idiopathic epilepsy and clinically healthy dogs.

The volume of the temporal lobe of subjects with idiopathic epilepsy ranges from 10.12 ± 0.34 cm3 to 16.20 ± 0.34 cm3, the mean volume is 12.24 ± 0.34 cm3. Control group volumes ranged from 7.33 ± 0.34 cm3 to 11.22 ± 0.34 cm3, with a mean volume of 9.58 ± 0.34 cm3. The Mann–Whitney U test suggests that the difference between groups was statistically significant ($p<0.001$).

There is no statistically significant difference between groups of parietal, thalamus, hippocampus, piriform forebrain lobes.

Brain volumetry measurements in dogs can be very prognostic for patient with idiopathic epilepsy to prognose status epilepticus or cluster seizures condition, but further research is needed

References

1. Rusbridge C., Long S., Jovanovik J., et.al., International Veterinary Epilepsy Task Force recommendations for a veterinary epilepsy-specific MRI protocol, BMC Veterinary Research, 2015, 11, 194, 15 pp.
2. Huaijantug S., Yatmark P., Chinnabrut P., et al.. Quantitative brain histogram of canine epilepsy using magnetic resonance imaging. Acta Radiol, 2021, Vol. 62 (1), pp. 93-101.
3. Cagnotti G., Ferrini S., Ala U., et al., Analysis of early assessable risk factors for poor outcome in dogs with cluster seizures and statuts epilepticus. *Frontiers of Veterinary Science*, 2020, 8 pp.

PATHOLOGICAL CHANGES IN ABDOMINAL ORGANS DETECTED WITH ULTRASOUND IN DOGS WITH HYPERADRENOCORTICISM

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Hyperadrenocorticism (Cushing's syndrome) is an endocrinological disease that causes an increase in cortisol levels and can result in several vital organs pathologies. The aim of this study was to figure out what pathological changes in abdominal organs are usually detected with ultrasound in dogs with hyperadrenocorticism.

Hyperadrenocorticism (Cushing's syndrome) can be caused by a pituitary gland pathology, adrenal gland pathology, and it also can be caused by big and often administered doses of corticosteroids (iatrogenic Cushing's syndrome). Most usual symptoms – polyuria, polydipsia, polyphagia, enlargement of the abdomen – are not very specific and that is why sometimes it is not easy to diagnose it. Diagnosis of this disease is based on anamnesis, clinical examination, diagnostic imaging and adrenal function tests [1].

According to a previous study, high levels of cortisol affect abdominal organs such as liver, gallbladder, spleen, kidneys, urinary bladder and adrenal glands. Pathological changes in echotexture, echogenicity, size, loss of definition and structure, changes in wall dimensions can be seen in dogs with hyperadrenocorticism [2]. In addition, in another study in which age, gender, castration status and weight were investigated as risk factors for hyperadrenocorticism, it was noticed that hyperadrenocorticism is more prevalent in middle aged and old dogs, spayed females and medium or small size dogs [3].

This retrospective study included 32 dogs of various breeds, ages, weights, different genders whose low dose dexamethasone test result was positive and to whom abdominal ultrasound was done. The subjects of this study were of 16 various breeds, most of them (31.25 %) were mixed breed, more than a half (56.25 %) of them were female dogs and the average age of all the subjects was 10.09 ± 2.26 years. The average weight of the dogs included in the study was 12.70 ± 11.38 kg.

Pathological changes that were mostly detected with ultrasound in dogs with hyperadrenocorticism were a loss of definition in the corticomedullary junction (65.62 %), sediments in the gallbladder (59.38 %), rounded poles of both adrenal glands (40.63 %), bilateral adrenomegaly (34.37 %), heterogeneous echogenic pattern of the liver (31.25 %) and enlarged renal collecting system (28.13 %).

After investigation on how age, gender, and castration status affect the pathological changes detected with ultrasound in dogs with hyperadrenocorticism, it was discovered that neither of those factors have an impact on any of the changes detected in abdominal ultrasound in dogs with hyperadrenocorticism ($p>0.05$).

References

1. Bennaim M., Shiel RE., Mooney CT., Diagnosis of spontaneous hyperadrenocorticism in dogs. Part 1: Pathophysiology, Aetiology, clinical and Clinicopathological features, *The Veterinary Journal*, 2019, Vol. 252:105342.
2. Bueno E.L., Rossetto V.J., Romão F.G., Ultrasonographic findings in dogs diagnosed with hyperadrenocorticism – retrospective study (2013 to 2020), *Acta Veterinaria Brasilica*. 2022, Vol.16 (1), pp. 65–70.
3. Martins F.S.M., Carvalho G.L., Jesus L., Pöppl Á.G., González F.H.D., Epidemiological, clinical, and laboratory aspects in a case series of canine hyperadrenocorticism: 115 cases (2010-2014), *Pesquisa Veterinária Brasileira*, 2019, Vol. 39(11), pp. 900–908.

REPRODUCTION AND PRODUCTIVITY ASPECTS RELATED TO TWIN PARTURITIONS IN DAIRY CATTLE

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Cows are usually uniparous, though the incidence of multiparous parturition has increased in the past decades in correlation with the increase of milk yield. [1] Twin parturitions in dairy cows are commonly associated with dystocia, reduced birth weight of the calves and higher number of stillbirths. Furthermore, not only the calves are affected, but also the increased risks from twin parturitions detrimentally affect the cows' overall health, reproductive health, and further performance. [2]

Thus, the aim of this research was to compare twin versus single parturitions focusing on the cows´ reproduction and milk production, specifically milk yield and somatic cell count. In this research, data of cows (n=20) with both single and twin parturitions were analysed regarding the number of days from parturition until the first artificial insemination (AI), total number of open days, total number of AI until the next pregnancy, to compare parameters after single versus twin pregnancies. The data for analysis were collected from a conventional dairy farm in Latvia [3] with 352 lactating cows housed in a closed tie stall barn and fed with total mixed ration. The milking and parturition are happening in the same place, but from spring to autumn they are going on pasture. The average milk production in 2022 was 7534kg per cow. AI is based on visual observation of oestrus. In this study, no significant difference in number of days until the first AI was detected in single versus twin pregnancies (72.26±20.54 and 75.16±17.97, respectively). Furthermore, no significant difference in total number of open days in single versus twin pregnancies was detected (125.94±72.22 and 125.35±58.74). Although the total number of inseminations was not significantly different between single (2.71±1.82) and twin pregnancies (2.50±1.40), the number of AI per pregnancy was even slightly better in twin pregnancies. In contrast to twin pregnancies being unfavourable, this research showed a significant increase in milk productivity with a mean of 7788.54±1229.00kg per lactation after twin pregnancies versus 6013.85±777.26kg in single ones. Nevertheless, twin pregnancies seem to affect the somatic cell count negatively with a mean of 177.00±238.93 (44.83±40.35 in single pregnancies) but in this sample the result can not be seen as representative since the deviation is quite huge (±238.93).

In conclusion, contrary to other research papers, this study indicates that twin pregnancies could be more favourable than single ones since the reproduction aspects are not impaired and milk production is even improved. Further investigations are needed to ascertain the impact of the environmental conditions and management of the farm on the outcome of the pregnancies. In particular, it must be noted that the total average milk yield in this herd is relatively low, thus, average milk yield may be a key leading variable to focus on in future investigations of outcomes of reproduction parameters after twin parturitions.

References

1. Garcia-Ispierto I., Lopez-Gatius F., Benefits and Risks of Preventing Twin Pregnancies, National Library of Medicine, 2021, Vol. 11 (1), 148 pp.
2. Bicalho R. C., Cheong S. H., Galvao K. N., Warnick L. D., Effect on twin birth calvings on milk production, reproductive performance, and survival of lactating cows, Journal of the American Veterinary Medical Association, 2007, Vol. 231 (9), pp.1390-1397.
3. Agricultural Data Centre: https://www.ldc.gov.lv/ (29.03.23).

AGE DETERMINATION IN THE GREY SEAL *HALICHOERUS GRYPUS* USING THE TRANSVERSE SECTION OF THE TOOTH

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Introduction: Age determination by counting growth lines in the cementum of mammalian teeth is a common method for multiple animal species. There is limited information on the age determination in the grey seal *Halichoerus grypus*, with the latest study being over 20 years old. The aim of this study was to standardise and verify the grey seal age determination method by counting growth lines in the cementum of the transverse section of the tooth. The task of this study was to determine the appropriate tooth and distance from the tip of the root for more accurate age detection [1, 2].
Materials and methods: The study was carried out from May 2022 to March 2023 in the Institute of Food Safety, Animal Health and Environment "BIOR" in Riga, Latvia. Necropsy of 48 wild grey seals, which were found dead in the Baltic Sea next to the Latvian coastline, was conducted. X-ray examination of the upper and lower jaw was done to reveal the teeth root form, location and position. Based on this data and teeth wear, the canine tooth was chosen and got extracted for further examination. Each tooth was cut by a **Variable Speed Precision Diamond Saw.** Three transverse sections were used: 1st – 2-3 mm from the tip of the root, 2nd – in the middle of the root, and 3rd – two-thirds from the tip of the root; each section was 150-200 µm thick. To evaluate the cementum, its thickness and count the number of growth lines, the Nikon ECLIPSE Ci-L light microscope, along with the data processing program NIS-Elements D 5.30.05., were used. In each section, the maximum and the minimum thickness of the cementum was measured. The statistical analysis was performed using the "Jamovi" program. The three sections were compared using the Kruskal – Wallis H test, and the relationship between the age and the thickness of the cementum was evaluated by linear regression.
Results: The number of growth lines differ significantly between sections ($p = 0.005$). There was no significant difference ($p = 0.915$) between the first and second sections (median = 5, Q1-Q3 4 – 7), whereas the third section (median = 4, Q1-Q3 2 – 6) was significantly different from all the others ($p < 0.05$). The thickness of the cementum increases with the age of the animal ($p < 0.001$).
Conclusions: the age determination method in the grey seal using the transverse section is standardised for the lower canine tooth, 1st and/or 2nd section, 2-3 mm from the tip of the root and in the middle of the root, respectively.

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References

1. Mansfield A. W., Accuracy of age determination in the grey seal Halichoerus grypus of Eastern Canada, Marine Mammal Science, 1991, Vol. 7(1), pp. 44-49.
2. Scheffer V. B., Myrick A. C. Jr, A Review of Studies to 1970 of Growth Layers in the Teeth of Marine Mammals, *Reports of the International Whaling Commission*, 1980, Special Issue 3, pp. 51-63.

COMPLEMENTARY FOOD CONTAINING PROBIOTICS EFFECT ON FOOD PROCESSING AND WELL-BEING OF DOGS

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One of the factors that can affect a dog's life is successful or unsuccessful food processes in the digestive tract. The digestive tract is ´home´ to numerous microorganisms that form the intestinal microbiome, which can be disrupted and cause various diseases such as allergies and diarrhoea. There are microorganisms (probiotics) that improve the functioning of the microbiome, thus improving digestion. Lactobacillus, Bifidobacterium, and Enterococcus species are well-known microbes with probiotic potential. Probiotics can improve general health and well-being as well as food digestion. Additionally, probiotics can also protect against harmful pathogens that may threaten the microbiota. [1, 2]

Dog owners have access to probiotic supplement X (Protexin Probiotics: Enterococcus faecium (NCIMB 10415) 4 b1707 2x10" CFU/kg 2x 101 CFU/g). The research problem is relevant in cases where dog nutrition is adapted to the human diet, which may not provide the necessary nutrients for optimal absorption. The purpose of this study is to determine whether the regular consumption of complementary food containing probiotics can improve food digestive processes in the dog's digestive tract, the absorption of the necessary nutrients, and general well-being of dogs.

Hypothesis: if there are minor disturbances in the functioning of the intestinal tract, probiotic supplements can help to enhance gut microbiome, contributing to the general well-being of dogs.

The tasks of the research were: 1) to gain a better understanding of the dog's digestive tract; 2) to find out how the probiotics can affect the microbiome; 3) to evaluate general health status of the dogs before and after 30 days of probiotics X consumption; 4) to carry out physical properties' evaluation and microscopic examination of the dog fecal samples before and after using probiotics supplements; 5) to analyze the obtained data and provide recommendations to dog owners.

Laboratory tests showed that probiotics do not have a significant effect on fecal examination indicators, such as the number of leukocytes, erythrocytes, as well as the digestibility of vegetable proteins. In other indicators such as type and consistency of feces, epithelium, indigestibility of plant food, starch, and fat, all dogs showed an improvement in one of these indicators. It demonstrates the beneficial effect of using probiotics on the health of dog's digestive tract and microbiome. In the indicators that demonstrate the health of dogs: intestinal gases, bad breath, appetite, hair quality, oral mucosa, saliva pH and tartar formation, can be seen improvements which means that after a course of probiotics, the general health of the dogs remains within normal limits or there are visible improvements. The research hypothesis was confirmed. If the functioning of the dog's intestinal tract does not meet the norm, then the use of supplementary feed containing probiotics improves it and animals' well-being.

References

1. Grześkowiak Ł., Endo A., Beasley S., & Salminen S., Microbiota and probiotics in canine and feline welfare, Anaerobe, 2015, 34, pp.14-23, doi: 10.1016/j.anaerobe.2015.04.002. (9.04.2023).
2. Jang H-J., Son S., Kim J-A., Jung MY., Choi Y-j., Kim D-H., Lee H.K., Shin D., Kim Y., Characterization and functional test of canine probiotics, Frontiers in Microbiology, 2021, Vol.12, pp.1-15: https://doi.org/10.3389/fmicb.2021.625562 (9.04.2023).

COMPUTED TOMOGRAPHY AND LABORATORY DIAGNOSTIC FINDINGS IN DOGS WITH UPPER RESPIRATORY TRACT DISEASE

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Canine nasal disease is commonly encountered in small animal practice. Clinical signs are similar regardless of the specific cause of nasal disease. A thorough history and physical examination, followed by a stepwise diagnostic evaluation, often identifyies a specific diagnosis, and thus facilitate an accurate prognosis and development of an optimum treatment plan [1]. The diagnostic approach to nasal disease is complicated by the difficulty in accessing the nasal cavity. That is why imaging is important in the investigation of nasal disease. Computed tomography (CT) offers several advantages over radiography in most cases, including elimination of superimposition, better turbinate detail, superior evaluation of the frontal sinuses, and better evaluation of the cribriform plate [2].

The aim of this study was to find out the most common causes in dogs with symptoms of upper respiratory tract diseases.

Data were collected in time period from January 1st 2020 to January 11th 2023 in Veterinary Hospital of Latvia University of Life Sciences and Technologies. Descriptive statistic was used.

In this time 73 CT examinations of dogs were conducted, which presented upper respiratory tract disease (URTD) symptoms such as sneezing, nasal discharge, or difficulty breathing. Based on CT findings, dogs were divided in four groups: non-specific rhinitis, destructive rhinitis, neoplastic changes, and other findings. 33 dogs had additional diagnostic tests made, such as histology, mycology, bacteriology, and PCR testing.

Non-specific rhinitis was found in 26 dogs, 14 of which had additional diagnostic testing done, such as bacteriology, histology and in one case PCR testing. The most common isolated pathogens in bacteriology were *Streptococcus spp.* and *Staphylococcus spp.* But the most common histological diagnosis was lymphocytic rhinitis. In one case, non-specific rhinitis was caused by *Mycoplasma spp.* which was confirmed by PCR testing. Destructive rhinitis was found in 14 dogs, 12 of which had additional diagnostic testing done such as mycology, bacteriology, and histology. *Aspergillus spp.* fungi were found in all five mycological examinations. The most common histological diagnosis was suppurative rhinitis, which was caused by bacteria and in some cases by fungi or both, but in one case, the cause of destructive rhinitis was adenocarcinoma. Neoplastic changes were diagnosed in 21 dogs of which seven had histology made. Six nasal neoplasia were confirmed histologically, such as squamous cell carcinoma, fibrosarcoma, osteosarcoma and adenosquamous carcinoma. Other findings causing nasal discharge, sneezing and difficulty breathing were discovered in 12 dogs. The most common findings were oronasal fistula, which caused secondary rhinitis in three dogs and tooth root destruction with secondary rhinitis in two dogs.

