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of Life Sciences  
and Technologies

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**STUDENTS ON THEIR WAY TO SCIENCE**  
**(undergraduate, graduate, post-graduate students)**  
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## **STUDENTS ON THEIR WAY TO SCIENCE**

(undergraduate, graduate, post-graduate students)

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## **AGRICULTURE**

# YIELD AND QUALITY OF SPRING BARLEY DEPENDING ON SOWING PARAMETERS

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Spring barley (*Hordeum vulgare*) is more widely used for animal feed than for food in Europe, but in Asian countries it is more commonly used for food. In many countries, barley is mainly used in the brewing industry and for baking [1]. It has been proven that the sowing rate affects the grain yield and its quality significantly, so it is important to choose the optimal sowing rate [2]. Not only the sowing rate can affect grain yield and quality; another important factor is the chosen row spacing, which may affect grain yield and tiller number [3]. The aim of this study was to determine barley grain yield and quality depending on genotype, row spacing and sowing rate.

The field experiment was conducted at the “Agriculture Science Centre of Latgale” in 2020. Two genotypes ('Austris' and hull-less breeding line 'ST-13053K'), two row spacings (12.5 and 25.0 cm) and two sowing rates (300 and 400 seeds per 1 m<sup>2</sup>) were used. Pre-crop of spring barley was soybean (*Glycine max*). In 2020, temperature and precipitation was suitable for spring barley growth. The evaluated parameters are shown in the table below. Three-way variance analysis was used for data analysis. The results showed that a genotype affected the yield and all the quality traits ( $p < 0.01$ ) significantly, the row spacing affected the yield, 1000 grain weight (TGW), volume weight (VW) and protein content significantly, but sowing rate affected only TGW significantly (see the table). The highest yield was provided by the variety 'Austris' and by the traditional row spacing (12.5 cm) (see the table). Higher VW was provided by hull-less barley line 'ST-13053K'; the row spacing of 25 cm gave a small, but significant VW increase.

## Average yield and quality of spring barley depending on the studied factors

Studied factors	Yield, t ha <sup>-1</sup>	TGW, g	Volume weight, g L <sup>-1</sup>	Protein content, %	β-glucan content, %	Starch content, %
<b>Genotype</b>						
p-value	<0.001	0.002	<0.001	<0.001	<0.001	<0.001
'Austris'	9.49	50.91	732.57	12.83	3.951	60.78
'ST-13053K'	7.79	49.23	821.61	14.10	4.269	62.12
<b>Row spacing</b>						
p-value	0.003	<0.001	0.037	0.027	0.877	0.071
12.5 cm	8.79	48.72	775.19	13.10	4.106	61.67
25.0 cm	8.50	51.42	778.99	13.83	4.114	61.22
<b>Sowing rate</b>						
p-value	0.868	0.025	0.259	0.773	0.498	0.741
300 seeds per m <sup>-2</sup>	8.65	50.66	778.08	13.42	4.13	61.49
400 seeds per m <sup>-2</sup>	8.64	49.49	776.09	13.51	4.09	61.41

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# CHARACTERIZATION OF THE MOST IMPORTANT OAT LEAF DISEASES

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In Latvia, oats currently rank third in cereal production after wheat and barley, and sowing areas and yields have been steadily increasing. Intensive production of oats under organic and also conventional conditions increases the development and harmfulness of oat diseases, including leaf diseases. There is very little research done related to oat diseases in Latvia. The aim of this study is to describe the most important diseases of oats caused by fungi (kingdom *Mycota*).

Oat crown rust caused by *Puccinia coronata* f. sp. *avenae* is one of the most widespread and devastating diseases all over the world, including in Latvia. *P. coronata* belongs to the *Basidiomycota* phylum, *Pucciniales* order, and *Pucciniaceae* family. This pathogen is a typical macrocyclic and heteroecious fungus, which has an obligate biotrophic lifestyle. Urediniospores, teliospores and basidiospores develop on oats, but spermatia and aeciospores occur primarily on *Rhamnus* species. An epidemic of crown rust spreads in areas with warm temperatures (20–25 °C) and high air humidity. High pressure of this disease leads to plant lodging and shriveled grain of poor quality [1].

Leaf spot is a common foliar disease of oats caused by *Pyrenophora chaetomioides*. It is a necrotrophic pathogen that belongs to the phylum *Ascomycota*, subphylum *Pezizomycotina*, order *Pleosporales*, and family *Pleosporaceae*. The primary infection of the disease arises from seed-borne infection. Spores form early leaf stripes then splash up the plant producing the secondary infection. Eventually, spores splash up onto the ear where the grain becomes infected. Infected grain can cause seedling death during or soon after the emergence. Infected debris is not thought to be a significant part of the disease cycle [2].

Powdery mildew is caused by *Blumeria graminis* f. sp. *avenae*. It belongs to the phylum *Ascomycota*, subphylum *Pezizomycotina*, order *Erysiphales*, and family *Erysiphaceae*. Powdery mildew appears as white, later grey-tan mould on all aerial parts of cereals, i.e., leaves, stems, and ears, although leaves are most commonly infected. Masses of conidia are produced during the season of vegetation, even by gently shaking the plant, clouds of conidia are released from the patches [3]. At the end of summer dark chasmothecia develop on the leaves.

The knowledge about the life cycle of diseases and ecological requirements is necessary to build up an effective and environmentally friendly disease control system.

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# EFFECTIVENESS ASSESSMENT OF THE DIFFERENT VARROA MITE (*VARROA DESTRUCTOR*) CONTROL STRATEGIES IN THE HONEYBEE (*APIS MELLIFERA*) COLONIES

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The most invasive bee parasite *Varroa destructor* has spread almost worldwide and caused a major impact not only on the beekeeping sector, but on the whole agriculture industry as it is estimated that the *Apis mellifera* influences 76% of the total food production in Europe as the most common pollinator [2]. The life of *V. destructor* occurs in two stages: an adult dispersal stage during which the mites feed upon the bees [1] and a reproductive stage within the capped brood cells. Each mite can produce 0.7–2.5 fully developed offspring. The feeding holes that have been carved out by the *V. destructor* remain open and serves as a path for different viruses [3]. It is important to keep the invasion threshold low to maintain good health of bee colonies. The aim of the work was to determine the most effective biological control strategy for *V. destructor* mites in honeybee colonies.

The research was carried out in the apiary in the western part of Latvia (56°47'22.8" N; 23°05'32.5" E) from April 2020 to March 2021. A one-factor research trial was set up to compare four different *V. destructor* control strategies (biomechanical method with 3-section drone brood frame comb removal, formic acid vapor treatment, oxalic acid preparation BeeVital® HiveClean treatment, complex method of combine drone brood frame comb removal and oxalic acid preparation BeeVital® HiveClean treatment) with the untreated control hives.

The experiment was performed in 15 colonies – one strategy per three hives. The biomechanical method involved the following: an empty 3-section drone brood comb was placed on the side of the brood nest. The drone brood was removed by cutting out 1 section every 7<sup>th</sup> day. The formic acid vapor treatment was the following: a wood fiber board impregnated with 85% formic acid in polyethylene with holes 1.5 cm in diameter was placed in the hive for 10 days in October. BeeVital® HiveClean was trickled on the bees between the combs three times in the September – each time 15 mL per hive. The complex control method involved a combination of drone brood frame comb removal and treatment with BeeVital® HiveClean. The samples of live bees were taken before and after each trial of each strategy as well as after wintering. The number of mites were counted and calculated as equal to the number of mites per 100 bees.

A significant difference was not found between all samples in June. Equal variance ( $p > 0.05$ ) may be assumed also for the July and August, but some increasing trend of the invasion of mites could already be observed at the control and formic acid strategy hives.

The research demonstrated a significant difference between all strategies after treatment and after wintering. The complex control method ( $p > 0.014$ ) and BeeVital® HiveClean treatment ( $p > 0.007$ ) after treatment, the complex control method ( $p > 0.034$ ) and the biomechanical method ( $p > 0.045$ ) after wintering in comparison with the control hives have a good performance to slow down the development of the Varroa destructor.

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# IMPACT OF SEVERAL FACTORS ON HEMP SEED YIELD DURING TWO YEARS

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During the last decades interest in growing hemp (*Cannabis sativa*) has increased, even if it cannot be considered as a traditional crop in several countries, including Latvia. Further research is needed to understand the agrotechnological aspects. The main challenge in Latvia is to find suitable varieties for the local agro-climatic conditions [1]. The aim of this study was to compare different parameters (see Table) of six hemp varieties during the time period 2019-2020 in two growing systems: conventional and organic. The varieties 'Finola', 'Adzelvieši', 'Pūriņi', 'Zenit', 'Uso 31' and 'Felina' were sown at the Priekuļi Research Centre of Institute of Agricultural Resources and Economics. Three-factor analysis of variance (RStudio) was performed for data processing.

Three of six varieties were harvested which gave low seed yield in 2019 ('Uso 31' – 0.25 t ha<sup>-1</sup>, 'Zenit' – 0.27 t ha<sup>-1</sup>, 'Felina' – 0.22 t ha<sup>-1</sup>), but in 2020 they did not mature and were not harvested due to adverse meteorological conditions. In 2019, the highest 1000 seed weight and oil content of the mentioned three varieties were reached by 'Uso 31' (15.26 g and 34.94%, respectively), while the open seeds were lower for varieties 'Zenit' and 'Felina' (13%).

Average seed yield in two years of other three varieties was moderately high: 0.75–0.78 t ha<sup>-1</sup> (Table). Other authors obtained similar hemp seed yields: 0.3–2.1 t ha<sup>-1</sup> [1]. The results showed that all three varieties gave similar seed yield with similar oil content and percentage of open seeds. Only 1000 seed weight was influenced by the variety. The growing system affected all parameters significantly, and higher average seed yield was obtained from the conventional growing system (1.20 t ha<sup>-1</sup>). The conditions of the growing year affected three out of four evaluated parameters, with the exception of oil content (Table).

## Impact of the variety, growing system and conditions of a growing year on hemp seed yield and its quality parameters

Factors	Oil content, %	1000 seed weight, g	Open seeds, %	Seed yield, t ha <sup>-1</sup>
<b>Variety</b>				
'Adzelvieši'	34.42a	12.12a	13a	0.75a
'Pūriņi'	34.84a	13.72b	13a	0.78a
'Finola'	35.15a	12.04a	15a	0.77a
<i>p-value</i>	0.188	<0.001	0.405	0.940
<b>Growing system</b>				
Conventional	35.17a	12.55a	12b	1.20a
Organic	34.44b	11.75b	16a	0.33b
<i>p-value</i>	<0.010	<0.001	<0.001	<0.001
<b>Year</b>				
2019	34.76a	12.80a	15a	0.93a
2020	34.85a	11.50b	12b	0.60b
<i>p-value</i>	0.776	<0.001	<0.001	<0.001

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# FERTILIZATION OF JAPANESE QUINCE (*CHAENOMELE JAPONICA*)

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Cultivation of Japanese quince has a high potential since there are numerous ways how to use the yield of this perennial crop. As this is a relatively new crop in Latvia, there is limited scientific information and practical experience about nutrient requirement and fertilisation practice. Currently some analogies with other perennial plants are used to fill this gap [1]. Fertilisation system for Japanese quince should consider particular features of this crop which sometimes are rather different from other orchard plants. For example, Japanese quince requires soils that do not contain free carbonates and have pH below 6.0. Therefore preference is given to the use of fertilisers making soil reaction slightly acid but not basic. In some specific cases, soil acidification materials are recommended to use, e.g. elemental sulphur, ferrous sulphate or similar [2].

Another aspect is low competitiveness of Japanese quinces with other plants, especially in the first years of growing [1 – 2]. Therefore, weed control is very important for these plants. Even the use of grass sward for suppression of annual weeds is not recommended while Japanese quinces are in juvenile phase. Top dressings of fertilisers, especially nitrogen, promotes the growth of not only the crop, but also weeds; therefore, this method of fertilisation is not the best for Japanese quince.