Based on the finding above, it is important to come to the final diagnosis, because it can determine the patient's further treatment plan, and in some cases, knowing the final diagnosis can play a big role in assessing patient's life span and quality of life.

References

1. Cohn A. L., Canine Nasal Disease: An Update, *The Veterinary clinics of North America, Small animal practice*, 2020, Vol.50 (2), pp. 359-374
2. Moores A., Walker D., Canine nasal disease: investigation and management, *Clinical Practice*, 2013, Vol 35 (4), pp. 197-211

EVALUATION OF CHANGES IN X-RAY, BLOOD SAMPLES AND SYNOVIAL FLUID IN DOGS WITH CRANIAL CRUCIATE LIGAMENT DISEASE INDUCED OSTEOARTHRITIS

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Cranial cruciate ligament disease (CCLD) induced osteoarthritis (OA) has often been viewed as a degenerative non-inflammatory disease; there is now clear evidence that synovitis plays an important role in OA pathogenesis [1]. The most accurate method to confirm synovitis is the analysis of the physical, chemical and citological properties of synovial fluid. Biomarkers such as C-reactive protein (CRP) and cytokines, especially TNF-α and IL-6, are important in assessing potential articular cartilage damage and its progression [1, 2]. In keeping with the Starling–Landis theory, it was further suggested that changes in synovial fluid inflammatory biomarkers levels could influence levels found in the blood [3].

The degree of effusion and osteophyte formation of the stifle joint was evaluated in the radiographs, and the tibial plateau angle (TPA) was measured. The main indicators determining the physical (amount, color, turbidity, viscosity), chemical (mucin clot test, protein content) and cytological properties of the synovial fluid were determined. CRP concentration was determined with a FUJIFILM DRI CHEM NX600 biochemical blood test analyzer. The concentration of the cytokines IL-6 and TNF-α was determined in blood plasma samples by enzyme-linked immunosorbent assay (ELISA) using commercial ELISA kits.

The formation of the 2 degree osteophytes was found in 90.0 % of all dogs and 46.7 % had an average degree effusion of stifle joint. Morphometric measurements showed that mean TPA was 25,71º (SD-3,60, 95% IP 24,36-27,05), which was 1.2 times higher than the maximum allowable TPA mean for healthy dogs (20.6 º) ($p>0.05$). Synovial fluid viscosity was 2.4 cm (SD-0.96, 95% CI 2.0-2.8) ($p<0.05$). In the 66.7 % of synovial fluid samples, the amount of protein was higher than 3.0 g/dl and varied from 2.0 g/dl to 9.5 g/dl (median-3.4 g/dl). 97.7 % cells of synovial fluid consisted of oval-nucleated macrophages with slightly vacuolated cytoplasm and 1.9 % was neutrophils, with a segmented nucleus and light blue stained granular cytoplasm. 73.3 % of all dogs did not have systemic inflammation (CRP ≤ 7 mg/dl). The concentration of TNF-α in dogs with osteoarthritis was 20,608 pg/ml (SD-20,8, 95% IP 3,218-37,999) and was 1.98 times higher than in clinically healthy dogs $p<0.05$). IL-6 levels in dogs with CCLD induced OA ranged from 0.196 ng/ml to 0.448 ng/ml (median 0.229 ng/ml) ($p>0.05$).

In order to more accurately determine and follow the progression of OA in clinical practice, we recommend performing an X-ray examination, cytological evaluation of the synovial fluid, and determination of the viscosity and protein content of the synovial fluid.

References

1. Kuroki K, Williams N, Cook J.M., Histologic evidence for a humoral immune response in synovitis associated with cranial cruciate ligament disease in dogs, *Veterinary Surgery*. 2021, Vol. 50 (5), pp. 1032-1041.
2. Koh S.M, Chan C.K, Teo S.H, Singh S., Merican A., Ng W.N, Abbas A., Kamarul T., Elevated plasma and synovial fluid interleukin-8 and interleukin-18 may be associated with the pathogenesis of knee osteoarthritis, *The Knee*, 2020, Vol. 27 (1), pp. 26-35.
3. Starling E.H., On the absorption of fluids from the connective tissue spaces, *The Journal of Physiology*, 1896, 19 (4), pp.312-326.

ENGINEERING

TORQUE MEASUREMENT IN A ROTATING SHAFT

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Torque measurement is of great importance for engineers, users, and manufacturers of test benches and in other industries. Torque is a crucial parameter used to determine the condition and performance of most mechanical systems such as pumps, rotational cutting equipment, gearbox shafts, vehicle axles, and electric motors. Furthermore, measuring torque also helps in reducing the time of calibration on the spot, improving product quality, and increasing the energy efficiency of the test equipment [1].
The goal of this research is to develop a non-contact measuring device for torque measurement, without the need to modify the existing mechanism.
The importance of using the contactless measuring method is that it does not introduce any friction or wear on the rotating shaft, and it can be used in high-speed applications where physical contact may not be feasible or not even achievable with sensors that use electrical wiring. Additionally, contactless sensors are less prone to mechanical failure and can be more reliable in harsh environments [2].
To achieve the goal, a prototype will be made to determine the design and accuracy of the device using consumer-grade electronic components, the results of which will show what accuracy of the measuring device and its sensitivity to changes in torque value can be achieved.
This step is crucial because accurate torque measurement ensures the efficient and safe operation and maintenance of quality control in manufacturing processes.
Installing a contactless torque measuring device is very expensive to the consumer, because this process involves development of special parts that can be used only in that specific application. By using simple consumer-grade components it is possible to use the measuring device in multiple application and maintain a low cost for the end consumer.
The prototype will consist of two slotted optical switches, two perforated disks and a microcontroller that will interpretate the input data and will output a torque value. To calibrate the device, various diameter shafts, from 50mm to 150mm, will be used, and a wide variety of rotational frequency from 500rpm to 5,000rpm will be tested.
The result of this study will be a device that is capable of measuring torque on rotating shaft without the need to disassemble the existing shaft or make some modification to it; this will help to maintain the structural integrity of machinery.

References

1. How to Measure Torque on an Existing Shaft: https://binsfeld.com/how-to-measure-torque-on-an-existing-shaft/ (15.03.2023)
2. Demand Growing for Non-Contact Torque Measurement: https://www.sensors.co.uk/demand-growing-non-contact-torque-measurement/ (15.03.2023)

SOLUTIONS FOR INCREASING THE EFFICIENCY OF THE SMALL HEPP POWER UNIT

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In present days, when the prices of energy resources are high and the demand for the use of renewable energy resources is growing, it is very important to identify the possibilities of increasing the efficiency of electricity produced from renewable energy resources. One such type of electricity producers are small hydroelectric power plants (HEPP), which produce about 10% of the total amount of electricity in Latvia [1].

In Latvia, Kaplan-type turbines are most often used in combination with an asynchronous generator; these turbines are intended for use at small waterfalls (up to 17m), to generate substantial amount of power when the working head of water is low and large flow rates are needed. Water enters the Kaplan turbine through guide vanes that are aligned to provide a suitable degree of vorticity for the flow to the turbine rotor. The axial flow of water with a component of swirl applies force on the blades of the rotor and their product is the power in the shaft [2].

Due to the fact that these HEPPs were built at the end of the 20th century and at the very beginning of the 21st century, the control equipment used in them is not capable of accurately adjusting the vane and rotor angle in order to make the most of the potential of the power unit. The turbines themselves are designed to be used at a certain level difference, but in reality the level difference is very variable, which drastically reduces the efficiency of the power unit. This problem could be solved by changing the rotation speed of the turbine, but the existing generators do not allow this, because they are designed to work at certain revolutions; therefore, different generating equipment is needed that allows operation at different rotation speeds. These generators could be replaced with axial generators with increased efficiency (up to 97%); reduced length and mass (5 to 8 shorter and up to 5 times lighter); reduced resources requirement (up to ⅓ of materials required); perform very well over a wide range of rotational speeds, which makes them suitable for high-speed-low-torque and low-speed-high-torque applications [3].

It is expected that by studying the operation of the power unit under variable levels and flow conditions, by changing the HES generating equipment and control module and software, making it work according to the real conditions (by adjusting the guide vanes and rotor working angle, as well as the turbine rotation speed), it is possible to drastically increase the operating efficiency of the small HEPP power unit.

References

1. Oficiālās statistikas portāls. Datubāze: https://data.stat.gov.lv/pxweb/lv/OSP_PUB/START__NOZ__EN__ENB/ENB010m/table/tableViewLayout1/ (28.03.2023)
2. What is Kaplan Turbine? Propeller Turbine. Types of Hydraulic Turbines. BrightHub Engineering: https://www.brighthubengineering.com/fluid-mechanics-hydraulics/27426-hydraulic-turbines-kaplan-turbine/ (29.03.2023)
3. High Efficiency Axial Flux Machines: http://www.labc.usb.ve/paginas/EC5136/Motores_axiales/WP-%20High%20Efficiency%20Axial%20Flux%20Machines%20-%20whitepaper%20v1.5.pdf (29.03.2023)

LAND MANAGMENT AND GEODESY

APPLICATION OF UNMANNED AERIAL VEHICLES IN LAND MANAGEMENT

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Drones, also known as unmanned aerial vehicles (UAVs) in the land surveying and land management industry, are often presented as a new and innovative technology. However, modern UAVs, equipped with various types of active or passive sensors, have been in commercial use for more than 15 years. Therefore, they have also been utilized in the surveying and land management industry as long as it has been possible to attach additional equipment.

As drones are used for various purposes and tasks, their construction, design, and performance are tailored to meet specific needs. If the surveyed area is too large for the drone operator to perform their tasks safely and accurately, it is necessary to use automatic or semi-automatic navigation technologies, which can be divided into two groups: motion planning methods and mapping methods. Many of these techniques have been designed, developed, and adapted from the robotics industry. The author has chosen to describe two approaches, the first one being the motion planning method. The purpose of this method is to create a continuous movement route from the starting position to the finish, while avoiding all known obstacles. The second group of technologies related to navigation, which the author focuses on, refer to mapping methods. An autonomous drone uses or needs to create a map to locate itself. One of the most popular and developed methods to create a map in an unknown area is the simultaneous localization and mapping (SLAM). By means of this method, UAVs are able to upgrade existing maps and monitor their present position simultaneously [1].

Initially, obtaining ground photos or video material from the air used to require the services of helicopters or airplanes controlled by pilots. This process was expensive and time-consuming. Today, the same tasks can be done with drones, which are several times cheaper, more accessible, and faster at acquiring images of the land surface. Due to their wide availability, drones are used in environmental sciences for species detection, mapping, surveillance, agriculture and land management monitoring, and hydrological assessments. In regions where there is rapid development and an increase in people's living standards, agricultural requirements and energy demand are also rapidly increasing. These changes can conflict with the functions and capabilities of the environment. In such situations, it is especially important to find a compromise in land management where the capabilities provided by drones come in handy [2].

New opportunities along with the development of technology in surveying and land management are emerging to complete tasks faster, safer, and in places where humans would otherwise have no access. Seeing the situation from the air makes it possible to analyze a wider region and better plan land management.

References

1. A review of rotorcraft Unmanned Aerial Vehicle (UAV) developments and applications in civil engineering: https://www.researchgate.net/publication/263810544_A_review_of_rotorcraft_Unmanned_Aerial_Vehicle_UAV_developments_and_applications_in_civil_engineering (27.03.2023.).
2. Drone imagery to create a common understanding of landscapes: https://www.sciencedirect.com/science/article/pii/S0169204622002201 (01.04.2023.).

COMPARISON OF LIDAR SCANNERS

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Laser scanning is a surveying technology for rapid and detailed acquisition of a surface in terms of a set of points on that surface. Laser scanners are operated from airborne platforms as well as from terrestrial platforms (usually tripods). Terrestrial laser scanners are usually operated from a stationary platform such as a tripod. The horizontal and vertical deflection of the laser beam is controlled by a system of two rotating mirrors. Various ranging techniques are applied for terrestrial laser scanning. Beside the "time-of-flight" principle, as applied by airborne laser scanners, continuous wave (phase measurements) and optical triangulation are used [2].

There are many different companies that manufacture terrestrial scanners, but three of them stand out the most because of their quality and history of making optical devices. Those are Stonex, Leica and Trimble. One of the best scanners Stonex has made is Stonex x300 laser scanner it's a mid-range (1.6–300 m) laser scanner, able to detect color and intensity information alongside three-dimensional data. It has accuracy of 5mm at 50m, it does 60,000poin/s, and it has a price of around 29,000 € [3]. Trimble x12 has accuracy (0.2mm at 10m) and range of 0.3-365m, it also does 2.18million points/s, it has 360° horizontal field of the view and 320° vertical view and a price of around 98,000 € [4]. The third scanner is the average compared to both the Leica ScanStation p40 has 3mm at 50m accuracy, range of 0.4-270m, 1 million points/s, it has the field of the view 360° horizontally by 290° vertically and a price of around 40,000 € [1].

Comparing all these specifications, the conclusion can be made that, while Stonex x300 is the cheapest one, it does the least amount of points/s meaning that it has the worst accuracy, and, while a range is quite good compared to Leica ScanStation p40, it is not so excellent at the close range because of a small vertical angle. Therefore, scanned objects cannot be as accurately measured and scanned as by its competitors, and a scanner cannot reach higher objects in the close range [3].

Leica ScanStation p40, on the other hand, is the average compared to both; it has 290° a vertical field of the view and has a really good accuracy of 3mm at 50m and does 1 million points/s, but it is not good at long ranges. Keeping this in mind, it is quite good at short distances meaning that it can scan at a closer range higher objects because of its field of view [1].

And the last one is the best at everything. Trimble x12 does 2.18 million points/s, has the a horizontal field of the view of 320°, and does have the best accuracy compared to both, but it also has the highest price [4].

In conclusion, choosing between the three of them, the best one is Trimble x12; it has the best specifications and is the best at scanning complex objects with the high accuracy.

References

1. Verbeurgt J., De Sloover L., Assessment of handheld mobile terrestrial laser scanning for estimating tree parameters, 2021: https://doi.org/10.1007/s11676-020-01214-7 (6.03.2023.)
2. Vosselman G., Laser Scanning. In: Shekhar S., Xiong H., Zhou X. (eds), Encyclopedia of GIS. Springer, Cham, 2017: https://doi.org/10.1007/978-3-319-17885-1_68 (6.03.2023.)
3. Nikolova V., Kamburov A., Rizova R., Morphometric analysis of debris flows basins in the Eastern Rhodopes (Bulgaria) using geospatial technologies, 2021: https://doi.org/10.1007/s11069-020-04301-4 (6.03.2023.)
4. Trimble, Inc. Trimble X12 3D laser scanning system, 2022: https://geo-matching.com/terrestrial-laser-scanners/trimble-x12-3d-laser-scanning-system (6.03.2023.)

SOIL SAMPLING STRATEGIES BASED ON REMOTE AND PROXIMAL SENSING TECHNIQUES

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Soil is a major source of nutrients needed for plants to grow. Soil sampling and evaluation of soil pH and the content of available nutrients such as potassium and phosphorus is very important in crop production because it allows the optimization of soil fertilization and liming [1].
Soil attributes (sand fraction, clay fraction, bulk density) play an important role in nutrient availability and can significantly vary within fields. The apparent electrical conductivity (EC) of soil and Normalized Difference Vegetation Index (NDVI) are spatial predictors widely used in precision agriculture to define site-specific soil sampling zones.
One of the most common spectral indices used for delineation of soil sampling zones is NDVI from satellite sensors of high or medium spatial resolutions (remote-sensing method): for example, Sentinel-2. The main reason why NDVI is used for such a purpose is its strong positive relationship with crop biomass. However, the relationships between NDVI and soil properties can vary in different years and between crops [1]. Some research shows no relationship between NDVI and soil macronutrients (phosphorus and potassium) concentration in cereal fields [2].
Another commonly used variable is apparent electrical conductivity (EC) (a proximal sensing method). Electrical conductivity is strongly correlated with soil moisture, which in turn is related to soil texture [1]. The dynamics and the interaction among the soil attributes are decisive in the range of variation of the apparent soil electrical conductivity, which can cause positive and negative correlations between EC and soil attributes [3].
Delineation of management zones for stratified soil sampling can be efficient based on EC, which is directly connected with soil properties, as well as based on NDVI, which is indirectly related to soil properties. However, the results indicate that the most beneficial strategy is the combined use of the two indicators, as it allows the definition of distinct sampling zones regarding important soil variables and crop nutrients [4]. Remote and proximal sensing methods are effective tools for delineation of soil sampling zones, resulting in increasing efficiency of fertilizer applications, economic and environmental benefits. However, validation of results from previous studies in different conditions such as farm size, crop type, soil type, topography, and different regions is necessary.

References

1. Mazur P., Gozdowski D., Wnuk A., Relationships between Soil Electrical Conductivity and Sentinel-2-Derived NDVI with pH and Content of Selected Nutrients, *Agronomy*, 2022, Vol. 12(2): https://www.mdpi.com/2073-4395/12/2/354 (07.03.23).
2. Bascietto M., Santangelo E., Beni C., Spatial variations of vegetation index from remote sensing linked to soil colloidal status, *Land (Basel)*, 2021, Vol. 10(1): https://www.mdpi.com/2073-445X/10/1/80 (07.03.23).
3. Medeiros W. N., Valente D. S. M., Queiroz D. M., Pinto F. A. C., Assis I. R., Apparent soil electrical conductivity in two different soil types, *REVISTA CIÊNCIA AGRONÔMICA*, 2018, Vol. 49(1): http://www.gnresearch.org/doi/10.5935/1806-6690.20180005 (07.03.23).
4. Esteves C., Fangueiro D., Braga R. P., Martins M., Botelho M., Ribeiro H., Assessing the Contribution of ECa and NDVI in the Delineation of Management Zones in a Vineyard, *Agronomy*, 2022, Vol. 12(6): https://www.mdpi.com/2073-4395/12/6/1331 (07.03.23).

UAV: MULTIROTOR OR FIXED-WING

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With their ability to capture data from above, drones have been successfully integrated into surveying workflows to perform land surveys, photogrammetry, 3D mapping, topographic surveying, and more [1]. UAV are divided into two types based on their shape: fixed-wing and multirotor. **The authors will describe both types of drones and** present the comparison of advantages and disadvantages of both types focusing on flight time, stability, crashes, altitude, manoeuvrability, take-off and landing, and vulnerability to high winds.

First, the authors will analyze fixed-wing drones. While less common, fixed-wing drones can offer some key advantages over their multirotor counterparts [2]. F**ixed-wing drones have the following a**dvantages: flight time – the biggest advantage of using fixed-wing drones is their ability to fly faster and over longer distances than multirotor drones, stability – fixed-wing drones are also more stable thanks to their aeroplane design and they are able to fly in higher winds than multirotor drones, crashes – even if they lose power it is possible for fixed-wing drones to glide and land safely thanks to their design, altitude – they are more suitable for mapping at higher altitudes since their gliding design can withstand the thin air at height [2]. However, there are some disadvantages: manoeuvrability – fixed-wing drones can only fly forward, so they don't offer the same level of manoeuvrability as multirotor drones, take-off and landing – fixed-wings need a large, clear space to take-off and land [2].

The second type of drones are multirotor drones. Multirotor drones have a central body and multiple rotors that power propellers, enabling flight and maneuverability [3]. We can mention such advantages as: **manoeuvrability** – they can hover in place and fly forwards, backwards, left and right without having to change their orientation, e**asy take-off and landing** – multirotor drones can land and take-off vertically. This means it is necessary to have a small, clear, flat space to get the drone in the air [2]. Speaking about disadvantages, the following ones should be mentioned: short flight times – the biggest disadvantage with multirotor drones is that their method of flying is quite energy intensive, vulnerability to high winds – multirotor drones rely on the spinning of their rotors to stay stable in the air making them vulnerable to high wind, altitude – there are restrictions on the altitude most standard multirotor drones can fly at [2].

Multirotors tend to offer a shorter lifespan, with more moving parts that are of lower quality than what one would find on a more expensive fixed-wing drone. Depending on frequency of use, one might end up replacing their quadcopter every couple of years. Fixed-wing drones are more costly, but their construction and parts mean that they will last longer [3].

Multirotor drones are recommended for smaller worksites. It is possible to get great image quality and long enough flight times to accommodate sites. Fixed-wing drones are suitable for flying over large, open worksites.

References

1. Knisely T., A guide to drone surveying, deliverables, accuracy, and workflows. (2021, November 20). All You Need to Know About Drone Surveying: https://enterprise-insights.dji.com/blog/all-about-drone-surveying (20.03.2023)
2. Crosby A., Fixed-wings vs multirotor drones: Which is better?. (2021, November 20). Fixed-wing vs multirotor drones: Which is better?: (geonadir.com) (20.03.2023)
3. Fixed-Wing & VTOL Drones vs Quadcopters for Surveying: How to Decide. (2021, November 20). Fixed Wing vs Quadcopter for Surveying: www.https://propelleraero.com (20.03.2023)

GEODESY AND ARTIFICIAL INTELLIGENCE. HOW AND WHEN?

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Artificial Intelligence (AI) is the simulation of human intelligence processes by machines, especially computer systems. AI is one of the key technologies in many of today's novel applications. Geodesy is no expectation for that also. Artificial Intelligence is used for practical applications – data analysis, deformation analysis, network adjustment, and optimization of complex measurement procedures. The start of using AI in geodesy dates back to the late 1990's. One of the first creations of Artificial Intelligence was used to operate incomplete or uncertain information; methods used for uncertain reasoning are probabilistic in nature such as Bayesian networks. Probabilistic algorithms can also be used for filtering, prediction, smoothing and finding explanations for streams of data, helping perception systems to analyze processes that occur over time. AI techniques also include classifiers and statistical learning methods [1].
Today, Artificial Intelligence is used in many ways from data analysis and calculations to GIS systems and measurments in the fields. Rapid developments in engineering, microelectronics and computer science have greatly changed both the instrumentation and the methodology in engineering geodesy. Advanced technology is needed to meet the challenges of today. In dynamic monitoring, for instance, there is an urgent need for continuous geodetic measurements to determine complex movements. The development of an early warning system is possible only when exact knowledge of the process of the object's movement (e.g. of a landslide area) and all the other physical parameters are available. Special emphasis is laid on the following research areas: detection of potential movements on a large scale, an efficient and continuous observation of critical areas and knowledge-based derivation of real time information about actual risks in order to support an alert system [2]. The necessary tools range from conventional terrestrial measurements and alignment technology (GNSS, InSAR, geotechnical instrumentation) to software systems such as GIS, Spatial Decision Support Systems (SDSS) and so on.

References

1. Reiterer A., Egly U., Vicovac T., et al., Application of artificial intelligence in Geodesy – A review of theoretical foundations and practical examples, Technische Universität Berlin. *Journal of Applied Geodesy*, 2010, 201-217 pp.
2. Retscher G., Mentes G., Reiterer A., Advances of engineering geodesy and artificial intelligence in monitoring of movements and deformations of natural and man-made structures. Springer-Verlag Berlin Heidelberg. *Earth on the Edge: Science for a Sustainable Planet*, 2014, 481-485 pp.

ENVIRNOMENT AND WATER MANAGMENT

LANDSCAPE DESIGN OF GLUDA HOME SCHOOL

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Nowadays, various alternative education methods and approaches are becoming more and more popular. The approach of holistic education is derived from the Greek philosophy of “holos", which translates as "whole" or "complete" [2]. The overall (holistic) approach to the development and upbringing of young people assumes that a person can fully live a harmonious life where all the aspects of life are equally developed: spiritual, intellectual, physical, and emotional [1]. Nature is one of the most important elements in the education system. The aim of the project was to develop the improvement of the landscape design of Gluda Home School through principles of holistic pedagogy. Gluda home school is an educational institution that focuses on the principles of holistic pedagogy for children from 1.5 to 18 years of age. The location is Gluda Parish in Latvia.

Various research methods were used in the project, such as the empirical research method where the study of the location’s history was carried out and information analysis, and the monitoring method where analysis of the landscape using photo fixations was reported and graphic method where the existing situation of the area was compared, analyzed and developed. The whole research and development proposal was carried out through fall semester of the year 2022 in Latvia, Gluda Parish.

The main findings of the research were a different design solution with a holistic approach where a scholar can play, observe and educate oneself and nature. These include a monk labyrinth, playground, and different biotopes such as rain garden, coastal sand, forest park and meadow.

The outdoor space of the Gluda school is a potential place where a scholar can develop their inner world by learning about the outside world where the principles of holistic pedagogy meet the rich and varied presence of the nature on the site. By creating an outdoor space and focusing on the holistic principles, Gluda school would gain more value in the pedagogy system in Jelgava region.

References

1. Ikskiles brivskola https://www.brivaskola.lv/apraksts/ (20.09.2022)
2. Matulena E., Gluda home school https://www.brivaskola.lv/apraksts/ (02.09.2022)

APPLICATION OF DIFFERENT GROUND COVERING MATERIALS IN THE PLANNING OF ACTIVE LEISURE AREAS IN THE URBAN ENVIRONMENT

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The selected ground covering materials in urban environments ensure several quality requirements related to accessibility and usability of various functional spaces of the city according to the planned activities and potential users. Ground covering materials in active recreational areas influence how the various functional areas in children's playgrounds and recreational sports areas are used by ensuring accessibility, general safety requirements, additional functionality, and defining the design principles applied.
The objective of the study is to identify the most commonly used ground covering materials and their compliance with environmental quality requirements in terms of accessibility and safety. It also evaluates whether the ground covering materials used provide additional functionality and are the main components that define the design principles applied.
The main focus is on the use of different covering materials in the design of active recreational areas, which provide broader opportunities for the development of different senses and give the area a more comprehensive functionality [1]. It also points out the problems caused by the ground covering materials and their influence on the users depending on different temperatures and weather conditions, as well as how the type of material, colour and placement can affect them [2].
The study focuses on evaluating the quality of active recreational areas in urban environments and identifies the key design principles for ground covering materials in children's playgrounds and recreational sports areas. For the study, scientific research literature was reviewed and areas in Riga and Tallinn were surveyed in summer and autumn of 2022. The results were prepared using the monographic or descriptive method and summarised in photographs and tables for quality assessment.
The main results highlight the problems related to the accessibility of active recreation areas and the inadequacy of the covering materials used for their intended purpose. For the most part, the covers in the functional areas studied met general safety requirements. Although safety requirements were substantially assured in all areas studied, the covering materials selected in several areas did not conform to classical design or natural design principles, but were sometimes combined, which may be related to limited financial resources or the application of inadequate solutions in the selection of cover materials.
Regardless of whether children's playgrounds and recreational sports facilities are designed according to natural or classical design principles and using various natural or artificial surfacing materials, they must meet all environmental quality requirements, with an emphasis on accessibility, safety, and sustainability.

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References
1. Talarowski M., Cohen D.A., Williamson S., Han B. Innovative playgrounds: use, physical activity, and implications for health. Public Health, 2019, Vol. 174, pp. 102-109.
2. Pfautsch S., Wujeska-Klause A., Walters J. Outdoor playgrounds and climate change: Importance of surface materials and shade to extend play time and prevent burn injuries. Building and Environment, 2022, Vol. 223, 13 pp.

POLLUTION, ITS CAUSES AND SOLUTIONS IN KLAIPĖDA CITY

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The topic of pollution is very relevant in the city of Klaipėda. The research of this topic was further encouraged by the Fourth Climate Week organized by the Ministry of the Environment which aimed to draw the public's attention to the most pressing issues of the climate change. The main goal is to prove to the public that the climate crisis is not science fiction or a conspiracy theory. People need to do something more than watching news and listening passively. Therefore, the following tasks were set: to find out what pollution from the sea port is, what the causes of pollution are, and what actions have been taken in the city of Klaipėda to control pollution and waste management.

In Klaipėda city, one of the main sources of pollution is the port activity. NOx emissions from ships operating in Klaipėda were calculated using the Lloyd's Register detailed ship movement method after collecting the information about technical characteristics of each marine ship visiting the port and the time spent staying in the port. When performing the evaluation of NOx emissions, it was estimated that most of these pollutants enter the atmosphere from stationary vessels moored to quays with active auxiliary motors; this accounts for up to 72% of the total NOx emission from marine ships in Klaipeda port [1]. The fossil fuel which powers the ships releases enormous emissions into the atmosphere. Because of this, it is necessary to evaluate and try to control these emissions. Released pollutants have a negative effect on the environment and human health, which are especially high in port cities such as Klaipėda. Mainly, the results of various types of pollution are influenced by the intensity of the port work, shipping and various similar activities which emit pollutants [2].

In Klaipėda Port, a total of about 10,000 m³ of oily water was collected in 2008. Applying LCA methods (Staniškis, Varžinskas, and Uselytė, 2005), the scope of research has been determined and research sphere has been defined to include all flows of oily and engine bilge water in Klaipėda port. Waste management and control include oily and engine bilge water collection from ships and document flows control, collection of spilled oil products keeping to all safe exploitation requirements, exploitation of medium accumulative tanks in the port, regular transportation of accumulated oily and engine bilge water to the oil-polluted water treatment station and distribution, storage, and treatment (mechanical, physical, sorption) of delivered oily and engine bilge water [3].

In conclusion, many port cities have a pollution problem, Klaipėda is not an exception. Klaipėda city's biggest pollution problem is tied up with its port activity. Various pollutants and huge emissions from the city's port are contaminating the region of Klaipėda city. Although the pollution is huge, we have reviewed some of the ways that we could look at the pollution issue, analyze the causes and the solutions that are could help fighting the pollution.

References

1. Abrutytė E., Žukauskaitė A., Mickevičienė R., Zabukas,V., Paulauskienė T., Evaluation of NO_x emission and dispersion from marine ships in Klaipeda sea port. *Journal of Environmental Engineering and Landscape Management*, 2014, 22(4), pp.264-273. https://doi.org/10.3846/16486897.2014.892009
2. Rapalis P, Šilas G, Žaglinskis J. Ship air pollution estimation by AIS data: case port of Klaipeda. *Journal of Marine Science and Engineering*. 2022, 10(12), 1950. https://doi.org/10.3390/jmse10121950
3. Dvarionienė J., Zobėlaitė-Noreikienė G., Kruopienė J., Stasiškienė Ž., Application of the life-cycle assessment method for pollution prevention in Klaipėda Sea Port, Lithuania," *Journal of Coastal Research,* 2013, 29(5), pp. 1083-1091, https://doi.org/10.2112/JCOASTRES-D-11-00167.1

CIVIL ENGINEERING

CORROSION AND PROTECTION OF METALS

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Some of the most important and used materials in construction are various metals. Metals have many positive properties that are necessary in construction, but they also have the defect of corroding which can reduce construction strength and must be reduced as much as possible.
Metal can be a chemical element such as an alloy or stainless steel, iron or a molecular compound such as polymeric sulfur nitride. Corrosion is a natural process that converts a refined metal into a more chemically stable form such as oxide, hydroxide or sulphide [1].
Atmospheric corrosion occurs in the surface of the metal, where water vapour condenses. It usually takes place with oxygen depolarization. Its rate depends on the humidity of the air. When different impurities and gases dissolve in the air layer of the condensed water, electrolytes are formed. One of the most familiar corrosion processes is the rusting of the iron. It requires both oxygen and water. Other factors – such as the pH of the solution, the presence of salts, contact with metals more difficult to oxidase than iron, and stress on iron – can accelerate rusting [1]. Stress corrosion is the combined action of a tensile stress and the corrosive environment on a metal. This type of corrosion is seen in fabricated articles of certain alloys due to stress, but pure metals are immune to stress corrosion. Thus, the stressed part is easily attacked, even by a mild corrosive environment, resulting in the formation of crack. It an be prevented by giving suitable treatment to relieve internal stresses, adjusting the composition, and eliminating impurities, selecting more resistant material, removing corrosive environment. There are many ways to prevent this type of corrosion, but the best one is regular maintenance [2]. One of the biggest issues in corrosion engineering is estimating the durability of the use. Corrosion prediction has become very difficult, as there is no direct correlation with service lifetime and experimental lab results, usually as a result of discrepancies between accelerated testing and real corrosion processes [3]. It is very important to predict the effect of corrosion-based losses on society and the global economy, because existing infrastructure is gradually becoming old and worn out, therefore solutions should be found to replace them in buildings. It is very hard to estimate the service time of metals, which is why they need to be maintained regularly.