There is still the question of plant nutrient requirements for Japanese quince. Our investigations are focused on this topic. The balance approach is mainly used. Experimental scheme includes the use of well-developed plants, analysing all biomass components (shoots, branches, roots, leaves, fruits). Dry matter accumulation and nitrogen, phosphorous and potassium content in plants are checked. Based on obtained results, provisional amounts of plant nutrients required for Japanese quinces are calculated. Then the use of these fertiliser norms will be confirmed by the application of methods of plant diagnosis. Therefore information about plant nutrient content in young-growing leaves and shoots is important. Additionally, the plant nutrient content in soil as well as other soil fertility parameters' control relevant to Japanese quinces cultivation are also under investigation. Japanese quinces compared with other perennials start their vegetation earlier. Therefore, fertilisation in these plantations should be started before those of other common orchard crops cultivated in Latvia [1; 3].

## Acknowledgement

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# POSSIBILITIES OF THE CONTROL OF FABA BEAN DISEASES

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Faba bean (*Vicia faba*) is one of the most valuable crops in the world because its seeds contain high amounts of protein and are able to fix nitrogen. The areas for growing faba beans have been increasing in the last decade. Faba bean diseases are the major problem in their cultivation; therefore disease control is required. The most damaging diseases are chocolate spot caused by *Botrytis* spp. and leaf spot caused by *Alternaria* spp./*Stemphylium* spp. complex. Both diseases are caused by a complex of pathogens, and different causal agents, sometimes even several of them, are mentioned in existing literature. At least four species of *Botrytis* are found in Latvia [1], but precise species of *Alternaria* and *Stemphylium* responsible for leaf blotch are unknown in the conditions of the Baltic and Nordic region.

Previous investigations have proved the efficacy of fungicide application, which reduce the severity of diseases [2] and can increase the yield even by 1 t ha<sup>-1</sup> [3]. However, results are controversial because the spectrum of pathogens and conditions vary across the regions and years.

The aim of the present study is to evaluate the efficacy of fungicide application during a six-year research period in the conditions of Latvia.

Field trials were carried out at the Study and Research Farm “Pēterlauki” of the Latvia University of Life Sciences and Technologies in 2015-2020. The assessment of diseases was performed in a large field experiment conducted by Ieva Plūduma-Pauniņa. Disease development was analysed in treated and untreated fields. The fungicide Signum with active substances boscalid (267.0 g kg<sup>-1</sup>) and pyraclostrobin (67.0 g kg<sup>-1</sup>) were used. The severity of diseases was assessed approximately once in two weeks, starting from the appearance of first symptoms. In each trial plot, 20 plants were randomly selected and valued on a 0-9 points scale (0 - healthy plant, with no symptoms; 9 - all leaves covered with symptoms). The total disease impact was evaluated by calculating the area under the disease progress curve (AUDPC). Data were statistically processed to determine the significance.

The level of the diseases differed depending on year. Chocolate spot was the most important disease in 2016 (value of AUDPC was 154 units), and 2017 (134 units). Leaf spot caused by *Alternaria*/*Stemphylium* complex dominated in 2019 (value of AUDPC was 72 units) and 2020 (114 units). Fungicide application for leaf spot caused by *Alternaria*/*Stemphylium* complex and for chocolate spot did not reduce disease level significantly since there were no significant differences on average ( $p > 0.05$ ). The efficacy of fungicides was influenced by the severity of diseases; the best effect was observed in years with a higher pressure of diseases. However, obtained results are controversial and further studies are required to clarify regularities between the development of diseases, a fungicide application and the efficacy of control.

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# SCRAPIE DISEASE PRION PROTEIN GENE POLYMORPHISM IN LATVIA BRED GOATS

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Transmissible spongiform encephalopathies (TSEs) are slowly progressive, fatal neurodegenerative diseases which affect a variety of mammalian species. Classical scrapie occurs in sheep and goats. The development of scrapie in sheep is closely linked to polymorphisms in the host prion protein gene (*PRNP*), and resistant genotypes have been found in sheep. Unlike sheep, the genetic basis for goats' susceptibility to scrapie is not yet fully understood. Recent studies have shown that three *PRNP* gene alleles, K222, D146 and S146, provide a strong protection against scrapie in a different breed of goats [1]. The disease is hereditary and can be limited or eliminated by a thoughtful animal breeding by the selection of scrapie-resistant animals. The aim of the research was to explain the polymorphism of Latvia bred goat population according to codons 146 and 222 of the *PRNP* gene. Genetic analyses were performed in Germany in a veterinary laboratory certified by Eurofins Medigenomix GmbH. In total 656 samples were analysed which had been taken in 2019 and 2020. Samples were taken from 3 goats bred in Latvia: two milk goat breeds (Latvian native goat (LVK) and Saanen (ZK) goat), and one meat breed (Boer goat (BK)). 395 samples of LVK goat breed animals were analysed. The frequency of NN146 genotype was 99.2% and the frequency of the genotype NS146 of heterozygous animals was only 0.8%. In LVK breed allele S frequency was only 0.4%. There were taken 243 samples from ZK goat breed animals and only 2 goats had heterozygous NS146 genotype, with frequency 0.8%. The frequency of allele S in this breed goats was 0.4%. The highest frequency of heterozygous genotype in codon NS146 was in Latvian-bred BK breed animals – 35.2%. From 54 analysed samples, there was one BK breed goat (breeding male goat) that had homozygous SS 146 genotype or 1.9%. Furthermore, BK breed goats were found to have the largest S allele frequency, which is 19.4%. Codon QQ222 analysis shows that LVK goat breed animal K222 allele frequency was 15%, while Q222 allele frequency was 85%. Homozygous KK222 genotype was found in 5 LVK breed animals, with genotype frequency – 1.4%. In LVK breed animals the heterozygotes QK222 genotype was in 27.3% and among them 0.4% were breeding male goats, and the QQ222 genotype frequency was in 82.16%. ZK breed goats genotype frequency of allele K222 was 3.1%. Only one of ZK breed animals that was a breeding male goat had homozygous KK222 genotype with frequency of 0.4%. Among ZK breed goats heterozygous QK222 genotype frequency was 5.4% and homozygous QQ222 genotype frequency was 94.2%. In Latvia bred BK breed animals' allele K222 was not found. Although there are few animals with resistant alleles, scrapie has not been observed in goats in Latvia. In the subsequent breeding process, it is important to gradually increase the number of animals with resistant alleles. In general, the best way to combat scrapie is to breed scrapie-resistant animals with appropriate genotypes.

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## **INFORMATION TECHNOLOGIES**

# OPEN DATA IN LATVIA: TOWARDS QUALITY OR QUANTITY

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Open data is a freely available source of information without re-use restrictions, and it can be edited and automated with free software. The most significant difference between open data and any other available information sources is that open data shall be free to use without any limitation on the licence and shall be in a machine-readable format. The quality of open data released is an essential factor for their use and for the data consumer to be interested in using this type of information source [1]. On February 2021, 452 open data sets were published in Latvia's open data portal, an increase of 80 data sets compared to April 2020. The rapid publishing rates and the absence of internal controls on data content in the open data portal have an impact on the quality of the data. Study hypothesis: The increase in the number of open data sets is not a reason for the quality of these data and for the development of methodological guidelines developed in Latvia.

For an assessment of open data, the open dataset names, description, category, file format, and number of views were retrieved from the open data portal. This principle has been chosen because it allows for the use of much information at the same time.

The open data was assessed in two directions: the first analysis did not assess the quality of metadata by nature, but assessed whether the data field in question exists and is visually assessed as appropriate, such as whether the link to the file is there or not, but not where it is taken when it is opened [2]. It also did not assess the extent to which the specified keys describe the file, such as when it was specified in 2018, which in itself represents only a number of years it was believed that the key words were. The first evaluation looked at the metadata provided by the open data portal itself. The criteria for the second direction of the evaluation were whether the data were added to the categories, whether the data were restored within the specified deadlines, or whether there is a description of the dataset. Unlike metadata analysis, a description of the data contained in the dataset is understood as a description of the data published in files or GIS (Geographical Information System) systems services, such as tabular data structures, description (description of the structure, column transcript, use of the instructions as data), the overall relevance of the data set to the nature of the open data. A general assessment determined whether the data was machine-readable and whether it was formally matched with open data, with the understanding being that the first row of data in the file was the name of the columns.

In many cases, data publishers are limited to publishing the file to the open data portal. All of the criteria were met only in some of the sampling data sets viewed by the author. As mentioned in the 5-star evaluation of the open data – it is better to publish some data than to not publish anything [3]. It is a positive development that the amount of open data is increasing, but professional data users who could use it for business IT solutions will be looking at whether such data will be addressed, as the author considers it important that the data should not be further processed to be licensed, and would be regularly restored.

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# TIME-AWARE EVENT RECOMMENDATIONS USING TOPIC MODELLING

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The problem of event recommendation differs from the problem of usual recommendation (e.g., products, music, movies or place), because events have a short life time and recommendations of events are only valid after the event has been created and before the event starts [1]. In addition, event recommendation is intrinsically cold-start, because published events, by definition, are always in the future [2]. To overcome these limitations, topic modeling was used as an instrument to simulate the event description discovery process, which is normally done by the users before they make the decision to participate [3].

In terms of time-awareness, social event can be characterized by two major features: event time and event location [1]. Event start time is an additional dimension, because most users tend to visit different places or events at different times in a day [4]. To ensure locality, we took data from undergraduate students who lived and studied in the same city. Because research mainly focuses on a content-based approach, a small control group was chosen consisting of undergraduate students N=15 living in the second largest city in the country of Latvia, but most effort was given to events descriptions N=161 analysis by the topic models.

Three topic models were used for evaluation: Latent Dirichlet Allocation (LDA), Correlated Topic Model (CTM) and LDA + Gibbs sampling. Dissimilarity method also known as mismatch ratio was used to calculate differences between words generated by the topic models, whereas weighted average was used to calculate relevance from time, average match count and relative match (average match count against description's word count).

For Top 10 result evaluation, two metrics were used: precision@k and recall@k, which are suitable for binary output. Results show that LDA + Gibbs sampling performed significantly better on suggesting the first item in the list and scored on average better than CTM and standard LDA. All topic models showed highest results on recall@10, which indicates that most of the relevant items are located within the list of Top 10 recommended items. In conclusion, the solution performed better on events descriptions with similar topics which leads to necessity for the keyword context. High diversity in visited events showed significant impact on match count, which in turn determined an event's ability to surpass the relevance threshold.

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# THE ROAD TO MORE PRECISE DATA ANALYSIS: THE GENERAL CONCEPT OF DATA LAYERING

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The precision in data analysis can be achieved by optimization of such aspects as data gathering, data processing and data interpretation, where the aim of data analysis is to find correlation between different parameters.

The principles of data gathering using sensors and multi-sensor systems are well researched. While there are some novel ideas and research regarding the use of sensor data, most are focused on optimizing data gathering flow and data synchronization aspects [1]. The gathered data are then processed according to a particular task's needs, whereas the data from multi-sensor systems prior to being analysed are typically undergoing the process of data fusion [2]. Data fusion provides possibilities to selectively tune the precision and accuracy of information obtained by processing the data. However, this is achieved by implementation of machine learning and deep learning algorithms that must be trained accordingly – in order to increase precision, the training data set must be increased [3]. Thus, while data fusion methods provide the most precise and accurate information for analysis, the methods themselves require very large data sets. Firstly, this limits the use of data fusion as the main approach to obtain information to scientific fields that have sophisticated and large data sets. Secondly, data fusion implementation requires powerful calculation performances, typically provided by large and resourceful institutions.

The aim of this research is to propose a method to obtain interpretable information resulting in processing data from multiple independent data sources, where each data set may have a unique data type and temporal periodicity. The method aims to abstain from machine or deep learning, while simultaneously include principles of data fusion at its core. While undergoing data fusion methods, data is stacked by using temporal data entries, and each data source is represented by its own data stack. Proposed method data is layered, where each layer represents a data from a unique data set. Thus, the proposed method is called Data Layering. The method consists of two main stages – data preparation and data layering. Data preparation aims to identify a common temporal parameter, i.e., day or hour, between all data sets in interest, and performs normalization and transformation each data set's data into uniform percentage-based values, whilst data layering is applied to stack transformed values resulting in visually interpretable layered stack. The layered stack and its overlapping areas can be analysed using a mathematical or analytical method of the practitioners' choice.