References

1. Syed P.S., Corrosion and corrosion control. 2008, 49: https://www.researchgate.net/publication/275028997_Corrosion_and_Corrosion_Control (19.02.2023.)
2. Kantminienė K., Fundamentals of general chemistry, 2001, 104 pp.: https://ebooks-ktu-edu.db.kvk.lt/pdfreader/fundamentals-general-chemistry (19.02.2023.)
3. Bastidas, D.M., Corrosion and Protection of Metals. *Metals,* 2020, *10, 4*58. https://doi.org/10.3390/met10040458 (19.02.2023.)

THE MAIN PROPERTIES OF BUILDING MATERIALS

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When choosing materials for building structures, it is necessary to take into account their properties to withstand real loads without shrinking and without changing their initial dimensions. The properties of building materials include their properties to react to individual or complex, external and internal factors – forces, thermal changes, water or other liquids, the operation of the medium, etc. The aim of this paper is to name and describe the properties of building materials.

Technological progress is always associated with the development, production and use of new materials. The scope of use and durability of building materials and products is determined by a number of characteristics. Features of building materials are divided into such groups: physical, mechanical, operating, technological. Some materials better withstand crushing, others tensile forces arising from the load or other factors [1].

Physical properties are those properties that indicate the relationship of substances to various physical processes: density, porosity, dampness, frost resistance. As regards mechanical properties of materials, they may change over time, especially if the materials are particularly exposed to the environment. Stretching, crushing, bending, twisting, shearing and plucking depend on these factors and the decomposition of materials [2].

Speaking of the most important operational properties of building materials, they are aging and durability. The chemical composition of building materials, their chemical, physical, technological properties are regulated by equivalent standards.

Technological features refer to knowing the technological properties of any material to be able to justify, rationally design and carry out technological processes. Technological features are considered to be such material, the production of which requires the lowest consumption of labor, the least amount for material required, and the provision of necessary operational properties. The main thing is to choose the right material for the products to ensure that it is reliable and of good quality [2].

In conclusion, we would like to say that the main properties of building materials are physical, mechanical, operational and technological. The properties of building materials include their properties to respond to individual or complex, external and internal factors. Also, when choosing materials for building structures, it is necessary to take into account the properties of them to withstand real loads without changing their initial dimensions.

References

1. Nagrockienė D., Žurauskienė R.et al., Statybinės medžiagos. Laboratorinių darbų metodikos nurodymai, Vilnius “Technika”, 2009, 168 pp.
2. Naujokaitis A., Medžiagų mokslas, Vilnius “Technika”, 2009, pp. 128 - 161.

SELF-HEALING ROMAN CONCRETE

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Roman concrete is a material that raises many questions in the world of construction when we see the very good condition in which the buildings built during the Roman period are. For years, many theories about this have come out but one of them claimed something extraordinary: Roman concrete is self-healing.
First of all, Roman concrete, also known as opus caementicium, was a building material used by ancient Romans from the the 3rd century BCE until the 7th century CE. It was made from a mixture of lime, volcanic ash and water and was used to build many impressive structures, including the Colosseum and the Pantheon. One of the interesting properties that was discovered about Roman concrete is its ability to self-heal. This self-healing property of Roman concrete is believed to be one of the reasons why many of the structures built with this material have lasted for thousands of years. In contrast, modern concrete is prone to cracking and deteriorating over time and requires regular maintenance and repairs [1].
The first theories that came out about this self-healing process said that the use of seawater in the construction process may have played a role in the self-healing properties of Roman concrete. The seawater would react with the pozzolana and other materials in the concrete, creating a chemical reaction that would cause the concrete to harden and become more durable.
But recently, a new theory came out which said that the Roman concrete has the ability to self-repair thanks to its lime clasts [2]. The hot mix makes its structure brittle, which allows the formation of cracks that expose the calcareous lime clasts. When water enters these cracks, it becomes saturated with calcium, which can crystallize into calcium carbonate and strengthen the crack, thus giving the concrete this capacity for self-healing. The researchers created samples of concrete using quicklime and intentionally cracked them, only to find that the cracks had healed two weeks later [2]. This self-healing capacity of Roman concrete is of interest to researchers with a view to creating a stronger, lighter and more durable “green concrete”, with less environmental impact.

References

1. Radio France: https://www.radiofrance.fr/franceculture/le-beton-romain-secret-de-la longevite-des-structures-antiques-8261913 (07.03.2023)
2. Massachusetts Institute of Technology: https://news.mit.edu/2023/roman-concrete-durability-lime-casts-0106 (07.03.2023)

ASSEMBLY FOAM AND HUMAN HEALTH

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Assembly foam did not reach the construction market until around 1970, before that flax and cannabis packages were used to assemble windows and doors. The aim of the present paper is to find out the impact of assembly foam on human health.

Polyurethane which is widely used now contains a variety of chemicals, and one of them is methylene diphenyl diisocyanate (MDI), which can have a dramatic effect on human health. The specialists of the field consider that "56.3% diphenylmethane diisocyanate (MDI) and 40.2% polyols, 3% pentanes and 0.4% heterocyclic amines are used as starting materials for assembly foam" [1]. Methylene diphenyl diisocyanate may be toxic by ingestion, inhalation or getting on the skin. Polyols are a group of organic compounds that contain several hydroxyl groups. Therefore the cylinder with foam should be shaken very thoroughly before each use to mix isocyanate and poliol in the cylinder, resulting in a prepolymer. When sprayed, the building material swells significantly and hardens due to the influence of air humidity and ambient material humidity.

The safety regulations require an employer to provide employees with personal protective equipment free of charge and take measures ensuring the maintenance of a personal protective equipment in the working order and compliance with hygiene requirements in accordance with the manufacturer's instructions [2]. In spite of the strict safety requirements, it still happens that workers without personal protective equipment are seen working in the construction site. It is important to carry out a survey to find out the employees' awareness of using personal protective equipment, and if they have been informed about it. Without using the appropriate clothing, the employees may put themselves in a dangerous situation.

As regards PU foam cylinders, it is not possible to completely empty them due to technical reasons. The remaining quantities of liquid prepolymer and propellant are left in the cylinders, therefore this valuable materials can be reused in the manufacturing process [3]. The remaining substance in cylinders is considered harmful to human health, and used PU foam cylinders are classified as hazardous waste. Consequently, they must not be disposed of with waste.

Assembly foam is based on polyurethane and contains harmful substances. For example, MDI damages skin, eyes and respiratory tract. Workers should wear gloves, goggles and respirators when working with assembly foam. During production, isocyanate and poliol are mixed in the cylinder, resulting in a prepolymer that reacts with moisture and swells up. The cylinders contain the remaining quantities of liquid prepolymer and propellant that can be reused during the manufacturing process. Without recycling these substances will not decompose in the next 100 years.

References

1. Bokalders V., Bloka M., Ekoloģiskais dzīves veids un būvniecība: kā projektēt veselīgas, racionālas un ilgtspējīgas ēkas, Rīga, Domas spēks, 2021, 726 pp.
2. Latvijas Brīvo arodbiedrību savienība, Darba drošība, Rīga, 2010, 278 pp.
3. Recycling – das zweite Leben für Bauschaumdosen: https://www.pu-schaum.center/energie-nachhaltigkeit/recycling-das-zweite-leben-fuer-bauschaumdosen/ (27.10.2022.)

TRENDS AND APPLICATION OF REINFORCED CONCRETE

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Reinforced concrete is a composite material in which the relatively low tensile strength and ductility of plain concrete are compensated by the reinforcement with higher tensile strength or ductility. The aim of this paper is to analyze new trends and application of reinforced concrete.

The construction sector is constantly in development, although the visible effects on society take more time to be detected compared to other industries, like the aeronautical and the automotive industries [1]. This is mainly due to the fact that construction is more conservative and because products must be cost effective. Today, the pressure on construction is to have innovative solutions with higher performance, higher eco-efficiency, and lower costs, but innovation in concrete structures can only take place through new materials or new building techniques [1]. Research studies conducted in the last decade aimed at contributing to the knowledge on concrete as building material, and new types of concrete with enhanced properties were implemented: lightweight aggregate concrete with very reduced density and high strength, ultra-high performance concrete with ultra-high strength and ultra-high durability, concrete incorporating different types of nanoparticles to enhance its mechanical properties, and low binder concrete with reduced cement dosage while exhibiting adequate strength [1].

Many different types and components of structures can be built using reinforced concrete or prestressed concrete. Reinforced concrete can be classified as precast or cast-in-place concrete. Reinforced concrete is being used for the construction from foundations to the rooftops of buildings, in the construction of highways roads traffic, precast structures, floating structures, and hydro-power tunnels, irrigation canals, drains, and all other conceivable structures listed as follows: buildings, foundations, roads and bridges [2]. Many different types and components of structures can be built using reinforced concrete or prestressed concrete, which promotes the application of new trends (lightweight aggregate concrete, ultra-high performance concrete, low binder concrete).

References

1. New Trends for Reinforced Concrete Structures, 2017: https://www.researchgate.net/publication/320681026_New_Trends_for_Reinforced_Concrete_Structures_Some_Results_of_Exploratory_Studies (19.02.2023.)
2. Ding Y., Ning X., Reinforced Concrete: Basic Theory and Standards, Springer, 2022, pp. 5-8.

THE MOST FAMOUST GOTHIC BUILDINGS IN LITHUANIA

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The purpose of this paper is to analyse the most famous Gothic buildings in Lithuania from the XV – XVI centuries. Gothic architecture is architectural style in Europe that lasted from the mid-12th century to the 16th century. Masonry buildings characterized by large spaces with the expanse of walls broken up by overlaid tracery are examples of Gothic architecture [1]. In the 12th–13th centuries engineering practices permitted immensely gigantic buildings. Rib vaults, flying buttresses and pointed (Gothic) arches were used to create a very tall structure while preserving as much natural light as possible. Stained-glass window panels rendered amazing interior effects lightened by the sun [1].

While Europe was erecting sky-seeking sharp towers, Lithuanians fought in wars. The castles built from boulders considered that outdoors and fortresses better served the purpose of defending people from enemies than the elegant, tall, and straight towers. The latter appeared after dramatic fights when Christianity was introduced in Lithuania. Cities began building churches, town halls, guild houses and establishing the yards of merchants [3]. Lithuania is not rich in Gothic architecture, but it provides a few very different and quite unique examples. Some of the few Gothic buildings that survived are found in Vilnius and Kaunas [2]. Lithuanian Gothic style appeared slightly later, yet it is original and distinct, and it has laid a firm foundation for further development of architectural styles [3]. The most elaborate Gothic building was constructed in Vilnius. The St. Anne's church in Vilnius Old Town (1500) is a true masterpiece. It is joined by a larger not so elaborate Saint Francis of Assisi church (1516) in a single religious complex. Kaunas Old Town has several 15th century Gothic churches, including the Kaunas Cathedral, the Vytautas church and the Saint Gertrude church. There are also some Gothic townhouse facades left in these two largest cities. A small brick Zapyškis church (near Kaunas) built when most buildings in Lithuanian villages were completely wooden is also famous [2].

Gothic interiors, however, have been largely damaged; the only Gothic interiors that can be found in Lithuania are in the cellars which were long regarded as useless and thus not reconstructed. Currently, the Gothic cellars are sometimes used as a romantic location for restaurants [2].

Thus, to summarize, the most famous Gothic buildings in Lithuania in XV – XVI century are the St. Anne's church in Vilnius Old Town, the Kaunas Cathedral, the Vytautas church and the Saint Gertrude church.

References

1. Gothic architecture: https://www.britannica.com/art/Gothic-architecture (07.02.2023).
2. Romanesque, Gothic and Renaissance Architecture in Lithuania (13th – 16th centuries): http://www.truelithuania.com/tag/gothic-buildings-in-vilnius (07.02.2023).
3. Gothic: https://www.lithuania.travel/en/category/gothic (07.02.2023).

EXPLOITING WASTE HEAT POTENTIAL BY LONG DISTANCE HEAT TRANSMISSION

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In the modern world, the development of civilization on the Earth requires providing mankind with enough energy. The limited reserves of traditional fuel and energy resources has forced us to turn to energy saving. In this paper, we will describe heat collection and variants for cheaper energy resources.

Harvesting the waste heat from industrial processes is a very effective way to increase the efficiency of an energy system. As it is usually available as low-grade heat, it needs to be transferred to the points of consumption. Feasible heat transmission distance is usually estimated by considering a limited number of parameters [1]. Currently, the mainstream energy carrier for long distance transmission is electricity, with AC grid lines covering hundreds of kilometres. Recent policy papers recognize the importance of district heating networks and heat synergies in the energy system. Nevertheless, projects that utilize heat as long-distance energy carrier are not as mature as in the electricity sector, among others for the following reasons:

- Electrical flows have a higher density than physical thermal flows and are therefore more cost effective.
- Long distance transmission in electric lines is made possible by increasing the voltage, thus decreasing the current [2].

The maximum feasible distance depends on several factors: site-specific parameters (quantity and quality of heat), market conditions (electricity and heat price), climate data and design data (pipe material and diameter and efficiency of its insulation) [3].

The main challenge is to propose a techno-economic model with the following characteristics:

- All major capital and operating expenditures are identified and included.
- The levelized cost of delivered heat is computed and the maximum economically feasible transmission distance is derived.
- The model is generic enough to be applied very diverse situations across Europe [1].

Thus, to summarize, the particularities of long-distance heat transmission and the main parameters influencing its feasibility, it can be used for the identification of potential utilization of waste heat from industries and cogenerated heat from power plants and for the calculation of a threshold that heat could be transmitted economically.

References

1. Exploiting waste heat potential by long distance heat transmission: Design considerations and techno-economic assessment: https://www.sciencedirect.com/science/article/pii/S0306261918302058 (09.03.2023).
2. Energy Analysis: Principles and Practice: https://asmedigitalcollection.asme.org/gasturbinespower/article-abstract/116/2/285/408410/Exergy-Analysis-Principles-and-Practice?redirectedFrom=fulltext (09.03.2023).
3. Cogeneration of heat and power: https://energy.ec.europa.eu/topics/energy-efficiency/ cogeneration-heat-and-power_en (09.03.2023).

WOOD DEFECTS

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Wood defects are formed during the growth, transportation, storage, or processing of wood. Damaged wood loses its quality and value but can be preserved with the right methods. In this paper we will discuss wood main defects and how to avoid them.

The main defects of wood are various: knots are the most common and very visible defect. It is the part of a dead or cut tree branch left in the wood of the trunk; wood checks or splits are horizontal cracks in a growing tree or felled drying wood [1]. Stem cracks are divided into radial, circular, cold, and drying cracks according to the causes of their occurrence; stem shape defects - stem curvature, droop, camber, ovality and stem growths. Defects in the stem shape reduce the yield of sawn timber; defects in wood structure are irregularity of fibres and grooves; fungal damage - wood damaged by fungi changes colour and begins to rot; insect infestations are called worm infestations [1]. Wood is damaged not so much by the insects themselves as by their caterpillars. Damage usually worsens the quality of wood and reduces its possibilities of use [1]. Wood has many defects that can be reduced in various ways, such as by improving the quality of its storage.

As regards natural defects, they are abnormalities which develop in the standing tree naturally, they are difficult to control but they can be minimized up to some extent, e.g., the development of knot (a natural phenomenon) is difficult to control but can be minimized by the Silvicultural operations such as pruning [2].

Biological defects refer to deterioration in the wood caused in a tree due to the biological agencies such as fungi, insects and can be controlled by the insecticides, pesticides, or fungicides, and biological control is also done to reduce the biological defects in some wood [3]. Wood should be supervised from the moment it is planted.

It is also necessary to properly store and prepare timber. Wood can be protected in various ways, but highly damaged wood is no longer suitable for construction and can be recycled for other purposes. In conclusion, wood must be protected so as not to spoil its quality.

References

1. Albrektas D., Baltrušaitis A., Juodeikienė I., Keturakis G., Minelga D., Norvydas V., Pranckevičienė V., Ukvalbergienė K., Medienos inžinerija, KTU "Technologia", Kaunas, 2011, 266 pp: https://ebooks-ktu-edu.db.kvk.lt/pdfreader/medienos-inžinerija (23.02.2023.)
2. Faisal Ahmed, Defects in Timber | Defect Types & Causes: https://civiltoday.com/civil-engineering-materials/timber/85-defects-in-timber-types-and-reasons (23.02.2023.)

COMPARISON OF INSTALLATION TECHNOLOGIES FOR SLAB STRUCTURES

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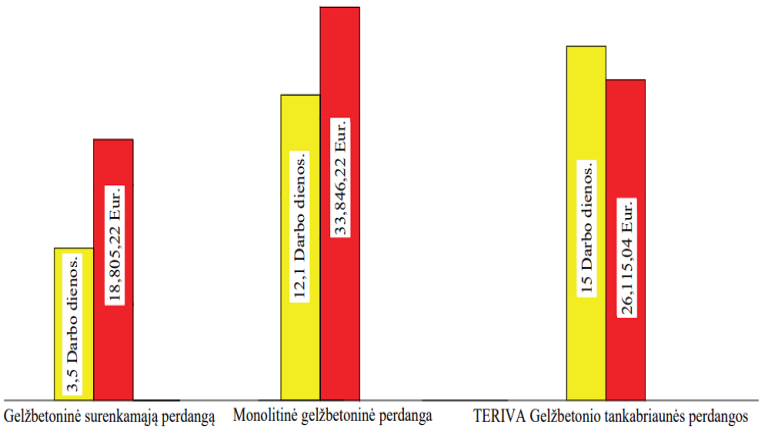
One of the most dependable forms of overlays is monolithic overlay. Compared to concrete structures with factory-reinforcement, they are stronger and more resilient. Although they take a long time to produce, monolithic overlays are very strong and long-lasting. For instance, in the event of a domestic gas explosion, the panel does not immediately use the safety margin. It does not crumble within the first few hours, enabling evacuation. Monoliths are the greatest choice for spans of irregular forms since they can withstand weight, stress loads, and temperature variations without fear. Monolithic overlays cannot move in either the longitudinal or transverse directions because of their extreme stiffness. An even distribution of the weight on the foundation and walls is ensured by a solid overlay. All different types and sizes of spans can use the overlay.

A prefabricated floor slab is a concrete and reinforcing product that is typically 220 mm high and 3-6 m long. Due to its ease of fabrication and low production costs, tension reinforcement is widely used throughout the world. The prefab ceiling panel has the benefit of being fire resistant. It may be constructed during the winter (at -20°C temperatures). In comparison to creating structures out of other materials, construction takes place in half the time.

Prefabricated floor slabs made of Teriva reinforced concrete are a great option for new construction and renovation of both low-rise and high-rise residential structures. These buildings frequently have hollow blocks, ribbed beams made of lightweight reinforced concrete, hollow blocks, and monolithic concrete poured on the construction site. It is not necessary to use a crane or elaborate formwork systems to install this overlay. The installation is easy, and the components are lightweight. This sort of overlay's lengths are adjustable, making it simple to cut the beams and blocks on site. The overlay of a typical-sized non-residential structure with a surface area of 472.18 m2 was selected for comparison by evaluating the expenses of construction work and labor.



A reinforced concrete prefabricated floor may be erected for 18,805 EUR and would take 3.5 working days to install with the least amount of time and money costs, according to the comparison. It would take 12.1 working days to complete the monolithic reinforced concrete overlay, which costs 33,846 EUR. This price includes two layers of reinforcement work with reinforcement. The longest number of working days would be required to install the Teriva reinforced concrete tank rib overlay.

References

1. The website of the company StoneHome: http://stonehome.lt/monolitines-plokstes/ (16.03.23).
2. Lietuvos statyba: https://www.statyba.lt/straipsniai/Perdanga-TERIVA-genialu-tai-kas-paprasta/11983 (16.03.23).

LIGHTWEIGHT CONCRETE

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In the modern world, concrete has become the second (after water) most used material by mankind. Concrete is a building material consisting of cement, fine aggregates (sand) and coarse aggregates mixed with water, which hardens over time. Traditional concrete as a composite material has not only advantages, but also a number of disadvantages. One of the main ones is the large mass of the volume, which often limits its application to large structures: bridges, high-rise buildings, etc. This trend has led to a worldwide search for innovative concrete mixes. One way to solve this problem is to lighten the concrete. In this abstract, we will present what lightweight concrete is and what its advantages are [3].

First of all, it has a more effective ratio of strength to its own weight, as a result of which the amount of concrete and reinforcement is reduced, it becomes possible to build taller buildings, and reduce the cost of installing foundations. In this aspect, lightweight concrete is especially important when strengthening or reconstructing operational structures, such as bridges, when additional loading of supports or foundations is not possible. Lightweight concrete has better heat and sound insulation properties. Global research has shown that if lightweight concrete were used for buildings in Europe instead of conventional concrete, heat energy costs could be reduced by about 15 percent [1].

In addition to the above advantages, next to ordinary concrete, lightweight concrete has better durability properties (greater resistance to cold, etc.), greater resistance to fire and seismic loads. Additional possibilities are provided by the application of self-compacting concrete mixtures. The combination of lower volume mass and self-compaction allows producers to improve the operational and technological properties of concrete and the elements produced from it. By applying self-compacting mixtures that do not require additional compaction during production, the cost of constructions is reduced on average by about 10 percent, and the construction time is reduced by up to 20 percent [2].

Thus, to summarize, lightweight concrete presents a number of benefits to the building industry – lighter weight on a building's structural load, greater sound absorption, better shock absorption and flexibility, and improved insulation values – when compared to standard concrete blends.

References

1. Lengvasis konstrukcinis betonas: Lengvasis konstrukcinis betonas: šiuolaikinės taikymo perspektyvos transporto statiniuose: https://sa.lt (07.02.2023)
2. Spangler J., Lightweight Concrete vs Normal Concrete: Lightweight Concrete: Weighing in on the Differences (wagnermeters.com) (08.02.2023)
3. Rumšys D., Bačinskas D., Spudulis, E., Mechanical properties of lightweight concrete produced with expanded glass aggregate, *Science – Future of Lithuania*, 2017, 9(5), pp. 500-506.

DETERMINATION OF RHEOLOGY FOR PROTEIN BASE FOAM

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To solve construction optimization problems and to improve the heat-technical generators of buildings and structures, it is necessary to introduce energy-efficient building materials that combine versatility and low costs. Such materials include foam concrete.

Despite the high thermophysical properties of foam concrete, the problem of obtaining a strong durable composite material with an optimal pore structure is still relevant. In the production technology of foam concrete, special attention should be paid to the properties of foam formers and the quality of the obtained foam. The introduction of complex admixtures increases the strength of concrete, reduces water demand and shrinkage during drying, increases water and frost resistance, and reduces equilibrium moisture and operational thermal conductivity.

The purpose of this research is to experimentally investigate protein foam rheology parameters and analyse it influence to cellular lightweight concreate. Foam density at least (80 g/l) was obtained experimentally. Foam parameters were determined and analysed using the discovery rheometer. The research hypothesis is the following: “Foam rheology parameters is depending on the speed of mixing to obtain foam.”

The rheology of foams is a difficult subject due to the complexity of their structure and the nature of their components. It’s influenced by multiple factors including liquid bulk properties, gas properties, air phase volume, liquid volume fraction, solution viscosity, interfacial thin film visco-elasticity, bubble size distribution, and bubble shape. [3] Therefore, this review is focused on rheological studies and comparisons between various rheometer process abilities.

Foam rheology is a new area of scientific research. The different rheological examination methodology lead the additional problems. The foam samples were studied by cone-plates, parallel plates, and self-design geometry. Therefore, the analysis of the data are complicated. It was clearly established that the stability of foams and their rheological properties are depended on the speed of mixing.

References

1. Germain J.C., Aguilera J.M., Multi-scale properties of protein-stabilized foams, *Food Structure*, 2014, 1(1), pp.55-70.
2. Hashim M., Tantray M., Comparative study on the performance of protein and synthetic-based foaming agents used in foamed concrete, *Case Studies in Construction Materials*, 2021, Vol.14, https://doi.org/10.1016/j.cscm.2021.e00524
3. Krzan M., Rheology of the wet surfactant foams and biofomas – a review, Technical Transactions, 2013, 27, pp.: https://www.ejournals.eu/Czasopismo-Techniczne/2013/Chemia-Zeszyt-1-Ch-(1)-2013/art/3535 (23.03.2023.)

SOCIAL SCIENCES

DIGITAL TRANSFORMATION IN MUNICIPALITIES: AN INVESTIGATION OF EMPLOYEES' DIGITAL SKILLS

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Reducing paper use and increasing digital competencies is becoming increasingly important, especially in municipalities. Reducing the use of paper has significant benefits, including cost savings, increased efficiency and improved transparency. In addition, digitising processes and documents minimises the environmental impact and increases the availability of services, especially in remote municipalities [1, 2, 5].

As technology advances, everyday tasks and processes are increasingly made digitally. In the available digital public services field, Latvia took 11th place in the European Union in 2022, which is above the average level [3]. However, for municipalities to fully implement a digital transformation, employees must be ready to take advantage of these opportunities.

In this study, a survey of 89 Liepaja municipality employees was conducted in October 2022 to determine their level of digital skills. The survey included 63 questions, which were divided using a framework of 5 digital competencies: [4]: (1) Information and data literacy - the ability to effectively find, evaluate, and use information and data to make informed decisions; (2) Communication and collaboration - the processes of exchanging information and working together to achieve a common goal; (3) Digital content creation – the use of digital tools and technologies to create and produce digital content, such as text, images, videos, audio, and interactive materials; (4) Security – use of the internet and digital technologies safely and responsibly to protect oneself and others from potential harm; (5) Problem-solving - identifying, analyzing, and solving problems related to digital technology and using digital tools. It is a critical thinking and decision-making process.

When processing the survey data, it can be seen that the rank of the skill is as follows: (1) the highest level of information and data literacy, (2) high level of communication and cooperation, (3) average level of problem-solving, (4) low level of security, (5) shallow level of digital content creation.

Following the conclusions, proposals have been developed to improve municipal employees' digital requirements in areas 3 (digital content creation) and 4 (security); however, area 5 (problem-solving) was not found relevant to improve.

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References

1. Dhumne P. K. M. Paperless Society in Digital Era. International Journal of Library and Information Studies, 2017, Vol. 7(64344), pp. 317–319.
2. Macaulay T., Progress towards a paperless NHS. BMJ: British Medical Journal, 2016, Vol. 355. https://www.jstor.org/stable/26947326
3. Morgan C., Soil Erosion and Conservation, Blackwell Publishing, London, 2005, p. 304.
4. Digital Economy and Society Index (DESI) 2022, https://digital-strategy.ec.europa.eu/en/library/digital-economy-and-society-index-desi-2022 (02.03.2023.).
5. Guidance Essential digital skills framework, 2019: https://www.gov.uk/government/publications/essential-digital-skills-framework/essential-digital-skills-framework (12.01.2023).
6. Trusina I., Jermolajeva E. The main indicators of digital transformation of the economy in a new approach to sustainability. EURINT conference Proceedings 2022, Centre for European Studies, Alexandru Ioan Cuza University, Rumania, Vol. 9, pp. 255-278. https://eurint.uaic.ro/proceedings/articles/EURINT2022_TRU.pdf (13.02.2023).

INTERNAL AUDIT AS A MANAGEMENT TOOL IN INCREASING CYBER RESILIENCE

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Cyber threats are an issue for any organisation or individual worldwide due to the increasing dependence on computer systems, infrastructure, the Internet, and technological innovation. The global cybersecurity ecosystem has dramatically evolved, and keeping it safe has become a complex issue, mainly because cybercriminals' persistent attacks evolve faster than security solutions are being developed.[1] Internal audit plays a significant role in this new risk environment as one of the tools for providing management with overall independent and objective assurance about the effectiveness of its operations and internal control mechanisms. The aim of this study is to assess the preparedness of Latvian internal auditors, their capacity, knowledge, and skills to provide value to management for ensuring cyber readiness.

Cybercrime's rising cost has serious repercussions for the global economy. Various surveys and research confirm the need for organisations to continue to implement cybersecurity defences to prevent an attack from occurring. Cyber resilience changes the focus from defence to enduring a hack and preserving corporate operations. Internal auditors must determine the areas where they can give assurance and consulting, and IT divisions must identify the cybersecurity components that focus on resiliency. Internal audit should seek ways to reinvent itself and expand its scope beyond typical IT, security, and regulatory assurance. [2]

Several Big 4 [3] companies have emphasized the role of internal audit in the changing threat landscape and increased cybersecurity initiatives, indicating that internal audit teams should be more diligent and take the lead in challenging cybersecurity practices.

This raises questions regarding the readiness of Latvian internal auditors to meet the requirements of worldwide trends in internal auditing and the evolving nature of this profession. Through research, the authors attempt to ascertain the perspectives and readiness of internal auditors to assume an active role in developing cyber resilience.

Achieving an optimal level of cyber resilience is a complex challenge that requires navigating various obstacles, including balancing performance-driven rationality with a resilience-focused outlook and overcoming hurdles such as insufficient investment and cognitive biases. The role of internal audit is particularly significant in this process. It can serve as a valuable ally in enhancing organisational resilience by identifying potential risks, assessing existing controls and procedures, and providing recommendations for improvement. Internal audit can play a vital role in the preparatory phase by identifying critical areas that require attention and by evaluating the effectiveness of existing cyber resilience plans.

References

1. Kassa S. G., Auditors have a role in cyberresilience, *ISACA Journal*, Vol 6, 2019: https://www.isaca.org/resources/isaca-journal/issues/2019/volume-6/auditors-have-a-role-in-cyberresilience (21.06.2022)
2. Douglas R., Knight R., Sborz N., Tobey M., Doing more with less, 2022: https://internalauditor.theiia.org/en/articles/2022/august/doing-more-with-less/?utm_campaign=2022-IA+August-Oktopost&utm_medium=social&utm_publishdate=2022-08-11+14%3A00%3A00&utm_source=LinkedIn (16.11.2022)
3. PricewaterhouseCoopers, The role of internal audit in cybersecurity, 2021: https://www.pwc.ie/services/audit-assurance/insights/the-role-of-internal-audit-in-cybersecurity.html (27.02.2023)

USER EMPOWERMENT IN DIGITAL TRANSFORMATION – TOWARDS ESTABLISHING A CONCEPTUAL RESEARCH MODEL

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This bibliographic review explores the concept of digital transformation (DT) and its importance in today's world of technological advances. DT is a process of using technology to modify existing business processes, cultures, and customer experiences to meet changing market requirements [1]. While DT initiatives are necessary for organizations to remain competitive, there is a global shortage of technical skilled workers to support this DT that leads to the necessity of empowering end users through user friendly technological platforms such as Low-Code/No-Code applications and an adequate leadership, like adaptive leadership. Successful DT covers five aspects: Vision & strategy, innovation, collaboration, talent, and skilled personnel, and access to technology and the effectiveness of implementation of technology-based solutions [2]. However, digital inequalities exist when not all individuals or organizations have access to the same information and communication technology resources, leading to uneven implementation of DT initiatives [3]. To ensure successful DT initiatives, organizations should address digital inequalities, provide access to technology and training, and holistically implement DT initiatives [4]. The review proposes a conceptual design for future research on the effect of empowerment of end users in DT in organizations.