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# **VIRTUAL REALITY TECHNOLOGY USAGE IN VARIOUS AREAS OF OUR LIFE**

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Nowadays, as VR (Virtual reality) technology becomes cheaper and simultaneously experiences more innovation and new technologies, it becomes useful not just for entertainment, but also in other various areas. Particularly recently, when a lot of company employees were working from home and students had to study through Internet, VR technology was a great opportunity that could provide better teamwork between people, and make students and employees more focused on their work.

VR technology is already used by a lot of companies. A lot of areas can increase their efficiency by implementing the VR technology. For example, the healthcare, education and industries widely use it [1]. Healthcare students and professionals use VR as part of their practice, which gives them a great opportunity for improving their skills without involving any of the risks that appear when real bodies are used. The Medical VR is a field that is relatively new, but it already has great examples of VR that helped cure a patient and make physicians' work easier. Also, in medicine VR can be used in different other ways. One possibility that is already available is watching operations as if you were wielding the scalpel that is used to train surgeons. Also, medicine uses it by bringing a VR headset to the patient, so he/she could see beautiful landscapes through it, relax and receive treatment with less stress. One more way how VR is used in medicine it is the recovery after a stroke or traumatic injury. VR brings a gamified approach to physical therapy for such patients. VR training exercises with machine learning is beneficial in such situations [2].

Virtual reality also can be used to make students more involved in the study process. The main feature that VR offers is the possibility to see how something works, such as the human body or an engine, without even leaving the lecture room. It can be really useful when the practice with real objects involves different risks, such as hurting yourself, or is too expensive to implement in real life. Students that are learning how to fly a plane know how useful virtual reality can be for their profession when studying. A flying school student can try flying in VR, which gives them basic skills to operate a plane.

Overall, virtual reality technology is a development trend that has many different uses and can increase efficiency and decrease costs that processes involve. This can happen by replacing the real-life objects that were used before with virtual ones that can be seen through the headset.

Further research about this topic could be very useful, as the development of this technology in the future can become a powerful tool for everyone in all areas. Gathering some statistical information about how big of an impact VR has made in areas where it is already used would allow people to better understand whether it is profitable from the economic side, and if it can be used to advertise to local companies so they could optimize their work by using the technology.

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## **FORESTRY**

# **MOST IMPORTANT PESTS OF *ALNUS GLUTINOSA* AND RISK OF MASS REPRODUCTION**

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This research study aims to understand what kinds of pests can exist which will limit or slow down the growth and development of *Alnus glutinosa* and what can happen in situations of their mass reproduction. The European alder, also known as black alder, belongs to the *Betulaceae* family. [1]. Trees grow quickly, and the young ones need a lot of light. The tree distribution areas extend from Europe to West Asia and North Africa. Depending on the area of distribution, the growth habit of the crown varies greatly and is usually pyramidal. The young branches of the tree appear green, green-brown, and shiny; leaves are round and obovate about 5 cm long. The first parts of the leaves are bald and dark green. In the autumn, black alder's leaves are seen as green.

The first species of the parasite is *Phytophthora alni* [2]. It lives in the soil in the form of mycelium. It is spread by soil, wildlife, humans, contaminated wood and especially by river water. It infects plants through the roots at the base of the trunk or through wounds in the bark. Today, it has spread throughout Europe and usually causes the death of the tree. In young plants, death can occur quickly, while mature trees may remain alive for several years. The disease is manifested by the appearance of small yellow leaves or from rusty to blackish spots at the base of the trunk.

Moreover, among *Alnus glutinosa* pests, one of the most popular and widespread, but inoffensive, is the Alnus sucker [3]. This kind of the parasite appears on alder leaves, with a size that does not exceed 5mm, and it acts by sucking the sap of leaves. It is hard to recognize these parasites because they have the same colour as the *Alnus glutinosa* leaves, which makes their control and treatment hard to set up.

Sap suckers collect sap from *Alnus* between April and June, and this can reduce the tree growth if these pests reproduce too quickly. However, these insects have no real effect on the tree itself, so no special treatment is required.

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# SCOTS PINE (*PINUS SYLVESTRIS* L.) NATURAL REGENERATION FROM SEED TREES IN CLADINOSO-CALLUNOSA AND VACCINIOSA

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Natural forest regeneration is the main regeneration method for the Scots pine (*Pinus sylvestris* L.) in poor soils. Natural regeneration is preferred when extreme conditions exist and cause high mortality of seedlings [1]. Seed trees should remain in stands until the average height of the seedlings is at least 30 cm. Seed trees have to be harvested before the average height of the young stand reaches 1m [2]. Under shelter-wood, the Scots pine has a slower height growth and survival prospects compared to clear-cut re-forestation [3]. Soil scarification is used for favourable regeneration because the majority of the biggest seedlings are found in scarified lines or patches [2].

The hypothesis of this study is that Scots pines, growing under the seed tree canopy, have a significantly lower annual growth than trees that grow elsewhere.

The study was carried out for six years old Scots pine stands, located in JSC “Latvia State Forests” Strenču forest district. In 35 circular sample plots, all Scots pine trees higher than 10 cm were measured. The diameter at the root collar and the annual height increment were measured and the locations were identified to find out whether the trees were located under a seed tree.

The average height increment was  $11.20 \pm 0.02$  cm: in the first year it was  $6.73 \pm 0.02$  cm, and in the sixth year  $21.49 \pm 0.02$  cm. With 95% confidence level, a significantly lower annual growth was found between the third and the sixth year height increment for the Scots pine which grows under a seed tree. However, the annual growth in the first and second years has no significant difference between Scots pines growing under the seed trees and in an open stand.

As the annual height increment is higher in each subsequent year, the results of this study show the necessity for removing seed trees after the stand has been regenerated to reduce the negative impact on the growth of the Scots pine.

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# ANNUAL INCREMENT OF *BETULA PENDULA* ROTH IN CHANGING CLIMATE

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One of the main tree species grown in Latvia is silver birch or *Betula pendula* Roth. The annual increment of *Betula pendula* is the change in its size between the beginning and the end of the growth period.

Even if it is a species neglected by the forestry and forest-based industry sectors, in the future, it will become an increasingly interesting species due to its many strengths and opportunities for the Europe of tomorrow.

Birch exhibits an annual increment which increases during the periods of climate change because it tolerates various climate conditions and soils with a high genetic variability that promotes its adaptability. It is weather resistant, and its location does not impact its increment: it can be isolated, or grown in alignment, or in a stand, etc. It is a colonizing and very adaptable species for integration into mixed tree stands, even if its fast height growth can affect the vitality of other species.

Birch strongly responds to climatic variations; it is a good indicator of global climate change, especially warming. It is a hardy tree, remarkably resistant to wild animals, with a high increment capacity; however, it has a limited tolerance to shade. This tree likes dry to cool soils, with a preference for siliceous, and acidic to alkaline soils do not bother it [2].

The evolution of its radial growth is especially important because silver birch is very sensitive to competition.

Better conditions of growth permit competition between birch trees and elimination of suppressed trees (suffering from more severe conditions of competition) by the wood rot occurring due to the lack of light and the diseases. This natural selection occurs mainly in young stands of silver birch trees [1].

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# **MOST POPULAR DISEASES OF SILVER BIRCH (*BETULA PENDULA* ROTH)**

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The Silver Birch (*Betula pendula* Roth) is one of the most popular and remarkable deciduous trees in Latvia due to its white and peeling bark in middle-aged specimens. This paper will focus on the most common and harmful pests and fungi of the *Betula pendula*. The aim is to find out the best conditions and protect it from such diseases.

*Betula pendula* can reach a height of 15 to 20 m. It is well known in the timber industry for its fast growth under extreme conditions and its straight slender trunk [2]. This adaptation capacity coupled with a great seed production and the fact that it is a monoecious tree makes it a great invasive species and a pioneer in extreme habitats. Although it is a very tough species, *Betula pendula* trees are prone to several diseases caused by fungi such as the canker diseases or the conks that break down dead wood and create some openings and hollows in the trunk and branches. There is no cure for canker diseases; no chemical control is available. The best defense against canker diseases is to maintain a healthy tree through watering and fertilization [3].

Some diseases, like tree dieback, can seriously harm and sometimes kill even adult trees. It is characterized by death of branches or roots due to fungi and bacteria, and also due to mechanical damage or excessive moisture [4].

Other fungi-related diseases may be less visible, and we can notice them only by looking at the tree leaves. For instance, anthracnose, caused by the fungus *Glocosporium betularum*, causes irregular dead areas on leaf margins and in more serious cases of anthracnose, the entire leaf can be engulfed in brown spots with black margins, which can spread to young shoots and small twigs, causing decay [1].

Despite all the research activities, scientists still do not know everything about silver birch diseases and how to treat them. However, trees already have an immune system protecting them naturally, but treatment is necessary to preventing trees from diseases.

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# ROOT-SOIL PLATE CHARACTERISTICS OF SILVER BIRCH ON WET AND DRY MINERAL SOILS IN LATVIA

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Climate change manifests itself as a change in the probability of extreme weather events, and windstorms are projected to become more frequent and intense in the Northern Europe [1]. Additionally, the frequency and length of warm periods with wet, unfrozen soil in winter will rise in this region [2]. These factors will lead to an increased risk of storm damages in forests. Factors affecting tree resistance to wind uprooting have been well quantified for some species, but not for a common and economically important tree: the silver birch (*Betula pendula* Roth.). Individual tree anchorage properties and susceptibility to wind damage depend on tree species, soil properties, tree health conditions, root architecture and the size of root-soil plate [3]. Trees have a capacity to adapt to wind induced movements; however, a poorly developed root system reduces tree stability. Therefore, this study aimed to assess the root-soil plate characteristics of silver birch on wet and dry mineral soils in hemiboreal forests. The tree height, diameter at breast height, root-plate width and depth were measured for 56 canopy trees uprooted in destructive, static-pulling experiments. Measurements of the root-plate width were done in five directions covering 180° of the root-plate; the rooting depth was measured on the horizontal and vertical axes of the root-plate. The shape of the root-soil plate corresponds to the elliptic paraboloid. A decreasing, yet slightly different trend, was observed in the root depth distribution with an increasing distance from the stem in both soils. The main factors determining the root-soil plate volume were width, which was notably larger on wet mineral soils, and the tree diameter at breast height.

Consequently, the root-soil plate volume was significantly larger for trees growing on wet mineral soils than for trees growing on dry soils, indicating a wind adaptation.

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## **FOOD SCIENCE**

# SUITABILITY OF PEAS FOR GLUTEN FREE PASTA PRODUCTION

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Peas have long been recognized as a cheap, readily available source of protein, complex carbohydrates, vitamins and minerals. The high nutrient density of peas makes them a valuable food that can provide for the needs of around 800-900 million malnourished people worldwide [4]. Celiac is a chronic, autoimmune, multisystemic disease that is relatively rare and affects individuals of all ages. Despite extensive research aimed at developing alternative therapies for celiac disease, a gluten-free diet (GFD) remains the only effective treatment available to date [2]. A gluten-free diet is low in dietary fibre, and trace elements are deficient, especially vitamins D, B<sub>12</sub> and folates, as well as iron, zinc, magnesium and calcium [3, 5]. Peas are a source of protein (19.9-28.8 g per 100 g<sup>-1</sup> of dry matter) and high in fibre (9.10-22.90 g per 100 g<sup>-1</sup> dry matter). The total fat content is 1.5-6 g in 100 g<sup>-1</sup>. Peas are rich in Fe, Mg, P, K, Cu. The most important vitamins are niacin, thiamine, folic acid and vitamin E and K, as well as essential amino acids such as lysine and leucine [1].

The aim of the present research was to investigate the suitability of large grey peas, yellow split peas, green split peas and chickpeas for gluten-free pasta production. As a binder, *Xanthan* gum (E415) was used in the prescription. Extrusion was performed using a single screw extruder, 80-94-100°C, pasta type-spaghetti. After extrusion, the pasta was dried in a rotary-convection type oven at 70±10°C 4±1h till 10±2% moisture content. The optimal cooking time (OCT) and water absorption (WA) was determined according to the AACC 66-50. The weight difference before and after cooking was used to calculate the water absorption. Textural properties (hardness) for cooked and uncooked pasta, and colour (L\*a\*b\* system) were analysed. Commercial chickpea pasta was analysed for control sample purposes.

The results of the present research demonstrates the following durations for the different types of pea pasta: - grey pea pasta - 12±1 min, yellow split pea pasta – 8±1 min, green pea pasta – 14±1 min, and chickpea pasta – 7±1 min. In the meantime, cooking time of control sample was 6±1 min. Grey pea and chickpea pasta water absorption was 80%, the one of yellow split pea 140%, whereas the one of green split pea and control sample was at 100%. Hardness for uncooked grey pea pasta was 4.86 ± 0.55 N, yellow split pea pasta - 1.29 ± 0.35 N, green pea pasta - 3.78 ± 1.49 N, chickpea pasta - 1.88 ± 0.21 N. Hardness for cooked grey pea pasta was 8.15 ± 2.06 N, yellow split pea - 4.98 ± 0.28 N, green split pea - 7.94 ± 0.98 N, chickpea pasta - 5.16 ± 0.30 N. Colour (L\*a\*b\* system) difference ΔE between large grey pea and control sample was 12.54, yellow split pea 1.89, green split pea 11.80, chickpea pasta 2.19 that mainly indicated significant differences in colour of analysed pasta samples.

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# OMEGA-3 FATTY ACID COMPOSITION IN HUMAN MILK

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Early life nutrition plays a foundational role in child brain development [1]. Among fatty acids (FAs), polyunsaturated fatty acids (PUFAs) are of principal importance. Although there are several omega-3 FAs, most of the research focuses on docosahexaenoic acid (DHA),  $\alpha$ -linolenic acid (ALA), and eicosapentaenoic acid (EPA). ALA contains 18 carbon atoms, whereas EPA and DHA are considered “long-chain” (LC) omega-3 FAs, because EPA contains 20 carbons and DHA contains 22 [2]. Human milk contains a relatively high level of omega-3 FAs, which are essential to child visual, motor, and cognitive development [3]. ALA is the most common omega-3 fatty acid in human milk [4] and can be converted into EPA and DHA in human body [5]. DHA is the most abundant omega-3 fatty acid in the central nervous system in mammals and forms the structural matrix of grey matter and retinal membranes [6]. EPA is used to produce eicosanoids, signalling molecules that play numerous roles, including reducing inflammation in the body and the brain [4].

The aim of the research was to analyse omega-3 fatty acid composition in human milk. Pooled diurnal mature human milk samples were collected from 70 participants. Omega-3 fatty acid was determined using gas chromatography and expressed as a weight percentage of all measured fatty acids. Statistical analysis was performed using MS Excel 2019.

Median ALA level in human milk sample was 1.7 %. This indicator was higher compared to data from Denmark and Poland where ALA was at 1.32 % (Denmark data) and 1.5 % (Poland data) [7,8]. In the meantime, median DHA level in human milk was 0.3 % lower compared to data from Denmark where DHA level in human milk reached 0.48 % [7]. Furthermore, the results from Latvia were considerably lower compared with Polish data, where DHA level in human milk sample was 0.7 % [8] and the median EPA level in human milk was 0.1 %. This is relatively close to data from Denmark, where EPA level in human milk sample was 0.11 % [7], but lower compared to Poland data where EPA level in human milk was slightly higher at 0.2 % [8].

Compared to data from other European countries, DHA and EPA levels were considerably lower in the analysed human milk samples. This could be explained by low consumption of fish and seafood in the mother's diet.

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# **DYNAMICS OF LACTOSE AND OTHER QUALITY PARAMETERS IN SHEEP AND GOAT MILK AND ITS FERMENTED PRODUCTS DURING DIFFERENT SEASONS**

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Small ruminant milk is the predominant source of nourishing food in many parts of the world [1]. However, in Lithuania most dairy products are made of cow milk. Sheep and goat milks are more popular among people who are interested in living a healthy lifestyle and are consumed more as functional products that are helpful for human wellbeing. In addition, non-cow milk has useful technological properties. For example, sheep milk has high casein content and larger casein micelle, which affects their renneting properties and coagulation time. Furthermore, goat milk is naturally homogenised because of small fat globules, and it also has a larger buffering capacity; therefore, it is more suitable for manufacturing [1,2]. The reason for manufacturers choosing cow milk instead of non-cow milk is their dependency on seasonality that affects the yield and chemical composition [3]. It is important to show that both sheep and goat milk could be better material for dairy product processing. The aim of the study was to evaluate the dynamics of lactose and other quality parameters of fresh goat and sheep milk and their fermented products depending on seasonality and storage.

Goat and sheep milk samples were collected each season from a local Lithuanian farm except for sheep autumn milk samples. Those samples were not taken because at the end of the summer milking was ceased and all of them were prepared for a dry period. Each season, fresh unpasteurized goat and sheep milk were tested for lactose content and titratable acidity (TA) to determine the effect of season on these parameter changes. The analysis of the products produced in each season (fermented milk, cottage cheese and whey) was performed to find out the changes in the observed indicators during storage. Dairy products were stored for a week at  $4\pm 1$  °C and tested after 0, 48 and 120 hours from the production of the product. The lactose content was determined by the polarimetric method, the TA expressed as Turner (°T) degrees determined by using 0.1 N NaOH. The dry matter content was determined according to the LST ISO 5534: 2004 standard. The lactose content and TA of sheep and goat milk varied depending on the seasons: the highest lactose content was determined in winter sheep and goat milk, accordingly,  $4.58\pm 0.03$  %,  $4.27\pm 0.01$  %, the lowest in summer milk, accordingly,  $4.03\pm 0.07$  %,  $3.87\pm 0.03$  %. The highest TA in goat milk was determined in spring ( $13.25\pm 0.25$  °T), the lowest in winter milk ( $8.25\pm 0.25$  °T). Sheep milk acidity remains relatively stable throughout all seasons. The study of physicochemical parameters in dairy products during storage showed that the content of lactose in fermented products decreases during storage, in contrast, TA in fermented milk and whey increases, with some exceptions in whey. The dry matter content for sheep and goat milk cottage cheese increased during the storage of all seasons.

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## **VETERINARY MEDICINE**



# OSTEOPATHIC MANUAL THERAPY EFFECT ON SYMPATHETIC AND IMMUNE SYSTEMS

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Nowadays, osteopathic manual therapy (OMT) is chosen as the primary method for treating musculoskeletal conditions in equine. It is known that these physical manipulations are used with joints, soft tissues, bones and muscles [3]. With this type of therapy, major results were achieved such as an increased range of motion and tissue extensibility, reduced pain and inflammation [2]. Also, after OMT, horses were found to be more relaxed. [4] This research could influence the future treatment choice for horses that require rehabilitation, as OMT is a non-invasive procedure that does not involve any harsh medication or surgical interventions. Thus, the aim of this research study was to evaluate the impact of OMT of equine regarding changes in physiological factors such as the heart rate (HR), respiratory rate (RR), temperature (T) and count of white blood cells (WBC).

The HR, RR and T were chosen as biomarkers to establish whether OMT would affect the sympathetic nervous system, the WBC level was also evaluated as an immune system biomarker [5, 6]. 30 sport horses were evaluated of which 15 were the experimental group (OG) treated by OMT; 15 horses were the control group (CG). Treatment was performed by the same equine osteopath. Measurements were taken before (P0), immediately after (P1) and an hour after (P2) OMT in OG and at the same time in CG. The average (avg.) HR of OG P0=30.33b/min, P1=35.07b/min, P2=35.3b/min. Avg. of the HR after procedure decreased 4.27b/min. The avg. HR of CG P0=42b/min, P1=38.67b/min, P2=36.8b/min. Avg. of the HR after procedure decreased 3.33b/min. The avg. RR of OG P0=14.13t/min, P1=12t/min, P2=13.73t/min. Avg. of the RR after procedure decreased 2.3 t/min. Avg. RR of CG P0=13.33t/min, P1=11.47t/min, P2=11.87t/min. RR decreased 1.87 t/min after therapy. Avg. T of OG P0=37.51°C, P1=37.68°C, P2=37.58°C. After the therapy, T increased 0.17°C. T in CG was P0=37.52°C, P1=37.55°C, P2=37.61°C. Avg. of WBC level in OG was P0=8.32 x10<sup>9</sup>/l, P1=7.76 x10<sup>9</sup>/l, P2=8.20 x10<sup>9</sup>/l. Avg. of WBC in CG was P0=8.43 x10<sup>9</sup>/l, P1=8.40 x10<sup>9</sup>/l, P2=8.45 x10<sup>9</sup>/l [5]. The analysis of the P1 data discovered correlation between HR and RR p=0.005 (p<0.05), and also between WBC and T p=0.04 (p<0.05) [2, 5].

The OMT had impact on all measured biomarkers. Decrease of HR, RR and WBC level was statistically significant in OG. The discovered correlation between HR and RR suggested: when HR increased, RR increased, too. The correlation between WBC and T suggested: when WBC level increased, T decreased. In conclusion, OMT affects the sympathetic and immune systems.

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# COMPARISON OF DIFFERENT DIAGNOSTICS METHODS EFFICACY IN DOGS AND CATS WITH SUSPECTED HEPATOBILIARY SYSTEM DISEASES

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On account of the veterinary medicine development, professionals can choose the best diagnostic methods for quick and accurate diagnosis. Usually, the hepatobiliary system is tested by doing routine blood serum tests [3], abdominal ultrasonography [1,4] and, if needed, fine needle aspiration (FNA) could be taken [2]. There are numerous studies investigating diagnostic methods of liver and gallbladder diseases, but none of them compare the efficacy of these techniques. This study intended to evaluate the ultrasonography examination by scores, decide whether hepatic enzymes are reliable biomarkers, and assess benefits of doing a FNA biopsy with routine ultrasound testing.

The aim of this study was to compare the diagnostic methods mentioned previously and to establish the most accurate one.

The study was performed in 2017-2021, at Dr. L. Kriauceliunas Small Animal Clinic, Lithuanian University of Health Sciences. Data for 53 client-owned animals was collected retrospectively. It consisted of 43 dogs and 10 cats. All patients included in the study underwent ultrasound-guided liver FNA cytology. The percutaneous puncture area was prepared aseptically; the biopsy was taken by the 22G needle. The smears were air-dried and stained with Diff-Quik™ (RAL diagnostics, Martillac, FR) rapid staining set. The results of the cytological examination were evaluated according to 11 outcomes as a binomial variable. Ultrasound examination was done in 48 patients (90.6%). Mindray DC-40 (Mindray Building, Shenzhen, China) equipment was used to assess 7 characteristics: echogenicity, size, edges of the liver, parenchymal echo structure, focal lesions, gallbladder wall thickness, and echogenicity of its contents. Ultrasonography findings were rated from 1 (the least amount of changes) to 13 (the highest number of changes). Liver enzymes were assessed as quantitative indicators of 49 subjects (92.5%).

For 2 patients (3.77%) the FNA study was inconclusive. 29 patients (61.7%) had an elevated ALT value and 31 (65.96%) had an abnormal amount of ALP. The increase in ALP for both cats and dogs directly correlated with the value of ultrasonography changes and their age. ALT inversely correlated with it. The results were highly significant clinically for dogs ( $p < 0.05$ ). The analyses of the FNA diagnoses determined that the lowest score of ultrasonography changes was in neoplasia cases. It was equal to 5.34 units and significantly lower (15.3%) than the overall average ( $p < 0.05$ ).

To conclude, hepatic biomarkers and ultrasonography are not specific for most hepatobiliary diseases, in particular, neoplasia.

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# **TYPES OF SUTURES IN THE SKULL OF A NINE MONTHS OLD FETAL FOAL**

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In vertebrates, the skull is the base of the head and is composed of many bones. In young animals, the bones of the skull are not completely fused together: they articulate, forming sutures, which allow for growth and then become ossified in adults.

The aim of this study was to determine suture types in a foal's skull and, based on literature, to compare them to other species.

In March 2020, at Latvia University of Life Sciences and Technologies, Faculty of Veterinary Medicine, necropsy of a mare in the ninth month of gestation was performed. The head of the fetal foal was preserved. The cold water maceration method was used to clean and disarticulate the bones and to study suture morphology and bone connections. Every suture was photographed and classified. Finally, the bones were glued together at the suture sites by transparent, universal glue. The necessary measurements were taken using a ruler.