This paper highlights the importance of end user empowerment, adaptive leadership, and the use of LCNC platforms in achieving successful digital transformation. End user empowerment enables users to take ownership of their own learning and development, while adaptive leadership ensures agility and quick response to changing conditions. The use of LCNC platforms allows for building technological solutions in resource-scarce environments. The authors conclude and suggest conducting quantitative and qualitative analyses to test the hypothesis that an integrative approach will enhance the successful adoption of DT proposing a conceptual research model. Overall, by implementing these strategies, organizations can unlock the full potential of digital transformation and achieve the expected benefits or more.

Keywords: Digital transformation, user empowerment, adaptive leadership, low code / no code applications, technology trends, digital inequalities

References

1. Gong & Ribiere V., Developing a unified definition of digital transformation. *Technovation*, 2021, 102, 102217. https://doi.org/10.1016/j.technovation.2020.102217
2. Gurbaxani V., Dunkle D., Gearing Up For Successful Digital Transformation, *MIS Quarterly Executive*, 2019, Vol. 18(3), Article 6: https://aisel.aisnet.org/misqe/vol18/iss3/6 (2.02.2023)
3. Casalet M., The Uncertain Future of Digitization in Mexico: Can It Take Off? *Economía teoría y práctica* [ISSN: 2448-7481] Nueva Época, Número especial, 2020, Vol. 5, pp. 45-68.
4. Hogan T. J., The Adaptive Leadership Maturity Model. Organization Development Journal, 2008, 26(1), pp. 55–61.

THEORIES OF AGGLOMERATION EFFECT

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Agglomeration is a concept that has gained significant attention in regional economics and urban studies. The aim of this descriptive research is to provide an overview of the theoretical sources on the topic of agglomeration. This research begins with a definition of agglomeration and its role in promoting economic growth and development, then it further explores the concept of agglomeration economies, which are the benefits that firms gain by locating in close proximity to each other.

One of the sources provides a basic definition of agglomeration as a mass, or collection of things clustered together. This source serves as an essential starting point to understand the concept of agglomeration [1]. Edwin von Böventer, B. G. Ohlin, E. M. Hoover, W. Isard highlight the importance of external and internal factors; in E.v. Böventer's model, where a relatively high proportion of transport costs is highlighted, the system elaborated by J. H. Thünen, A. Lösch or W. Christaller can be applied.

Another research source discusses agglomeration economies in detail and stresses the importance of clustering for companies to reap the benefits of agglomeration. This source provides valuable insights into how agglomeration can lead to increased productivity, innovation, and knowledge spill-overs [2].

The third source used for this research study, *Theories des raumlichen Gleichgewichts* by Böventer, provides a theoretical framework for understanding agglomeration. This source examines how agglomeration affects regional equilibrium and the role of transportation costs in shaping the location of economic activities [3].

Another significant source is "Regional Economics" by Roberta Capello, which contains a comprehensive overview of regional economic theory, analyzing the role of agglomeration economies and other regional growth factors. Capello presents the latest research and case studies, making this book a valuable resource for students and researchers in regional economics. One of the strengths of this book is its focus on the spatial dimension of economic development, including regional disparities, cluster analysis, and regional innovation systems. Capello also provides a clear and concise presentation of theoretical concepts and empirical methods used in regional economic analysis. Moreover, the book highlights the importance of policy interventions in promoting regional economic development and presents different policy approaches for enhancing regional competitiveness and reducing inequalities.

Capello's analytical approach and extensive use of case studies make this book a valuable resource for researchers, policymakers, and practitioners interested in regional economics. It also highlights the importance of agglomeration in promoting economic growth and development and the need to develop polycentric agglomeration [4].

The sources discussed in this study provide a comprehensive understanding of the theoretical foundations of agglomeration, which can be useful for policymakers and researchers interested in studying urban and regional development.

References

1. Agglomeration: https://www.merriam-webster.com/dictionary/agglomeration (01.03.23.)
2. Agglomeration economies: https://lv.economy-pedia.com/11030987-agglomeration-economies (01.03.23.)
3. Böventer E.V., Theories des räumlichen Gleichgewichts. Tübingen, 1962.
4. Capello R., Regional Economics, Second ed. New York: Routledge Taylor & Francis Group, 2016, 379 pp.

TAXES ON UNHEALTHY FOOD PRODUCTS

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According to the data of the Organization for Economic Cooperation and Development, on average, 53.84% of all citizens from the member states were obese or overweight in 2021 [1]. In order to reduce the increase in overweight and obesity in the population, several countries around the world have introduced taxes on products that are classified as unhealthy based on the discretion of each country. The aim of this study is to analyse the application of tax on unhealthy products and to calculate the potential budget revenues from such a tax in Latvia.

In Denmark, since 1968, chocolate and other sweets have been taxed at a rate of 2.97 - 3.49 euros per kg. The rate is differentiated based on the sugar content of the product. Revenues from this tax in 2019 were 318.6 million euros, which accounted for 0.22% of total budget revenues [2]. This tax was supposed to impact the eating habits of the society. Since the introduction of this tax, consumers reduced sugar consumption only by 3 – 5%. The tax on saturated fat applied in 2011 is a negative example in the Danish food excise tax system. It was applied to products containing more than 2.3 g of saturated fat per 100 g. The government's primary goal was to increase the budget revenues. This tax was cancelled due to its ill-considered application – the price of butter products, margarine, cookies, etc. decreased under the influence of the tax, but the price of butter, oil, heavy cream, etc. increased [3].

The World Health Organization (hereinafter – WHO) positively assesses the taxes introduced for unhealthy products in Hungary. Since 2011, such products as candies, cookies, jams, soft drinks with added sugar, beer with added sugar, alcoholic drinks, energy drinks, and snacks with high salt content have been taxed. The tax rate depends on the sugar or salt content of the product [4]. The goal of the government was to increase the income in the budget, so it can be spent on improving the healthcare system, and at the same time to improve public health overall. It has been estimated that, due to the tax, prices increased by ~29%, while the demand decreased by ~27%. According to the WHO, the price increase has educated the public about which products should be consumed in smaller quantities.

Evaluating the introduction of such taxes in Latvia, it is concluded that the potential budget revenues would increase by 4.70 – 5.70 or up to 45.39 million euros (depending on which product groups they would be applied to) [5], but taking into account the high inflation and the rapid rise in the prices of energy resources, in order not to cause greater losses to producers and citizens, it would be primarily more important to implement measures to inform and educate about the healthiness or harmfulness of different products.

References

1. OECD data (2022). Overweight or obese population: https://data.oecd.org/healthrisk/overweight-or-obese-population.htm (14.11.2022.)
2. European Commission (2022). Indirect taxes - Other Indirect: https://ec.europa.eu/taxation_customs/tedb/taxDetails.html?id=152/1609455600 (14.11.2022.)
3. Bødker M., Pisinger C., Toft U., Jørgensen T., The Danish fat tax-Effects on consumption patterns and risk of ischaemic heart disease. *Preventive Medicine*, 2015, 77, pp. 200–203, https://doi.org/10.1016/j.ypmed.2015.03.031
4. World Health Organisation (S.a.). PUBLIC HEALTH PRODUCT TAX IN HUNGARY: https://www.euro.who.int/__data/assets/pdf_file/0004/287095/Good-practice-brief-public-health-product-tax-in-hungary.pdf (14.11.2022.)
5. Pļuta A., Sauka A., et al., Akcīzes nodokļa politika Baltijas valstīs: alkoholiskie dzērieni, bezalkoholiskie dzērieni un tabakas izstrādājumi, 2020: https://www.ltrk.lv/sites/default/files/inline-files/Akcizes_petijums_digitala_versija_publicesanai_compressed.pdf (14.11.2022.)

REPowerEU AND ENERGY MARKET IN THE EUROPEAN UNION: POSSIBILITIES FOR DEPLOYMENT OF BLOCKCHAIN TECHNOLOGY

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Following the Russian Federation's invasion of Ukraine on 24 February 2022, on 18 May 2022, the European Commission introduced the REPowerEU Plan. It provides for a rapid end to energy dependence on the Russian Federation by promoting progress towards a clean economy and energy sufficiency, implementing energy savings, diversification of energy supplies, substitution of fossil fuels, and endorsing the European Union's move towards renewable energy and smart investments [1].

As part of the REPowerEU Plan, the EU Solar Energy Strategy was adopted, which foresees the installation of an additional 420 GW of solar power capacity by 2030. Gradually, over the next few years, the installation of solar panels on the rooftops of certain types of buildings will become a mandatory requirement, including panels on new public and commercial buildings larger than 250 m^2 (by 2026), on the existing ones – until 2027, on new residential buildings by 2029 etc. [2].

On 30 March 2023, the European Commission announced a decision of the European Parliament and the Council to include a target of at least a 42.5% share of renewables by 2030 and aiming at 45% in the revision of the Renewable Energy Directive [3].

The analysis of the Eurostat data shows that in the EU solar energy has evolved from a practically unused technology in 1991 to a state where in 2021 5.80% of the total energy used to generate electricity came from the sun. In 2021, the total share of renewables was 21.78%, of which wind energy accounted for more than a third, and solar energy accounted for 14.39% [4]. The combination of both the objectives to be achieved, set out in the planning documents, and the continuous increase in utilization of renewables illustrated by real-world statistics demonstrates the necessity for new technologies that can contribute to such decentralised renewable energy production. Blockchain technology solutions can be applied to ensure the execution of smart contracts and use of immutable smart metering. Similarly, due to the growing need to certify the origin of energy, this technology can ensure the issuance of secure, reliable, and irreversible certificates of origin [5] for the specific renewable energy produced.

References

1. Communication from the Commission to the European Parliament, the European Council, The Council, The European Economic and Social Committee and the Committee of the Regions. REPowerEU Plan: https://eur-lex.europa.eu/resource.html?uri=cellar:fc930f14-d7ae-11ec-a95f-01aa75ed71a1.0001.02/DOC_1&format=PDF (01.04.2023.)
2. Communication from the Commission to the European Parliament, The European Council, The Council, The European Economic and Social Committee and The Committee of the Regions. EU Solar Energy Strategy: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A221%3AFIN&qid=1653034500503 (01.04.2023.)
3. European Commission. European Green Deal: EU agrees stronger legislation to accelerate the rollout of renewable energy: https://ec.europa.eu/commission/presscorner/detail/en/IP_23_2061 (01.04.2023.)
4. Eurostat. Share of energy from renewable sources: https://ec.europa.eu/eurostat/data/database?node_code=nrg_ind_share (01.04.2023.)
5. Andoni M. et al., Blockchain technology in the energy sector: A systematic review of challenges and opportunities. *Renewable and Sustainable Energy Reviews*, 2019, vol. 100, pp. 143–174.

REASSESSING DURKHEIM'S SUICIDE TYPOLOGY THROUGH AN ANALYSIS OF DIFFERENCES IN VIEWS OF SUICIDE AMONG LATVIAN AND JAPANESE YOUTH

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The suicide rates in Latvia and Japan are compared with a focus on young people's mental health. This study aims to evaluate the relevance of Durkheim's suicide typology [1] in today's youth in Latvia and Japan. Eight online semi-structured interviews with young people in both countries were conducted during the period of October-December 2022. The research tasks include explaining Durkheim's theory of suicide, estimating the actual characteristics of suicide, and comparing predicted and resulting suicide characteristics based on young people's perceptions of their daily lives. The research object is youths born and raised in Latvia and Japan, aged 18-24 years old.

Based on Durkheim's suicide typology, anomic, fatalistic, egoistic, and altruistic suicides are the main types of suicide. With historical and social background, it is assumed that anomic suicide is more common among young people who feel a lack of recognition from society and a disintegration of moral rules in Latvia [2]. They may also experience isolation from government institutions. On the other hand, collectivist ideas are deeply ingrained in Japanese culture, leading to overwork and a fatalistic element of suicide, where individuals find self-worth within the group [3]. The burden of government policies such as the pension system also creates difficulties for young people to play an active role in society.

After the research, it was found out that Durkheim's typology remained valid but not entirely in accordance with the modern context. The 4 types of suicides (egoistic, altruistic, fatalistic, and anomic) were highly susceptible to the country's culture, principles, and historical background. In Latvia, egoistic, altruistic, and a combination of these types were found to be typical in informants' views, while in Japan, fatalistic, anomic, and a combination of these types were found to be typical. The study suggests that the error in deriving the estimation was due to the fact that the 4 types of suicides in the original scheme were not in accordance with the modern context. In the modern context, 4 types of suicides are also susceptible to factors generated at the individual level not only at the structural level.

References

1. Wray M., Colen C., & Pescosolido B., The sociology of suicide. *Annual Review of Sociology*, 2011, Vol. 37, pp. 505-528.
2. Agarin T., Political dejection in a divided society: A challenge for Latvia's democracy? *Taylor & Francis*, 2021: https://www.tandfonline.com/doi/full/10.1080/01629778.2021.1968917 (10. 01. 2023).
3. Egashira T. (Ed.)., On overwork suicide and Durkheim's suicide typology: http://jsasa.org/bulletin/bulletin37.pdf#page=30, 2010: (15.01. 2023).

ECONOMIC LINKAGES FOR GREEN HYDROGEN INDUSTRY DEVELOPMENT IN THE BALTIC STATES

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Connections between companies and industries are a decisive element for their economic growth. The Green Deal strategy, adopted by the member states of European Union, determines the need for new nature-neutral technologies and energy sources for further economic development. The aim of this research study is to identify connections between industry sectors which can facilitate green hydrogen industry development in the Baltic States. In the economic development processes, links among different companies exist. These links are directly related to the *input – output* analyses pattern and describe the input and output processes of production regarding relations between companies. There are **backward linkages** when a company requires inputs from other companies for the production process and **forward linkages** when the company produces inputs for other companies [1]. If manufacturers export goods to foreign markets and rely on imported inputs, linkages of local companies are weak, because most production output is sold abroad and there will be few backward linkages and small number of forward linkages, since most inputs are obtained from abroad [2]. Linkages among companies and industries within a particular territory facilitate industry concentration and increase of output. For the assessment of the green hydrogen industry in the Baltic States, three major factors were analysed: industry inputs – energy sources for the green hydrogen production, availability of electrolyser and fuel cell technologies, industry outputs – hydrogen application in transportation, energy, manufacturing, and indicators describing country's potential for innovative and productive economy uncovering more potential linkages among industries. Wind farms are considered major sources for green hydrogen production in the Baltic Sea region. Therefore, availability of electrolyser capacity and water purifying stations are essential. In 2021, Lithuania had a higher wind energy proportion in energy consumption in the Baltic States representing 11.5 % of the use. Nevertheless, Latvia has the largest renewable energy proportion in energy consumption – 42% in 2021, determined by three notable hydropower plants [3]. Currently, the Baltic States do not produce major components for electrolyser installations and fuel cells. Of the neighbouring countries, only Lithuania has a potential to use hydrogen at large scale production in mineral fertilizer plants and refinery. In the last decade, Latvia's steel plant and mineral fertilizer plant in Estonia stopped their operations. The Baltic States developed a natural gas transmission system and ports for hydrogen transportation. In addition, public transportation is perceived as another local consumer of hydrogen. Estonia has an overall lead in many indicators concerning its potential for an innovative and productive economy – complexity rating of economy, global innovation index, percentage of research and development in gross domestic product etc. According to the obtained data, conclusions are drawn that Lithuania has the highest potential among the Baltic States regarding the green hydrogen industry **forward linkages** and its utilization in the local economy. All three Baltic countries have comparable conditions for backward linkages. But Estonia possesses a higher rating concerning the overall potential for innovative and complex economy.