Literature suggests that the basisphenoid articulates caudally with the basioccipital, making the sphenooccipital synchondrosis (synchondrosis sphenooccipitalis), and rostrally with the presphenoid, making the intersphenoidal synchondrosis (synchondrosis intersphenoidalis) [1].

In a nine month old fetal foal, the connections by cartilaginous tissue were seen between the occipital and basisphenoid, basi- and presphenoid, occipital and petrous part of the temporal bone, and between all parts of the occipital bone. Cartilage between parts of the bones remained intact and was visible; however, cartilage between each individual bone in the maceration process degraded and the bones disarticulated. The studied literature indicated that a dog's skull has the same cartilaginous connections [1].

In the study about suture morphology in pigs and peccaries, 30 sutures were evaluated and classified by their types, most of them described as interdigitated [2].

After the analysis of the sutures in the fetal foal's skull, they were classified by types. Sutures formed in the foal were compared with the results of the study about pig's skull sutures. Identical suture surfaces were seen in frontoparietal and zygomaticolacrimal sutures (sutura serrata); parietotemporal, sphenosquamous and palatomaxillar sutures (sutura squamosa); sphenofrontal, frontonasal and lacrimomaxillar sutures (sutura foliata) and intermaxillar suture (sutura plana). Other suture morphology in these species was different.

In horses, the zygomatic process of the frontal bone (processus zygomaticus ossis frontalis) and the zygomatic process of the temporal bone (processus zygomaticus ossis temporalis) fuse and form the zygomatic arch (arcus zygomaticus), making the caudal margin of the eye orbit [3].

After connecting the bones that form the zygomatic arch, it could be seen that zygomatic processes of the frontal and temporal bones have not grown long enough to reach each other: in a nine months old fetal foal there is a two millimetres wide space between them.

Having analysed the bone articulations and having compared them to other species, many similarities were found by the authors of this study. Most of the skull bones were separated by sutures, but some of them – by cartilaginous synchondrosis. In the fetal period, every bone is separated, indicating the growth in the postnatal period. It would be worthwhile to study and compare suture ossification stages in the postnatal ontogenesis of different aged foals because the skull growth in foals can last more than 2,5 years after birth.

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## USE OF ANTIPARASITIC MEDICATION IN SHEEP FLOCKS

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Parasite infestations in both sheep and lambs vary from year to year and, therefore, treatment methods should be strategically focused on determining the initiator of the disease [1]. Incorrect use of medication, using inappropriate groups of drugs or improper anti-parasitic treatment measures can lead to resistance development in gastrointestinal *Strongyloides* [2]. So far, no research has been done in Latvia on anti-parasitic drug resistance and the implementation of preventive controls for this problem. The aim of this study was to examine anti-parasitic control in sheep farms of Latvia.

A total of 22 farms were surveyed – 8 in Vidzeme, 8 in Kurzeme, 3 in Latgale and 3 in Zemgale. A semi-structured questionnaire with multiple-choice and open-ended questions was developed to assess farmers' knowledge on management processes on farms concerning anti-parasitic control and prevention.

Only on 36% of the farms, parasite control was implemented. Deworming was performed on all farms. 50% of the farms dewormed sheep twice a year, 27% once a year, 9% up to four times a year, and 4.5% three times a year. Deworming was performed on all farms when disease symptoms were observed in animals, or as a regular anti-parasitic prevention. Only 4.5% of the farms performed anti-parasitological deworming based on the results of parasitic samplings and the recommendations of the veterinarian. 86% of the farms dewormed their animals in a barn, 9% in an enclosure near the barn, and 4.5% in a separate enclosure on another pasture. After deworming, 41% of the farms left the animals in the barn for a certain time, while 45% of the farms allowed the animals to graze in the same enclosure where they had been held before the deworming procedure. 59% of the farms performed deworming of the whole flock all at once, 18% of the farms dewormed all animals, but by dividing them into smaller groups and treating them at different times, 13% of farms dewormed only the infected animals, 4.5% of the farms indicated that deworming was performed only for a specific group of animals, namely, the lambs, 4.5% of the farms noted that deworming was performed on all animals, divided into smaller groups that were treated at different times, with the procedure being performed primarily on those animals that showed some visual signs of the disease. In 73% of the farms, sheep were not scaled and their weight was maintained by the farmer's visual experience; moreover, 45% of the farms indicated that they did not have scales for weighing their animals. Preventive anti-parasitological testing was performed in 32% of farms.

In conclusion, most farms lack the understanding of proper antiparasitic control measures, coprological examination and its necessity, as well as proper deworming management to limit the spread of parasites. Failure to properly perform all these actions can lead to development of resistance to anthelmintic drugs.

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# **SURVEY RESULTS ON PERFORMANCE OF VETERINARIANS PROVIDING SERVICES TO FARM ANIMALS IN LATVIA**

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To address the topicality of this survey, the publication “Challenges and solutions for the occupation of veterinarians” by Gundega Mičule [1] should be taken into account, where it was noted that, in the past, in papers and discussions on the future of the veterinary profession, diverse opinions existed — for example, that the profession was becoming more feminine; fewer young professionals had chosen the opportunity to operate in the industry of productive animals; the availability of veterinarians in distant regions was decreasing; veterinarians were not always competent enough, and many farmers, particularly, those working in the fields, could not make both ends meet, and therefore money was also earned by doing extra jobs.

The aim of the work was to clarify the working conditions of rural workers and, in particular, veterinarians working for animal services, their satisfaction with the principles and remuneration of organisation of professional activities, and their views on future prospects of ensuring the health of herds. An anonymous electronic survey of veterinarians involved in farm animal handling was conducted in 2021, from 5 January to 1 February. The questionnaire contained 40 questions created on the Internet portal visidati.lv. The survey reached 104 respondents – Latvian veterinarians involved in farm animal handling, referred to as veterinarians.

The questionnaire for veterinarians was created on the basis of suggestions given by the leading professional organisation — that is, the Latvian Veterinarian Society, Section for Farm Animal Veterinarians.

The analysis of the opinions showed that only 50 % of the respondents were satisfied with their remuneration, while nearly 19 % of the rural workers were happy to have a possibility to work at least somewhere.

The on-farm veterinarians were quite satisfied with their employment and work conditions provided by the farm owners (on average, 7 points out of 10 were given), probably because of their focused professional activities and the satisfying amount of remuneration. A greater percentage of females, or 62 % of the respondents, were working in farm animal veterinary services, and only 38 % were males. 60% of the practising veterinarians enjoyed the possibility to be independent in their professional activities. Nearly 77 % of the salaries of the specialists, who treated farm animals, were below €1600 per month. 81 % of them were earning under €800 (63% of the respondents were full-time veterinarians). 29 % of the respondents thought that in the near future there would not be any considerable decrease in diseases in the herds of Latvia if the animal welfare would not be improved and diseases prevented; for that goal “herd veterinarians” should be hired.

In conclusion, the tendency for women to work in the veterinary field is becoming much stronger. In Latvia, the salaries for work in large animal practices tend to be lower than 1000 euros. Thus, a vast majority of the veterinarians surveyed have been working in several workplaces where they have to perform non-professional duties. It should be noted that the majority of the problems on farms could be solved through wise management.

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# RESEARCH ON LATVIAN BLUE CATTLE AND MASTITIS

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The “Latvian Blue” cow is one of the Latvian native breeds which survives today. However, the count of this breed is not high. For this reason, Latvia has developed several programmes and a special association called “Zilā gov” focused on the preservation of the “Latvian Blue” cattle. The results of the preservation programmes are very promising, and the number of the cows is much higher than it was 20 years ago [1]. Reproduction of the “Latvian Blue” cow faces a critical situation because it is threatened by an increase in the inbred population, which represents approximately 2.8% of the generation [2]. Not only is saving the breed important, but also the results that can be achieved in milk fat and protein level, and animal diseases, including mastitis. Research studies carried out in other countries show that the somatic cell count can be used purposefully for the native breeds [3, 4]. The aim of this research was: to identify the somatic cell count as a genetic factor of mastitis and its use for inbreeding research.

In this research study, the “Latvian Blue” cows were studied on 4 farms. 4 milk samples from each quarter of the cow were taken. Samples were collected in plastic or glass sterile 10 ml tubes. In total, 108 samples were collected. Analyses were made by 3 methods: data analysis (somatic cells count), real time PCR using special mastitis kit (bactotype Mastitis HP3 PCR kit) made by QIAGEN in Germany, and the classical bacterial analysis. Of all the samples, 14 (13%) tested positive for diverse pathogenic bacteria. The most common were the environmental bacteria, such as *Staphylococcus hemolyticus* (4 samples), *Staphylococcus epidermidis* (3 samples), *Streptococcus viridans* (2 samples) and one sample with two mixed bacteria - *Staphylococcus hemolyticus* and *Streptococcus mitis*. They are coagulase negative staphylococcus (CNS), or opportunist bacteria. Of all samples, one had *Staphylococcus aureus*. In conclusion, the correlation analysis between the somatic cell count and the family (genetic factor) revealed that the use of one bull sperm for different cows in different farms results in a higher somatic cell count of that bull’s daughters, and several of them have subclinical mastitis with CNS. Negative consequences in the mother’s line were not found.

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# **VARIOUS BLOOD PARAMETERS, GONIOMETRY AND GIRTHOMETRY AS PREDICTIVE FACTORS OF CANINE STIFLE OSTEOARTHRITIS**

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Osteoarthritis (OA) is a progressive disease, characterised by changes of the articular cartilage, subchondral bone, synovium and other joint structures [1, 2]. OA can affect any joint, although the stifle joint is most commonly affected [3]. In the cases of OA, in the stifle joint, the disease is mostly related to the cranial cruciate ligament rupture (RCCL) and patellar luxation (PL). OA is most commonly diagnosed by physical and radiological examination. However, an early disease is quite difficult to identify [4, 5]. Therefore, the objective of this study was to determine correlation between the results of blood tests (hemogram and biochemical profile), amounts of CRP, stifle joint goniometry and femur site girthometry for prediction of canine stifle OA.

This research study was performed at LSMU, Dr. L. Kriaučeliūnas Small Animal Clinic between February 2020 and March 2021. Dogs with unilateral medial PL (n=6) and unilateral RCCL (n=9) without any concurrent diseases were included in this study. The data of each patient's blood tests (hemogram (Idexx Procyte DX, USA) and biochemical profile (Idexx Catalyst One, USA)) and CRP tests (Canine CRP Rapid Test, Biopanda Reagents, UK), stifle goniometry and femur site girthometry of both (affected and non-affected) hind limbs were collected. The OA degree of each patient with affected stifle joints was evaluated by Canine Osteoarthritis Staging Tool (COAST). We hypothesized that the parameters of blood test, CRP, suppressed goniometry and femoral girthometry could be used as predictive factors of canine stifle OA.

Pearson's correlation coefficient showed statistically significant ( $p < 0.01$ ) differences between the OA degree and changes of stifle joint range ( $^{\circ}$ ), and changes of femur site muscle volume (cm). The results showed a strong positive correlation between the OA degree and stifle joint range ( $^{\circ}$ ) ( $p < 0.01$ ). A strong positive correlation was found between the OA degree and femur site muscle volume (cm) ( $p < 0.01$ ). There were no statistically significant differences between the OA degree and hemogram parameters (WBC, LYM, NEU, MONO, EOS, BASO) ( $p > 0.05$ ), OA degree and biochemical profile parameters (CREA, UREA, ALT, ALKP) ( $p > 0.05$ ), as well as between the OA degree and CRP amount ( $p > 0.05$ ).

The stifle joint range and femur site muscle volume are associated with the OA degree and can be used as predictive factors of canine stifle OA. Further studies involving more animals and representative pathological conditions should be performed to assess the use of hemogram, biochemical profile parameters and CRP as predictive factors of the stifle OA.

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# MULTIPLE OVULATION AND EMBRYO FLUSHING: SAFE ASSISTED REPRODUCTION METHOD PROCEDURES IN COWS

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Multiple Ovulation (MO) and Embryo Transfer (ET) is the assisted reproductive technology method which allows to reproduce genetically valuable animals effectively, to maintain endangered species or breeds, and to increase selection intensity, and to reduce intervals of generations [1, 2]. From 2017 to 2019, Latvia University of Life Sciences and Technologies in collaboration with Animal Breeders Association of Latvia implemented ERDF project No.1.1.1.1/16/A/025 (*BioReproLV*) in order to preserve endangered cow breeds in Latvia using MOET. The aim of this study was to investigate the effect of MO and the embryo flushing (EF) procedure on cows' productivity and reproductive performance.

Data on 40 donor cows were analysed: 5 heifers (12.5 %), 10 primiparous (25 %) and 25 multiparous cows (62.5 %) in the MO and EF performing month, then in the next. In six cows, the EF procedure was not performed: two cows had unsuccessful MO, one cow had adhesions in cervix, two cows became sick unexpectedly, and one cow did not have *corpus luteum*. The parameters evaluated once a month were milk yield (MY), milk fat (MF), milk protein (MP), and somatic cell count (SCC). Reproductive performance parameters such as number of artificial insemination (AI) attempts to achieve pregnancy, calving interval (CI), calving-conception interval (CCI), days in milk (DIM) and length of dry period (DP) were compared with parameters of previous lactation. The donor cows were  $5.4 \pm 3.25$  years old (1.3-14.92 years),  $3.6 \pm 2.58$  lactations (0-10. lactations), the average DIM were  $253.3 \pm 208.22$  (71-945 days). Before the MO and EF, 18 cows (45.5 %) were planned to be discarded. Cows were distinguished in two groups: only MO performed, and MO and EF performed.

Results — Decrease was detected: MY ( $18.0 \pm 7.25$  vs  $16.2 \pm 7.12$  kg) ( $p < 0.05$ ). Increase was detected: MP ( $3.7 \pm 0.78$  vs  $3.8 \pm 0.53$  %), CCI ( $14.4 \pm 3.58$  vs  $17.2 \pm 3.48$  month), CI ( $159.0 \pm 99.83$  vs  $282.8 \pm 178.32$  days), DIM ( $370.3 \pm 101.96$  vs  $486.5 \pm 182.10$  days) ( $p < 0.05$ ). Other parameters (MF, SCC, number of AI attempts to get pregnancy, DP) did not have statistically significant changes ( $p > 0.05$ ). The cows which had only MO performed had more pronounced prolongation of CCI ( $22.5$  vs  $16.1$  month;  $p < 0.05$ ). MO and EF did not have a significant effect: MF, SCC, DP, AI times to get pregnancy. No significant effect was observed regarding the cow age, reproductive performance parameters, CI, DIM, DP ( $p > 0.05$ ).

In conclusion, the MO and EF did not have a significant impact: MF, SCC, DP, number of AI times to get pregnancy, but statistically significant changes were observed regarding MY, MP, CCI, and CI, DIM. Decrease of milk yield could be explained by physiological diminishing as lactation continues. Prolongation of CCI, CI and DIM intervals occurred because of the intervention in the natural donor cow estrus cycle to induce MO. MO and EF procedure has no harmful effect on cows' productivity and reproductive performance.

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# COMPARISON OF TWO DIFFERENT SEDATION PROTOCOLS FOR LARINGOSCOPY PROCEDURE IN 17 DOGS

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Laryngoscopy is a diagnostic procedure followed by the endoscopic approach through an open mouth, and it allows for the patient's sedation. The aim of the study was to compare the effects of two different sedation protocols, including mixed intravenous injections of 5 mcg/kg dexmedetomidine hydrochloride and 0.03 mg/kg butorphanol (DEX group; n=12) and 0.4 mg/kg of midazolam and 0.03 mg/kg of butorphanol (MID group; n=5) followed by induction of up to 2 – 4 mg/kg of intravenous propofol injection for laryngoscopy procedure of 17 randomly assigned, healthy dogs of ASA Group 1. In healthy dogs, premedication before the laryngeal examination provides better examination conditions and maintains overall adequate laryngeal motion in 83% of the studies [1]. Dexmedetomidine alone, or in combination with opioids, has an effective sedation protocol for laryngeal examination, producing sufficient immobilization to prevent jaw motions [2]. However, it is known to cause cardiovascular changes such as vasoconstriction and bradycardia. Dexmedetomidine in combination with butorphanol allows greater sedation and preparation for the induction event [3]. Midazolam co - induction reduces the propofol dose and improves the quality of induction in critically ill dogs without any improvement in cardiopulmonary variables when compared with propofol alone [4].

This study was carried out at the Lithuanian University of Health Sciences. All dogs had been weighted, and then clinical examinations and blood tests were accomplished before anaesthesia. During laryngoscopy, the patients were monitored, following the electrocardiographic heart rate (HR), oxygen saturation (SpO<sub>2</sub>), respiratory rate (RR), rectal body temperature (T), jaw and swallowing reflexes. The body weight in DEX Group was  $3.19 \pm 0.35$  and  $2.36 \pm 0.18$  in MID Group. In the DEX Group, HR was  $79.58 \pm 7.67$  bpm, RR was  $11.67 \pm 1.02$  breaths/min, SpO<sub>2</sub> –  $88.67 \pm 0.97\%$ , and rectal T –  $37.54 \pm 0.14^{\circ}\text{C}$ . MID Group dogs' HRs were  $154.4 \pm 11.81$  bpm, RR –  $13.8 \pm 1.85$  breaths /min., SpO<sub>2</sub> -  $96 \pm 1.05 \%$ , and T –  $37.72 \pm 0.22^{\circ}\text{C}$ .

The DEX Group had lower heart and oxygen saturation rates than the MID Group ( $p < 0.05$ ). Both protocols had no effect on the respiratory rate and rectal body temperature. All dogs in the MID Group had jaw and swallowing reflexes present, and they needed repetitive sedation while in the DEX Group these reflexes were absent ( $p < 0.05$ ). The use of dexmedetomidine hydrochloride and butorphanol for sedation, followed by propofol induction, ensured deeper general anaesthesia for the laryngoscopy procedure.

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## THE PREVALENCE OF *YERSINIA SPP.* IN LATVIAN PIGS

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Yersiniosis is the 4th most commonly reported bacterial foodborne zoonosis in the European Union [2]. This infection is caused by two human pathogenic *Yersinia* species - *Y. enterocolitica* and *Y. pseudotuberculosis*, and the main source of pathogenic *Yersinia* to humans is believed to be insufficiently cooked pork, fresh produce and untreated surface water. Both pathogenic *Yersinia* - *Y. enterocolitica* and *Y. pseudotuberculosis* were isolated from slaughtered pigs in previous studies [1]. The aim of this study was to determine the prevalence of pathogenic *Yersinia* spp. in Latvian pigs.

A total of 50 pig tonsil samples were collected in three slaughterhouses located in Latvia from December 2020 until March 2021. The sample suspension in peptone sorbitol bile (PSB) broth was plated out onto Cefsulodine-Novibiocine-Irgasan (CIN) agar after 2 h resuscitation at room temperature and after cold enrichment at +4°C for one and two weeks. One to three presumptive *Yersinia* colonies from each sample were confirmed with MALDI-TOF.

Altogether, five *Yersinia* species were isolated from the pigs of which two were pathogenic - *Y. enterocolitica*, *Y. pseudotuberculosis*, but three were non-pathogenic - *Y. intermedia*, *Y. kristensenii* and *Y. massilensis*. The overall prevalence of *Yersinia* spp. was 48% (24/50). Among them, the non-pathogenic *Yersinia* comprised 25.9% while the pathogenic one was 74.1%. The prevalence of *Yersinia* spp. in individual farms ranged from 40% to 50%. The present study indicated that the pathogenic *Yersinia* was widespread in Latvian pigs at slaughter. The slaughter of pathogenic *Yersinia* positive pigs may decrease the safety of pork due to the possibilities for cross-contamination during pork processing.

### Acknowledgements

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# **FELINE IMMUNODEFICIENCY VIRUS: CLINIC, DIAGNOSIS AND SURVIVAL**

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Feline Immunodeficiency Virus (FIV) causes Acquired Immune Deficiency Syndrome (AIDS) in domestic cats around the world and is an important veterinary problem. Epidemiologically, FIV is still not examined well in Lithuania, thus, further research is needed to determine the virus prevalence in the country and its effects on domestic cats. The purpose of this study is to assess the clinical signs of the feline immunodeficiency virus, the mechanism of the caused disease, the diagnostic methods, the applied treatment, and the preventive measures.

Major clinical signs of the disease are the following: cachexia, gingivitis, stomatitis, lymphadenopathy, rhinitis, uveitis, neurological disorders and renal failure [1]. ELISA tests are used widely to test the infection status of cats. These tests detect antibodies against the p24 protein of FIV and the p27 antigen of Feline Leukaemia Virus (FeLV). PCR test is used to confirm ELISA results, or the results are false/non-interpretable [2]. FIV infected cats can remain asymptomatic or live an ordinary life for many years due to preventive health measures. The survival time of infected cats is not always shorter than that of uninfected cats, and infected cats can survive as many years as the healthy ones [3].

This research study was performed at the Veterinary Clinic in Druskininkai, Lithuania, and the data was collected from January of 2018 to October of 2020. 30 cats were selected that had already been subjected to the BIONOTE FIV Ab/FeLV Ag chromatographic immunoassay for detection of feline immunodeficiency virus antibodies and feline leukaemia virus antigens in the cat blood. The animals were grouped into two groups – infected and non-infected cats, and the results were compared.

The main findings of the research were: 53 % of all subjects consisted of FIV-infected cats and 4 of 16 FIV-positive cats were infected with FeLV, too. 75 % of the infected cats were male (12 males). It was found that 56.25 % of the infected cats belonged to the second age group of 1 – 5 years. 13 of 16 FIV-positive cats (81 % of FIV-positive animals) have had free access to the outside and contacts with other animals, and 3 of FIV-positive cats (19 % of FIV-positive animals) were kept only at home. It was observed that the most positive immunoassays (5 tests) were performed in the summer, but the season did not affect the possibility of infection.

The results obtained prove that virus infection depends on the housing conditions of animals and the possibility of contacts with other animals. The study during the evaluation of blood biochemical and morphological parameters of the examined cats has found that the feline immunodeficiency virus affects the increase of erythrocytes levels in the blood. The most common clinical signs in FIV-infected cats are cachexia, respiratory distress, gingivitis, renal failure and stomatitis.

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# CONJUNCTIVAL MICROBIOTA SUSCEPTIBILITY TO ANTIBACTERIALS IN DOGS

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Eye diseases are common in humans and animals. The supply of medications is vast, however, only in human medicine. In veterinary medicine, due to the lack of other options, medications designed for human use are the treatments of choice. While some of them are really effective, they can irritate the eye. In such cases, a human patient waits until the irritation fades, whereas an animal immediately starts scratching and rubbing the eye, thus aggravating the inflammation and sometimes spreading it to surrounding tissues [1].

The aim of this study was to identify the conjunctival microbiota in dogs with conjunctivitis and to evaluate the antimicrobial susceptibility of the isolated strains.

The research was performed in the Dr. L. Kriaučeliūnas Small Animal Clinic (LUHS VA). The samples were tested in the microbiology laboratory of Microbiology and Virology Institute, LUHS VA. Dogs (n=31) with symptoms of conjunctivitis were selected for primary ophthalmological assessment and research. Samples for bacterial testing were collected from the conjunctival sac. Susceptibility to antibiotics was tested by the Kirby-Bauer disc diffusion method.

The identified bacteria belonged to the families *Staphylococcaceae*, *Corynebacteriaceae*, *Enterobacteriaceae* and *Bacillaceae*. Amoxicillin and cefalexin showed the greatest efficacy against the *Staphylococcaceae* family bacteria (91.2%), and the least susceptibility was established to amoxicillin/clavulanate (67.6%). Amoxicillin and amoxicillin/clavulanic acid compound showed the greatest efficacy against the *Corynebacteriaceae* family isolates (100%), and the least susceptibility was established to clindamycin (33.3%). Amoxicillin, tetracycline, amoxicillin/clavulanate, enrofloxacin, gentamicin, and sulfamethoxazole/trimethoprim showed the greatest efficacy against the *Enterobacteriales* isolates (100%), and the least susceptibility was established to cephalexin and cefoxitin (83.3%). Amoxicillin, amoxicillin/clavulanate, cephalexin, enrofloxacin, gentamicin, and erythromycin showed the greatest efficacy against the *Bacillaceae* family bacteria (100%), and the least susceptibility was established to tetracycline (40%).