References

1. Hirschman O.A., The Strategy of Economic Development. New Haven: Yale University Press, 1958, pp. 98-104.
2. Krugman P., Livas R.E., Trade Policy and Third World Metropolis. *Journal of Development Economics*, 1996, 49(1), pp. 137-150
3. Energy from renewable sources: https://ec.europa.eu/eurostat/web/energy/data/shares (09.03.2022).

TERRITORIAL DEVELOPMENT IN THE CONTEXT OF POST-KEYNESIAN THEORY

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The challenges faced by regions worldwide require an approach that is comprehensive and integrated, taking into account economic, social, and environmental factors and involving cooperation between the government, the private sector, and civil society. One of the most current and appropriate economic theories of regional development is the post-Keynesian theory. Unlike neoclassical economics, which emphasizes the role of markets in driving regional economic development, the post-Keynesian theory of regional development focuses on the role of government intervention and public policy in shaping regional economic outcomes. This includes the use of fiscal and monetary policies to stimulate regional growth, as well as the development of regional planning strategies that take into account local conditions and priorities [1]. The role of demand is of great importance in the alternative analysis of regional growth. This growth is determined by demand and cannot be limited by supply if production factors are mobile and free. In a region where capital and labor are highly mobile and migratory, the demand for growth must be determined. If demand for a region's output is strong, labour and capital will migrate in favour of that region and in competition with others [4]. The financial sector is one of the sectors where a centre that would benefit from dynamic economies of scale would be a fast-growing region with active markets and a developed financial system. The fact that the headquarters of financial institutions are usually located in the centre means distancing from investment demand in the more remote regions and a limitation of credit allocation [3]. Alternative policy recommendations for the eurozone based on post-Keynesian theory suggest that the monetary policy of the ECB should refrain from regulating aggregate output and inflation but should focus on low real interest rates, financial stability, and act confidently as a lender of last resort both in the banking system and the member states of the euro area. The ECB should determine the yield cap on government bonds given by the country's long-term nominal GDP growth rate. The goal of wage policy should be to stabilize income distribution and promote a stable inflation rate, in line with the target rate throughout the euro area. It is proposed to apply functional fiscal policy and use long-term budget deficits/surpluses to ensure a non-inflationary full employment level in each country, thereby also preventing current account surpluses and deficits [2]. A characteristic feature of the work of post-Keynesian regional development theory economists is an active and non-traditional approach to the problems of regional development, taking into account the regional differences, the interaction of the center and peripheral structures and the balancing of the overall economy. Such an approach can ensure the harmonious development of territories in the long term and prevent many threats of the modern world, such as economic migration, income inequality and other resulting problems.

References

1. Davidson P., Who's Afraid of John Maynard Keynes? Challenging Economic Governance in an Age of Growing Inequality. London: Palgrave Macmillan, 2017, 174 pp.
2. Detzer D., Hein E., Post-Keynesian Alternative Policies to Curb Macroeconomic Imbalances in the Euro Area. *PANOECONOMICUS*, 2015, Vol. 62, Issue 2 (Special Issue), pp. 217-236
3. Dow S., Endogenising Uncertainty *Annual Plenary Conference of INET, Hong Kong,* 2013. https://www.ineteconomics.org/uploads/papers/Dow-Paper.pdf (12.03.2023.)
4. Kaldor N., The case for regional policies. *Scottish Journal of Political Economy,* 1970, Vol. 17(3), pp. 337-348.

XBRL AS A DIGITAL REPORTING FORMAT FOR COMPANIES: EUROPEAN EXPERIENCE

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The context of the economic recession that the European Union (EU) is currently facing, caused by the COVID-19 post-pandemic difficulties and the ongoing war in Ukraine, claims for radical changes in the way the public and private sector locates, executes, and controls its funds. To face the growing economic challenge, new interoperable market processes and unified financial data reporting standards within the EU need to be implemented at a revolutionary fast pace.

The EU has already stepped on the path that requires a new form of data management and control by introducing the Transparency Directive by the European Parliament back in 2004. However, the actual policy was introduced to the EU market only on January 1st, 2020, when, according to European Securities and Markets Authority (ESMA), for publicly listed companies, it became mandatory to prepare their annual reports in European Single Electronic Format (ESEF), using Inline eXtensible Business Reporting Language (XBRL) format and IFRS taxonomy. XBRL is an open digital data standard that makes financial reports transparent, flexible for analysis and comparison and reduces information processing costs [4], [5]. Continuing digital reporting adoption in late 2022, the EU Council approved a new Corporate Sustainability Reporting Directive (CSRD) [1] that provides requirements for large European companies to digitalise their financial and sustainability reports in xHTML and Inline XBRL format starting in 2024. Voluntarily, XBRL is already in broad use by the regulators in some of the European countries [2], and several studies have already showed its effectiveness for a decrease in information asymmetry in reporting on EU and United States [3], [4].

This research is aimed to analyse existent utility evidence of the recent ESEF implementation experiences and to stipulate possible impact on the EU market through introducing non-financial reporting in Inline XBRL format according to CSRD.

In conclusion, XBRL format firmly took a stable leading position to become the main digital standard for financial and sustainable information disclosure by EU companies. However, the economic effect of the XBRL format introduction within the new EU regulation remains unclear and depends a lot on further steps taken by the European Commission in this direction and the local government's support of the companies for change.

References

1. Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32022L2464&pk_campaign=todays_OJ&pk_source=EURLEX&pk_medium=TW&pk_keyword=Investgreen&pk_content=Directive%20&pk_cid=EURLEX_todaysOJ (15.02.2023.)
2. Flores Muñoz F., Gutiérrez Barroso J., Báez García A. J., Estandarización digital, vulnerabilidad social y gobierno abierto: el caso de XBRL en Europa, *Revista Española de la Transparencia,* 2022, vol. 15, pp. 313 - 327
3. Liu C., Luo X., Lee Wang F., An empirical investigation on the impact of XBRL adoption on information asymmetry: Evidence from Europe, *Decision Support Systems,* 2017, vol. 93. pp. 42 - 50
4. Yoon H., Zo H., Ciganek A. P., Does XBRL adoption reduce information asymmetry?, *Journal of Business Research,* 2011, Vol. 64 (2), pp. 157-163
5. Zhang Y., Guan Y., Kim J.B., XBRL adoption and expected crash risk, *Journal of Accounting and Public Policy***,** 2019, Vol. 38 (1), pp. 31 – 52

STRATEGY ANALYSIS OF THE COMPANY "SADALES TĪKLS"

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The energy sector is shifting from large central power plants to decentralised generation. The current approach of promoting generation connections and electrification in the context of the grid reconstruction is not the most cost-effective option. With the development of electrification projects and technologies, the number of connections in Latvia continues to increase.

According to joint-stock company "Sadales tīkls" (ST), the rapid increase in the number of connections is leading to a reduction in freely available capacity, and more potentially new users are faced with a situation where they do not have access to free capacity to make a new connection without reinforcing the network. Flexibility services are an innovative approach to realising new connections to the existing grid capacity [2]. According to Article 1 (51) of the Electricity Market Law, a flexibility service is a temporary change in the use or production profile of electricity, which a user or producer has voluntarily undertaken in a contract with another market participant [1]. A study by the Euractiv news portal points out that flexible consumption in the energy sector in 2023 alone could reduce Russian gas imports by 3.7% and save €16 billion in European Union (EU). In 2025, savings are almost double a 7.1% reduction in imports - the equivalent of €31.4 billion in savings [3].

The positive impact of flexibility services is as one of the tools for end-users to benefit from lower bills at a time when geopolitical instability, risks of supply disruptions, and high electricity prices are key issues for the EU [2]. These savings would come from deferred investments in network reinforcement, which would reduce pressure on the electricity distribution system services tariff.

Network constraints on the one hand and consumer preferences on the other are motivating factors for system operators to develop new strategic directions. Evaluation of strategies such as flexibility services before network reinforcement and electricity consumption forecasts can promote or, on the contrary, discourage network development from the perspective of system operators such as ST. Local challenges such as voltage deviations outside the norm, network restoration after a breakdown and outages with long recovery time can be addressed through flexibility services [4]. For their development, the company should promote the development of innovative services and the involvement of potential market players in a transparent manner to implement users' flexibility in planning and managing the electricity distribution system.

References

1. Electricity Market Law (2005): Law of the Republic of Latvia, https://likumi.lv/ta/id/108834-elektroenergijas-tirgus-likums (12.02.23).
2. Flexibility approach standardised for GB distribution network operators: Smart Energy International: https://www.smart-energy.com/industry-sectors/energy-grid-management/flexibility-approach-standardised-for-gb-distribution-network-operators/ (12.02.23).
3. New report into Demand-side Flexibility quantifies huge scale potential in 2030 for both consumers and EU clean energy transition: EURACTIV: https://www.euractiv.com/section/energy-environment/opinion/new-report-into-demand-side-flexibility-quantifies-huge-scale-potential-in-2030-for-both-consumers-and-eu-clean-energy-transition/ (17.02.23).
4. Silva R., Alves E., Ferreira R., Villar J.,Gouveia C., Characterization of TSO and DSO Grid System Services and TSO-DSO Basic Coordination Mechanisms in the Current Decarbonization Context, Energies, 2021, 14 (15), 4451, pp. 12-13.

SOCIAL AND ECONOMIC EFFECTS OF DECLINING AGRICULTURE ON RURAL COMMUNITIES IN PAKISTAN: A STUDY OF PUNJAB PROVINCE

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Pakistan is home to more than 8 million farming families that are responsible for meeting the food security of the country. Presently, 90% of overall farmers are categorized as smallholder farmers. Approximately 6% of the total population of Pakistan resides in rural areas and is dependent directly or indirectly on agriculture for their livelihood. Houngbo (2020) writing for the World Economic Forum as part of the *Bold Actions for Food as a Force for Good* argues that small farmers play a crucial role in the future of food production and can help achieve sustainable development goals. Small farms are more efficient in terms of land use and can contribute to food security and poverty reduction in rural areas, the article also argues that investing in small farms can create jobs, improve nutrition, and enhance environmental sustainability. Additionally, empowering women farmers and promoting agroecology practices can further strengthen the role of small farms in sustainable food production.

However, agricultural growth has been declining in recent years, which has led to farmers moving to non-farm activities. This is corroborated by the study of Ahmad et al (2020) which conducted research in the Sindh part of Pakistan and has found that migration, coupled with exogenous shocks and urbanization, has led to a decline in agricultural productivity, exacerbating food insecurity and malnutrition.

Despite the significant contribution of agriculture to the rural economy in Pakistan, there is a lack of research on the social and economic effects of declining agriculture on rural communities in Pakistan as the small farmers are likely to be more vulnerable, making the subject topical and worthy of careful consideration. This paper aims to investigate the social and economic effects of declining agriculture on the rural economy in Pakistan, specifically in the province of Punjab, which is also known as the bread basket of Pakistan. With this study, the author seeks to understand the causes of the decline in agricultural productivity, the effects of the migration of farmers to non-farm activities on agricultural output, and the feasibility of non-agricultural livelihoods for small and marginal farmers.

The study will utilize a mixed-methods approach, combining quantitative and qualitative data. The quantitative data will be collected through surveys of small and marginal farmers in Punjab, using a stratified random sampling technique. The survey will cover topics such as household income, sources of income, land size, crop yields, and access to credit. The qualitative data will be collected through in-depth interviews with key informants, including farmers, policymakers, and experts in the field of agriculture.

This study aims to contribute to the understanding of the social and economic effects of declining agriculture on the rural economy in Pakistan, as well as to identify the feasibility of non-agricultural livelihoods for small and marginal farmers. The research will provide policymakers with recommendations on supporting the agricultural sector and promoting alternative livelihoods.

References

1. Ahmad M. I., Oxley L., Ma, H., What makes farmers exit farming: A case study of Sindh Province, Pakistan. *Sustainability*, 2020, Vol. 12(8), p. 3160.
2. Houngbo G. F., Why small farms are key to the future of food and how we can support them. International Fund for Agricultural Development (IFAD), 2020: https://www.ifad.org/en/web/latest/-/blog/why-small-farms-are-key-to-the-future-of-food-and-how-we-can-support-them(01.03.2023)

CHALLENGES OF INTEGRATING ELECTRIC VEHICLES IN LITHUANIA

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A convenient and environmentally friendly transport infrastructure stimulates money accumulation and improves the quality of life. A good example of today's transport technology is electric vehicles and their developed infrastructure. Thus, the purpose of this research study is to find out the reasons behind the backlog in the development of electric vehicle infrastructure in Lithuania and the necessary measures to overcome it [1].

Electric cars cost a lot. Many countries, including Lithuania, allow their citizens to own such vehicles. For example, Lithuanians can buy a car with a state subsidy as long as the car is less than 2-4 years old. According to the modern trends, the majority of Lithuanians buy used cars. Buying a used electric car can be very expensive and difficult. One of the biggest challenges for older electric vehicle buyers is shrinking batteries, whose capacity decreases over time. Another downside is that many EV owners complain about the lack of available charging stations. This is a big annoyance. All major Lithuanian cities have charging stations, but the lack of stations outside of these regions hinders further movemement [2].

The Ministry of Transport and Communications of the Republic of Lithuania reports that the country is in favor of electric vehicles and will facilitate their integration and expansion here. The design and maintenance of a network of publicly accessible electric vehicle charging stations will promote the use of electric vehicles in Lithuania, reduce the consumption of petroleum products in the transport sector, and reduce the environmental impact of transport. In particular, five major Lithuanian cities and resorts have already built an electric vehicle charging infrastructure. It was later extended to an international highway and eventually to other roads every 50 kilometers to provide an electric vehicle connection between cities [3].

Despite Lithuania’s transport sector contributing significantly to the overall country’s economy, the use of electric vehicles lags behind the neighboring countries. The transport sector is likely to experience moral and technological lagging behind in the long run. As a result, it is important to assess the advantages and disadvantages of integrating electric vehicles throughout Lithuania's transport infrastructure and providing additional vehicle charging stations.

References

1. A dedicated map for developing and coordinating electric vehicle charging infrastructure: https://sumin.lrv.lt/lt/naujienos/elektromobiliu-ikrovimo-prieigu-infrastrukturai-plesti-ir-koordinuoti-specialus-zemelapis (12.02.2023.)
2. Matthew N. Eisler, Age of auto electric: environment, energy, and the quest for the sustainable car, 2022: https://doi.org/10.7551/mitpress/14759.003.0014 (12.02.2023.)
3. Electric vehicle infrastructure development in Lithuania: https://sumin.lrv.lt/lt/veiklos-sritys/darnus-judumas/elektromobilumas/elektromobiliu-infrastrukturos-pletra (12.02.2023.)
4. Number of electric cars in Lithuania: https://sumin.lrv.lt/lt/veiklos-sritys/kita-veikla/pletra-ir-inovacijos/elektromobiliu-skaicius-lietuvoje. (12.02.2023.)

POTENTIAL FOR SEAWEED EXTRACT AS BIOPESTICIDE IN ORGANIC FARMING IN LATVIA

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An interdisciplinary approach provides an opportunity to achieve sustainability objectives. The European Union *Green Deal* holds that pesticide use should be reduced at the same time increasing organic farming areas [1].

The organic sector is developing very rapidly. In 2020, 9.8% of the agricultural land was processed as organic. Compared to 2012, its increase exceeds 50%. Latvia is one of the European Union countries that shows stagnant indicators for the growth of organic farming. Nevertheless, Latvia`s share of organic agriculture of the total agricultural land is above the average level of the European Union. In 2020, 14.79% of the total agricultural land in Latvia used organic farming, while the European Union average is only 9.8% .

The global and EU pesticide use is increasing. Its growth has been global. In 2018, the European Union showed a 3% reduction in pesticide use compared with 2017, while the 2020 data shows a repeated increase in pesticide use in agriculture. Pesticide use increased in Latvia faster than in other EU countries. In 2020, compared to 2019, the increase was 29%, while compared with 2012 the use rose to 160%.

The objectives of the Common Agricultural Policy (CAP) in Latvia, developed by the Ministry of Agriculture of the Republic of Latvia, focus on the direction of sustainability in agriculture, including organic farming as a vital agricultural sector [2].

The combination of the SWOT method and several quantitative methods, applied by the authors of this study, has identified the most important factors that can affect the development of organic farming. Three priority scenarios were developed reflecting a few problems, requiring solutions; innovative solutions in the field of pesticides are needed, which could facilitate organic production and increase of its added value; knowledge transfer should be developed for creating new solutions; cooperation between entrepreneurs and scientists should be enhanced, and high-intensity support from the European Union Structural Funds should be obtained to promote successful organic farming.

For modern organic farming, seaweed can be widely used, as its greatest potential is being a bio-pesticide (bio stimulant and fungicide) because it contains many valuable compounds such as amino acids, vitamins, plant hormones, etc., which affect soil microorganisms and contribute to plant root growth, seed germination and plant stress factors [3].

Two types of microalgae predominate in the open Baltic Sea: Furcellaria lumbricalis and Vertebrata fucoides. Their leached volumes range from 0-228 m3/100 m. However, due to the changing weather conditions, the leached volumes are changing.

The use of algae improves a range of physical-chemical properties of the soil.

The beneficial effects of seaweed are plant development and growth, seed germination and plant productivity.

References

1. European Parliament, Creating a sustainable food system: the EU's strategy. https://www.europarl.europa.eu/news/lv/headlines/society/20200519STO79425/ilgtspejigas-partikas-sistemas-izveide-es-strategija (18.03.2023).
2. Ministry of Agriculture Republic of Latvia, Strategy of Common Agricultural Policy of Latvia 2023-2027. https://www.zm.gov.lv/zemkopibas-ministrija/statiskas-lapas/apstiprinats-latvijas-kopejas-lauksaimniecibas-politikas-strategiskais?id=25211#jump (18.03.2023).
3. Skutele K., Mešķis S., Dorbe A., Macroalgae in Shore of Latvia – Opportunity or Simply Sea Waste? 2022, pp.80-83.

SOLAR ENERGY PRODUCTION AND CONSUMPTION IN LATVIAN HOUSEHOLDS: A CASE STUDY

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Solar energy has the highest potential of all renewable energy sources, and solar panels using PV (photovoltaic) technology are becoming extremely popular around the world. In only 10 years, the total electricity capacity of solar energy has increased more than 10 times – from 74 GW in 2011 to 855 GW in 2021. However, this was not the case in Latvia for a very long time. In 2021, the electricity capacity of solar energy in Latvia was only around 7 MW. Meanwhile, in neighbouring countries like Estonia and Lithuania, this number was much higher at 414 MW and 254 MW, respectively [1]. A study in Latvia showed that, considering the price of the PV system and the average price of the electricity in 2017, the payback time of a PV system was from 10 to 15 years [2]. However, the situation changed dramatically in 2022 when the price of the electricity increased multiple times. Considering that, along with technological advances in solar panels, the payback time of PV systems can now be less than 5 years. As a result, the total number of households using solar panels in Latvia increased more than 5 times in a single year, from 2145 households in 2021 to 11764 households in 2022 [3]. However, not all the electricity generated by solar panels is used in households. The excess electricity is sold (fed) into the main grid. During times when solar panels do not produce electricity, electricity is bought from the main grid, which includes a distribution fee and is therefore more expensive.

To determine the amount of electricity produced by solar panels and how much of it was used, a case study in the *Jasmīni* household from 01 January 2020 to 31 December 2022 was analysed. The household has an agreement that all excess electricity can be sold into the main grid. From January 1st, 2020 to December 31st, 2020, the total electricity capacity of the solar panels in the household was 5.94 kW, but since January 1st, 2021, it has been increased to 10.74 kW. The results of this study showed that the electricity generated by the solar panels was not largely used in the household, but was sold. During the study period, the household consumed only 23.30% of the electricity generated by the solar panels, and the rest was sold. Although the electricity capacity was increased in 2021, and solar panels were able to produce more electricity than the household consumed, the electricity consumption from the solar panels was never more than 50% in any month. Additionally, 70.02% of the electricity consumed in the household was bought from the main grid.

After data analysis, it was concluded that this situation is mainly due to the fact that solar panels do not produce electricity at night and do not produce enough during winter months and on days with insufficient sunlight. Furthermore, during sunny days, solar panels generate more electricity than the household is able to consume.

To improve the situation, households should optimize their electricity consumption by limiting their consumption during times when solar panels are not producing electricity and vice versa.

References

1. International Renewable Energy Agency, data of renewable energy electricity capacity: https://pxweb.irena.org/pxweb/en/IRENASTAT/IRENASTAT__Power%20Capacity%20and%20Generation/ELECCAP_2023_cycle1.px/ (20.03.2023.).
2. Rozentale L., Lauka D., Blumberga D., Accelerating power generation with solar panels. Case in Latvia, Energy Procedia, 2018, Vol. 147, pp. 600-606.
3. Sadales tīkls AS, Overview of the electricity supply in 2022: https://sadalestikls.lv/lv/elektroapgades-apskats (20.03.2023.).

DIMENSIONS OF HUMAN CAPITAL IN LATVIA

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People are the most important resource of any country. As regards sustainable development, the development of human capital, its economic potential and growth should be one of the main objectives. The aim of this research is to discuss dimensions of human capital in Latvia.

Investment in people (human capital) is the main source of economic growth in the modern economy. Human capital is percieved to include natural ability, innate and acquired skills, knowledge, experience, talent, inventiveness. Forms of increasing the value of human capital include spending on health, safety, science, research and education.[1] According to UNDP, Latvia ranks 39th out of 191 countries in the Annual Human Development Index 2021.[5]

As regards knowledge, the growth of the public education system ensures the advancement of technological knowledge, which is the basis for the country's economic growth. [2] The quality of the education system in Latvia is the key to progress. According to the UNDP Human Development Index, the expected length of schooling in Latvia is 16,2 years and mean years of schooling 13,3 years. [5]

Regarding long and healthy life, similar to Europe, depopulation and aging have a very strong regional dimension in Latvia. It is particularly important to invest in health care, related knowledge and technologies (life sciences, biomedicine, pharmaceuticals) and the promotion of healthy lifestyles in all generations. [3] Lifestyle also has a significant impact on health: Latvian citizens smoke a lot and exercise too little. Promoting a healthy lifestyle can significantly improve public health and extend healthy life expectancy. According to the UNDP Human Development Index, life expectancy at birth in Latvia is 73,6 years. [5]

The next aspect is the decent standard of living: the unemployment rate in the 15-64 age group has decreased to 7.9% in 2021. The share of the working-age population in employment is historically high and above the EU average. [4] Supply and demand ust be matched in the labor market. The shadow economy and non-payment of taxes distort the labor market. Emigration is also a problem that needs to be addressed. According to UNDP Human Development Index the gross national income (GNI) per capita in Latvia is 32,803 PPPs. [5]

It is important that human capital and productivity increase for Latvia’s continued existence and development as a country. The indicators characterizing human capital are primarily based on the population: its number and age structure, which includes healthy life expectancy, qualitative education, and integration into the labour market. The reviewed dimensions of human capital should not be seen separately, not even in a linear dimension, but in a complex network.

References

1. Kucharčikova A., Human Capital – Definitions and Approaches, Human Resources Management & Ergonomics, 2011, Vol. V, pp. 60-70.
2. Kristapsone S. Cilvēkkapitāls un tautas attīstība. In: Krišjāne and Krūmiņš, ed., Population Reproduction and Challenges for Renewal of Society in Latvia. 2019., Rīga, LU Akadēmiskais apgāds.
3. Latvijas ilgtspējīgas attīstības stratēģija līdz 2030. gadam, Latvijas Republikas Saeima, 2010.
4. Labour Market Report 2022, The Ministry of Welfare of the Republic of Latvia, 2022, Riga
5. UNDP Human Development Index: https://hdr.undp.org/data-center/human-development-index#/indicies/HDI (10.03.2023).

OUTFLOW OF YOUNG PEOPLE FROM THE RURAL AREA TO THE CITY: EXAMPLE OF MADONA DISTRICT

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The movement of people from rural areas to urban areas has been increasing in recent years [1] due to various factors such as economic opportunities; access to better education, healthcare, and social services; and the desire for a better quality of life. This study aims to identify the reasons for the outflow of young people from Madona district. Given the complexity of rural-urban migration, there is a growing need for research activities to better understand its causes, consequences, and implications for society.

The study is based on Everett Spurgeon Lee's Push and Pull theory [2]. The research was conducted over a total of 3 months, in October, November and December 2022. The study used a survey as the research method. The survey was conducted via the Facebook website. In total, 103 respondents participated in the survey. The research sample is young people who lived in the rural area of Madona district and have moved to one of the cities of Latvia, aged 18 to 30 years which is the emerging adulthood stage, according to Jeffrey Arnett [3]. 46.6% of respondents are between 18 and 25 years old and 53.4% of respondents are between 26 and 30 years old. 49.5% of respondents are men and 50.5% are women.

The results of the study show that the main pulling factors make up 84.4%, push factors making up 76.7%. Respondents have marked as the most important push factors such factors as the lack of job opportunities (29.1%), low salary (24.1%), lack of educational opportunities (17.5%) and unfavourable social conditions (8.7%). Respondents consider greater employment opportunities (25.2%), wider opportunities for self-realization (25.2%), higher wages (21.4%) and wider educational opportunities (12.6%) to be the main pull factors. 38.8% of respondents would like to return to their rural region in the future. The largest proportion of respondents (63.7%) have chosen Riga, the capital of Latvia, as their destination. As the result of the study, the pull factors are shown to be more important in the outflow of young people from the countryside to the cities.

The main conclusions of the study are that pull factors have a greater influence on young people's decision to move to cities than push factors in rural regions, the desire of young people to return to the rural region in the future creates a beneficial development situation, and the desire of young people to return to rural regions indicates that rural regions are still able to attract young people, but appropriate measures are needed.

References

1. Bauer P., Human migration: Human migration. Definition, Overview, & Facts, Encyclopedia Britannica: www.britannica,com (14.03.2023).
2. Push and Pull Factors and Lee’s Theory of Migration: 1525155291PS_MU_15Lee_Migration_Theory__Push_and_pullModule15Paper10Ed.pdf (inflibnet.ac.in), (13.03.2023).
3. Arnett J.J.: *Emerging Adulthood: A Theory of Development From the Late Teens Through the Twenties* (2000): ARNETT_Emerging_Adulthood_theory.pdf (jeffreyarnett.com) (14.03.2023).

PARTICIPATION OF THE POPULATION IN THE DECISION-MAKING OF THE MUNICIPALITY OF MARUPE

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As a result of the administrative territorial reform in Latvia, a new municipality, Marupe Municipality, has been created, bringing together Marupe parish, Babite parish and Sala parish. The changes have affected the day-to-day work of local government structures, services and institutions, as well as the involvement of citizens with the development of the municipality in discussing topical issues and the possibilities to participate in the decision-making of the local government.

The aim of the study is to explore and analyse the factors affecting the participation of the population in the decision-making of the municipality of Marupe, in order to develop proposals for the municipality to promote the participation of the population. The study used a quantitative and qualitative research approach. A population survey (324 respondents) and two semi-structured interviews were developed for the analysis of the results.

The present study is based on the Theory of Communicative Action of J. Habermas, which states that communicative action is merely a fully-fledged communication of individuals who have managed understanding. According to the communication of the population, the linguistic structure will be analysed for the regulatory understanding of the Marupe municipality society.

For the analysis of the study, the author used a code of good practice for public participation in decision-making, which includes four levels of public participation, such as information, consultation, dialogue, and partnership. The theory explains the hierarchy of levels from the lowest involvement., i.e., the transfer of information to the people, the creation of consultations up to the highest involvement which is the building of dialogue and partnership between non-governmental organisations, public institutions, and citizens.

The sense of belonging of the site is closely linked to environmental factors, accessibility of infrastructure, personal needs, and options. As one of the most important factors for the realization of local government communication and participation with citizens, it is not only the availability of information and the presentation of current events, but also the promotion of belonging to the local government among the population.

The author concludes that in the Marupe Municipality, information and consultation are of the highest level, but dialogue and partnership have not been created affected by significant obstacles: the uncertainty about the work and functions of the municipality, the lack of infrastructure and mobility, the lack of information on the possibilities of participation and lack of belonging. Citizens believe that, in order to be able to participate in municipal decision-making, online public consultation and a bus between villages are required.

References

1. PanTERA- WP6, Stakeholder consultation plans, Pan-European Partnership Group, 2019: https://pantera-platform.eu/wp-content/uploads/2020/01/D6.2-Stakeholder-consultation-plans.pdf.
2. Habermas J., The theory of communicative action, translated by Thomas McCarthy, Beacon Press, Boston, 1984, p. 465.
3. Scannell L., Gifford R., Place Attachment Enhances Psychological Need Satisfaction, *Environment and Behaviour*, 2017: https://www.researchgate.net/publication/299345824_Place_Attachment_Enhances_Psychological_Need_Satisfaction (30.01.2023.

ALCOHOL CONSUMPTION AMONG THE STUDENTS OF LATVIA UNIVERSITY OF LIFE SCIENCES AND TECHNOLOGIES

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Evidence suggests that large numbers of university students are consuming alcohol heavily, and they are frequently involved in binge-style drinking episodes [1]. Latvia has a relatively high alcohol consumption at 12.6 litres per capita a year, compared to the 8.8 litres in the OECD on average in 2018, and 59% of Latvian population have reported binge drinking in the last 30 days [2]. Such a binge drinking pattern has negative effects on health and education [3]. The aim of the research was to study alcohol consumption among the full-time students of LBTU. The research hypotheses are: LBTU students are more likely to consume alcohol in binge drinking pattern for social motives than other motives, and Latvian and international students of LBTU do not differ in their alcohol consumption. To test the research hypothesis, online survey was conducted in September 2022 (n = 417).

The empirical data show that 95% of LBTU students consume alcohol, 62% in a binge drinking pattern which is more characterestic to Latvian students whereas the international students consume alcohol in a moderate pattern. Alcohol is consumed more often for social motives (mean value 3.3 out of 5) than other motives - enhancement motives (2.8), coping motives (2.4) and conformity motives (1.6). The results of the study for the drinking motives are similar to other studies and do not show a significant difference between Latvian and international students. Students, especially binge drinking students, recognized negative effects: memory loss (31), lack of concentration for studies (22%), physical injuries (17%), missing lectures (16%), unprotected sexual acitivties (11%), becoming aggresive (11%), drunk driving (9%), Lacking money (5%), being a victim of assualt or theft (4%) and visiting hospitals (3%). Latvian students recognized effects such as missing lectures, the lack of concentration for studies, memory loss, becoming aggressive, drunk driving, and unprotected sexual activities more than the international students. On the other hand, effects such as physical injuries, visiting the hospital, a victim of assault or theft and lacking money were recognized more by the international students. The main conclusion is that the alcohol consumption is common among the LBTU students and the majority consumes alcohol in binge drinking pattern and for social motives. Among the Latvian and international students, there are differences in drinking patterns.

References

1. Brown R., Murphy S. Alcohol and social connectedness for new residential university students: implications for alcohol harm reduction, *Journal of Further and Higher Education*, 2018, Vol. 44 (2), pp. 216-230. DOI: 10.1080/0309877X.2018.1527024 (19.06.2022)
2. OECD Reviews of Public Health: Latvia: A Healthier Tomorrow, OECD Reviews of Public Health, OECD Publishing, Paris, 2020. https://doi.org/10.1787/e9f33098-en (14.07.2022)
3. Soares W.D., Paz C.J.R., Fagundes L.C., Freitas D.A., Jones K.M., & Barbosa H.A., The use of alcohol as a social mediator among university students., *SMAD Electronic Journal of Mental Health, Alcohol and Drugs*, 2018, Vol. 14 (4), pp. 257-266 https://dx.doi.org/10.11606/issn.1806-6976.smad.2018.000416 (29.06.2022)