Gram+ bacteria were most frequently isolated from the conjunctiva of the dogs diagnosed with conjunctivitis (89.5%). The best growth-inhibiting effect was demonstrated as follows: against *Staphylococcaceae* family by amoxicillin and cephalexin; against *Corynebacteriaceae* by amoxicillin and amoxicillin/clavulanate; against *Enterobacteriales* by amoxicillin, amoxicillin/clavulanate, enrofloxacin, gentamicin, tetracycline, and sulphamethoxazole/trimethoprim compound; and against *Bacillaceae* by amoxicillin, amoxicillin/clavulanate, cephalexin, enrofloxacin, erythromycin, and gentamicin. The least susceptible *Staphylococcaceae* isolates were to the amoxicillin/clavulanic acid compound; *Corynebacteriaceae* to clindamycin, *Enterobacteriales* to cephalexin and cefoxitin; and *Bacillaceae* to tetracycline.

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# UNUSUAL BIMODAL ANTIMICROBIAL SUSCEPTIBILITY PATTERN FOR AZITHROMYCIN OF *ALIARCOBACTER* SPP. STRAINS ISOLATED FROM CHICKEN MEAT AND ENVIRONMENTAL WATERS

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Members of *Aliarcobacter* gen. nov. (formerly, *Arcobacter*) are considered as emerging zoonotic food- and-water-borne pathogens that cause human gastroenteritis [1]. However, the contamination rates of food products and environment with *Aliarcobacter* in various countries remain undetermined. Furthermore, the lack of defined clinical breakpoints and epidemiological cut-off values (ECOFFs) complicates the monitoring of antimicrobial resistance in *Aliarcobacter* species. Hence, the aim of this study was to determine the prevalence and antimicrobial susceptibility of *Aliarcobacter* spp. isolated from chicken meat and environmental waters.

459 samples were collected for examination in the city of Kaunas (Lithuania) during 2018-2019. In total, 155 bacterial isolates from retail chicken meat (n = 331) and public beach water (n = 128) samples were identified and verified at the species level using multiplex polymerase chain reaction and RNA polymerase subunit beta (*rpoB*) sequencing [2, 3]. All *Aliarcobacter* strains were tested for susceptibility to six antimicrobial agents (azithromycin, ampicillin, ciprofloxacin, gentamicin, erythromycin and tetracycline) by the gradient strip diffusion method.

The study revealed that contamination rate of chicken meat (36%) with *Aliarcobacter* was higher ( $P < 0,05$ ) in comparison with the environmental water (28.1%) samples. *A. butzleri* was the most prevalent species (n = 144, 92.9%), followed by *A. cryaerophilus* (n = 11, 7.1%). *Aliarcobacter* spp. antimicrobial susceptibility test (AST) revealed unimodally distributed minimal inhibitory concentrations (MICs) for ampicillin, ciprofloxacin, gentamicin, erythromycin and tetracycline. However, a bimodal distribution for azithromycin was found regardless of the sample type and species with 96.1% of determined MICs (ranging from 0.5 to  $>256 \mu\text{g/ml}$ ) above the ECOFF defined for *C. jejuni* ( $0.25 \mu\text{g/ml}$ ). 87.1% of the tested strains showed high susceptibility to ciprofloxacin with MICs below or equal to the ECOFF value of  $0.5 \mu\text{g/ml}$ .

This is the first study reporting the prevalence and antimicrobial susceptibility profiles of *Aliarcobacter* in Lithuania and the Baltic countries. High contamination rates of chicken meat and water indicate their potential role in the epidemiology of *Aliarcobacter* infection. In the case of ciprofloxacin, the ECOFF value of *C. jejuni* could be applied for *Aliarcobacter* spp. as MIC distribution patterns were similar for both of these species. However, the ECOFFs for other antimicrobials might be higher and should be reassessed. AST also revealed different MIC distribution patterns for macrolides (erythromycin and azithromycin). However, full genome sequence-based analysis is needed to explain the genetic mechanisms responsible for the divergent MIC distributions.

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# GIRAFFES FORELIMB MUSCLES IN COMPARISON WITH BOVINE AND EQUINE

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Giraffes, the so called tall ruminants, are one of the most unique, awkward, ballerina-type animals on the Earth. Their disproportionate body is one to still be understood and researched. The aim of our study was to identify the types of forelimb muscles of giraffes and to compare them to bovine and equine muscles.

The giraffe's corpse used in this study was the Rothschild's giraffe (*Giraffa camelopardalis rothschildi*), a 14-year-old male, taken from Riga National Zoological Garden. It was transported to Latvia University of Life Sciences and Technologies, the Faculty of Veterinary Medicine, where path-anatomical dissection was performed. The limbs and other parts of the body were used for descriptive and comparative anatomy. The aim of the study was to determine the unique anatomical features of the giraffe's forelimb muscles. During the research study, the giraffe's forelimb was dissected with a *fresh never frozen* method. Firstly, the skin was removed. Secondly, muscles were dissected and compared to bovine forelimb muscles using data from the literature. The study was documented by photographs and some muscles were measured with a ruler.

Although giraffes are strictly considered to be ruminants, there has been an observation of some features a horse possesses that a ruminant does not possess. The m. extensor digitalis communis has two heads, a humeral and a radial head, which is also called the Philips muscle. [1] The muscles of the giraffe are concentrated on the proximal part of the forelimb, and the distal part of the leg is controlled by strong, long, and thick tendons that were confirmed during the study. [2] The antebrachii region was 76cm long and the muscles took over 2/3 of the bone. The extensor muscle tendons that seemed to stretch from the carpal bones all the way to the proximal bones were 96 cm long. The humerus was 44 cm long, and muscles, reaching over it, were approximately 55 cm long. The scapula was 72 cm long, and the muscles, covering the scapula, were approximately 85 cm long.

In conclusion, giraffes are very similar to bovine with a few differences, such as the Philips muscle, and the fact that their muscles are much longer because of the giraffe's size. They are one of the many rare species that should be examined more, compared to other animals, so that a clear understanding of their anatomy can be achieved.

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# EFFECTIVENESS OF OSTEOPATHIC TREATMENT ON EQUINE BACK PAIN: PILOT STUDY

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Back pain (BP) is a common health problem in equids. It can cause chronic pain, asymmetry and gait changes, and can aggravate ability to work, which is a common concern for veterinarians and physiotherapists working with sport horses [4]. Physiotherapists include palpation as the key method to assess BP before and after treatment, even though it is lacking objectivity [3]. A pressure algometer (PA) is one of the objective measuring methods which has been used to attempt to measure objectively mechanical nociceptive thresholds (MNT) in horses during their palpation [2].

PA studies evaluating physiotherapy and chiropractic treatment effectiveness [1] have been carried out. However, there is no data regarding equine osteopathy and BP. The aim of this research study was to assess the effectiveness of equine osteopathic treatment on BP horses by objective evaluating MNT, using PA.

A group of 16 thoroughbreds was examined; 8 stallions and 8 mares, having the median age of 6 years (the range was between 2 and 9 years) and the median weight was 452 kg (the range was 400-550 kg), suffering from BP, were included in the study in Stable X, Lithuania in year 2020. PA measurements were performed in the stables before and after osteopathic treatments with Pain Test FPX 100 Algometer (Wagner Instruments Inc., Greenwich, CT, USA). 6 points at the levels T14-L15, T18-L1 and L5-6 on the right and left side were measured. The points were adopted from K. Haussler [1]. The results were registered in kg/cm<sup>2</sup>. For statistical data analysis, SPSS version 24.0, Shapiro–Wilk test and t-test were used. It was considered statistically significant when  $p < 0.05$ .

After the treatment, the left side T14-T15 MNT point mean increased by  $1.69 \pm 1.94$  kg/cm<sup>2</sup>, which was a statistically significant difference as  $p < 0.05$  ( $t = -3.474$ ;  $p = 0.003$ ) and the right side T14-T15 MNT point mean increased by  $1.4 \pm 1.31$  kg/cm<sup>2</sup>, which was a statistically significant difference as  $p < 0.05$  ( $t = -4.256$ ;  $p = 0.001$ ). T18-L1 MNT point mean  $1.4 \pm 1.31$  kg/cm<sup>2</sup> statistically increased on the right side  $p < 0.05$  ( $t = -4.256$ ;  $p = 0.001$ ) on the left side T18-L1 MNT point mean increased by  $0.26 \pm 2.54$  kg/cm<sup>2</sup>, but there was no statistically significant difference  $p > 0.05$  ( $t = -0.412$ ;  $p = 0.686$ ). L5-6 MNT point mean increased by  $0.83 \pm 2.02$  kg/cm<sup>2</sup> on the left side and  $0.81 \pm 2.66$  kg/cm<sup>2</sup> on the right side, but this was not statistically significant as  $p > 0.05$ .

Pressure algometry provides a non-invasive tool to assess musculoskeletal pain objectively and to assess the therapeutic effectiveness of equine osteopathy. In all measure points the mean MNT was found to have increased after the treatment, and it showed that BP was felt less. In conclusion, this research study found that osteopathy is a good choice for horse BP treatment.

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# INFLUENCE OF BLOOD TRANSFUSION ON BLOOD LACTATE LEVELS AND OXIDATIVE STRESS IN ANEMIC DOGS

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Blood transfusion is an important tool in the management of severe anaemia in dogs. In case of anaemia hypo-perfusion, hypo-volemia, hypoxia leads to anaerobic metabolism, lactic acidosis and increased production of pro-oxidant compounds (ROS), subsequent depletion of antioxidants and oxidative stress (OS)(1, 2). Transfusion of blood products should restore tissue perfusion by increasing blood oxygen carrying capacity and improving oxygen delivery to tissues (1).

The aim of this study was to assess whether blood transfusion in anaemic dogs has a positive effect on the changes in blood lactate levels and oxidative stress status.

Nineteen client-owned dogs that required whole blood transfusion were admitted to the LUHS Small Animal Clinic between June 2018 and July 2020 and were assessed in this study. Blood samples were obtained from the cephalic vein immediately before blood transfusion (T0), and after the blood transfusion was finished (4 h  $\pm$  10 min) (T1) and 24 h  $\pm$  10 min after the T0 (T2). After filling the blood collection tubes and release of the stasis, a drop of the whole blood without preservative was analysed immediately by the lactate analyser Lactate Pro<sup>®</sup> LT-1710 (Arkray Inc., Kyoto, Japan). Morphological blood evaluation was conducted by IDEXX Lasercyte<sup>®</sup> haematology analyser (IDEXX Laboratories, Inc., Westbrook, Maine, USA) within 5 minutes of sample collection. Oxidative stress index (OSI) was determined using Lambda 25 UV/Vis spectrophotometer (PerkinElmer, Waltham, MA, U.S.A.) and Rel Assay Diagnostics kits (Mega Tip, Gaziantep, Turkey) by measuring TAS and TOS in blood plasma.

The study showed that the highest (4,67  $\pm$  5,81 mmol/l) level of blood lactate level was before blood transfusion (T0) and indicated a highly significant difference  $p < 0,001$  compared to T1 (1,89  $\pm$  0,96) and T2 (1,71  $\pm$  1,08). The results also showed a moderate negative correlation between blood lactate levels and HCT, RBC and HGB and a highly significant difference  $p < 0,001$  of HCT, and RBC changes. TAS and TOS levels increased after blood transfusion (T2), while OSI level decreased at T2 compared to T0, but the difference between T0, T1 and T2 was not significant ( $P > 0.05$ ).

We concluded that blood transfusion was effective for inducing a measurable significant decrease in the blood lactate level and decrease in oxidative stress level. The clearance of lactate had a moderate negative correlation with PCV and RBC. The findings showed that blood lactates can be used as biomarkers of a successful blood transfusion.

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# FRESH WOUND TREATMENT OF THE DOG USING PLATELET-RICH FIBRIN

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The platelet-rich fibrin membrane contains a fibrin matrix with leukocytes, erythrocytes, platelets, B and T lymphocytes, monocytes, stem cells and growth factors which provide better and faster tissue regeneration. Because of those features, PRF membrane is very useful in a contaminated and fresh wound treatment [1].

The clinical history was the following: a 12 month old female Curly-coated retriever dog, weight 24 kg BMI=3, was admitted to the the clinic for a fresh wound treatment, and then during a physical examination, a wound (10 mm x 13 mm) was noticed on a metacarpal pad (*torus metacarpalis*) of the front leg without any purulent discharge.

The method applied: the wound was cleaned with chlorhexidine 0.12% solution. The blood sample (10 ml) was collected from *v. saphena* into PRF sterile tubes without any anticoagulant. The WB sample was centrifuged on 2500 rpm, for 12 min. After separation and compression, the PRF membrane was put in a wound area and bandaged. Control re-checks and re-bandage were performed 5, 14 and 25 days after the procedure. For evaluation, the wound healing score system [2] and wound measurement were used.

During the first control check-up (after 5 days), the wound was without purulent discharge, a visible re-epithelisation margin, and its size was 8 mm x 8 mm (by 50% smaller compared to the first day). 14 days after the procedure, on the second control check-up, the wound had no purulent discharge, a wide margin of re-epithelisation, and its size was 3 mm x 3 mm (by 93% smaller compared to the first day). 25 days after the procedure, the wound was totally closed up, with no purulent discharges, and a small connective tissue scar was visible on the metacarpal pad.

To conclude, PRF may be a useful tool for wound treatment which helps to extend time between bandaging and to reduce the use of antibiotics, but there is a need for more thorough research of this concept for treatment of dogs.

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## **PARTIAL BODY CRYOTHERAPY IN VETERINARY MEDICINE**

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This study examined the possibility of applying the cold therapeutic technique to canine patients by using a novel canine Partial Body Cryotherapy (PBC) chamber. The aim of the experimental research was to determine the safety and feasibility of PBC for dogs while simultaneously providing initial information on its efficacy.

The therapy using the cold causes vasoconstriction, reduces blood flow and cellular metabolism, and decreases sensory and motor nerve conduction velocity. It is used for managing the acute phase of tissue injury because it minimizes the inflammatory process, oedema and provides analgesia and reduces muscle spasms, which facilitates improved mobility and fastens the healing process [2]. The low thermal conductivity, hair piloerection and fur thickness allow for an increased insulation from the cold; therefore, different types of fur is an important factor of lowering the efficiency of PBC for various breeds [1].

PBC involves rapid exposure to an extreme cold for a brief period; it is created by spraying nitrogen vapour directly on the body, excluding the head and neck of the patient, inside the tank. The study period was 3.5 months and was organised by the Latvia University of Life Sciences and Technologies, Small Animal Veterinary Clinic, Room of Physiotherapy. Before making a specific research on the therapeutic effects of PBC for various diseases, there should be a deeper understanding of animal's natural thermal barriers such as its fur, and how cryotherapy temperature penetrates the coat and reaches the skin.

The chamber was constructed so that the dog's head was outside of the chamber, while the entire body was exposed to vapour. The total of 16 dogs of various breeds and sizes were exposed to temperatures between -110°C and -150°C for two to five minutes. For 9 of these dogs, the surface temperature of their fur and skin was measured as well as the rectal temperature before and after the procedure.

The main findings, concerning the temperature differences before and after the study, were more pronounced on the surface of the fur than of the skin, and they differed between the breeds and the dog coat types. Measurements of the rectal body temperature in most of the dogs (5/9) increased after the procedure. Surprisingly, after cryotherapy, the temperature of the abdomen skin was increased in 3 out of 6 cases. Some dogs showed discomfort and fear during the first procedure. Especially, the Chinese Crested Dog did not tolerate the low temperature, which could be explained by its lack of fur.

There are many factors that have impact on the temperature differences before and after the procedures, such as the fur thickness, undercoat, outdoor weather, the time of the dog's arrival, stress levels during the procedure and appointment and, most importantly, the location of the vapour outlet and inconsistent measuring of the temperature on the sides of the animal. Vapour pours out through 2 sides of the device at 2 different levels. This study has observed some therapeutic effects as well, such as: increased activity and weight loss and reduction of lameness of the dog.

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## **ENGINEERING**

# MONITORING OF MOTOR OIL QUALITY DURING THE OIL CHANGE INTERVAL

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In most light passenger cars, the oil change interval is usually set at 15 to 30 thousand kilometers. However, this interval may be incorrect depending on driving mode and driving style, as engine wear and incorrect combustion can cause fuel to contaminate the oil, and wear particles and additive depletion can cause unwanted changes in viscosity [1]. The main goal of this research is to determine the condition of the engines mechanical components, and make necessary suggestions for extending engine life depending on results obtained from regularly monitoring engine oil during the oil change interval.

To achieve this goal, oil samples will be taken from multiple light passenger cars in Latvia multiple times after specific times during the oil change interval (approximately after every 2000 km). Cars using both petrol and diesel engines will be used in the research. These samples will be tested in a specialised laboratory and analysed for overall oil condition and viscosity, as well as contaminant and additive contents in the oil, and amount of engine wear particles. Kinematic viscosity will be measured using a capillary type viscometer, wear particles will be analysed using spectrometric analysis, which can detect different quantities of metal particles from engine wear that are present in the oil. For non-metallic contaminants FTIR (Fourier-Transform Infra-Red) spectroscopy will be used. FTIR spectroscopy can detect the presence of water, fuel, as well as other non-metallic and organic contaminants. FTIR spectroscopy can also detect oil oxidation, nitration and overall additive depletion. Each parameter from these results will be analysed, and a graph representing the changes in the parameter value will be created. From these graphs, a specific mileage, indicating when the parameter becomes harmful for the engine, can be determined. By combining these results, as well as analysing the possible impact each parameter can cause, an optimal oil change interval for each car can be created. Furthermore, the overall condition of the engine can also be determined, and necessary recommendations can be made.

Based on the results obtained in these tests, overall recommendations for oil change intervals in used passenger cars after the end of manufacturers` warranty (usually after 100,000 km) can be made, resulting in extended engine life.

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# DESIGN AND EFFICIENCY OF AUTOMATIC GEARBOX FOR A MECHANICAL ENGINE

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Every year in Hungary there is a competition for cars that are driven by compressed air, called pneumobiles. A pneumobile is a racing car driven by compressed air. It is built for a competition organized by the international company Aventics, one of the largest manufacturers of pneumatic components [1].

There are almost 50 teams competing from 9 countries. The aim of the competition is to find the best racing car built by students, driven by compressed air. The main goal is to design innovative solutions for pneumatic engines and their gearboxes. The aim of research is to design and test efficiency of an automatic gearbox for a mechanical engine.

The teams of the Faculty of Engineering of the Latvia University of Life Sciences and Technologies have participated in this competition for several years with self-designed and built machines. Previously, a pneumatic car with a uniquely designed engine was built which can change the output speed by changing the force on the pendulum moved by these cylinders. In the competition, it was found that changing the arm of force requires a mechanism that moves the cylinders so that it does not have to be done manually by the pilot. It is necessary to design a mechanism that is able to move and push the cylinders, thus changing the arm of force, and it must be easy and automatic control.

The following hypothesis has been formulated: using the designed gearbox it will be possible to improve race results in all 3 categories, with main emphasis on maximum speed in drag race and the travelled distance in endurance race. The research methods include study of previous solutions, design of a gearbox for a specific pneumatic engine [2], calculations of obtained gear ratios and engine torques and evaluation of efficiency of the designed gearbox.

Research was conducted to determine the best solutions for design for this specific gearbox. Threaded rods were used to move closer and further the ends of pneumatic cylinders attached to the pendulum to adjust gearing. It is moved by a stepper motor that is controlled by a specific driver and Arduino controller [3]. Testing of the designed system was performed in the pneumobile race in Hungary.

In field studies it was determined that this gearbox solution is easier for a pilot, as they do not need to change gears manually and can focus all attention on driving. However, because of mechanical problems it was not possible to compare results with those collected in the previous entries in race.

In conclusion, the above described solution can be considered a success in ease of use and small weight; however, more tests have to be performed to determine the efficiency of such construction with an engine and a gearbox, as it was not possible during the race due to mechanical issues.

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# **AS“LATVIJAS FINIERIS” MODERNIZATION OF VITS IMPREGNATION LINE**

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Currently in the modern manufacturing sector, the most desired and popular material is plywood due to its robust properties. The main topic of this research is understanding the optimization possibilities within plywood manufacturing with the main aim being on evaluation of timing of the processes included and acquaintance with similar automation solutions already used within the industry to avoid use of operators in future.

Each of the time study techniques is applied under certain conditions, and the best technique for manual production is the stopwatch time study because human performance is not consistent from time to time [2].

This is a valid point due to inconsistencies of productivity during each individual day and by avoiding human input it could be possible to improve the productivity of machinery by utilization of time studies for recording of activities and associated time spent.

Time study is used to determine the time required to perform the job. With the help of work study, the method of doing a job is decided [1].

This could be used to define which activities can be subject to automatization and therefore lower the possibilities for human error and increase the productivity. Through thorough investigation of packaging equipment available on the market based on available dimensions of free space near the machinery we can understand the limitations that are applicable to such implementation of automatization. Additionally, it is essential to adapt the new equipment to the needs of production through delicate modifications to ensure the highest levels of conformity and productivity available. The selected methods of research help to understand whether the implementation of automatization will ensure safe and efficient increase in lines productivity and efficiency through optimization of impregnated paper packaging process.

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# TECHNOLOGICAL PROCESSES OF WIND FARM DEVELOPMENT

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Wind energy has a critical role in the establishment of an environmentally sustainable low carbon economy. In this paper, an overview of wind turbine generator technologies is presented and the advantages and drawbacks of their application for wind energy utilization are compared. The wind turbines of today are considerably and continually improving compared to the first trialled ones in the 80s and 90s. We are increasingly seeing turbines becoming more cost-effective, more reliable and capable of much more power production – today's turbines are considerably larger with a greater power generation capacity of up to 12MW. As the technology matures, advancements are on the horizon that will extend wind project lifespan whilst simultaneously lowering the operational costs. The latest innovations and digital transformations are fantastic news for an industry that is set to go from strength to strength [3].

**The aim** of the research is to perform in-depth analysis of wind turbine performance using numerical, analytical and experimental methods to further improve wind turbine generators.

**Hypotheses** – In summary, there may not exist the best wind turbine generator technology to meet all demands.

The choice of complex wind turbine systems is largely dictated by the capital and operational costs because the wind market is fundamentally cost-sensitive. In essence, the decision is always down to a comparison of the material costs between rare-earth permanent magnets, superconductors, copper, steel or other active materials, which may vary remarkably from time to time [1].

The research methods include the comparative analysis, observations and experiments.

This paper has provided an overview of different wind turbine generators including DC, synchronous and asynchronous wind turbine generators with a comparison of their relative merits and disadvantages [2].

Engineers with technical skills such as mechanical, electrical and control and instrumentation, blade and turbine technicians will be needed increasingly to support growth. Now the required skill sets of engineers should also include key elements of IT / network system skills, such as work in such areas as fault finding and systems / performance monitoring is done through electronics, rather than mechanical means. Furthermore, in conjunction with the increase in wind turbine scale, the offshore wind industry will continue to develop tomorrow's innovators, particularly in areas such as vessels and logistics, subsea cables and transmission, foundations, turbines, artificial intelligence, robotics and data analytics and will naturally require the skills to underpin it.

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# **A ROBOT TRACKING SYSTEM BASED ON ULTRA-WIDEBAND TECHNOLOGY**

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The number of Automated Mobile Service Robots (AMSRs) for professional use worldwide increased more than threefold between 2016 and 2020 [1] due to the demand for innovation or for solving specific issues. Mobile robots are increasingly being used in such sectors as logistics, defence, medicine, public relations, and agriculture (planting and seeding, weed control, etc.).

A mobile robot is a machine controlled by software that use different kind of sensors and other technology to identify its surrounding and move around its environment [2].

In view of the increasing demand for AMSRs, leading companies in the industry, in the majority of cases, adhere to the strict set of manufacturing instructions. However, much remains to be done to effectively improve the basic functionality and compatibility of AMSRs, such as positioning, locating and tracking systems, which can be done by using new (non-standard) models of AMSRs technology systems.

The aim of this research is to find an efficient Ultra-Wideband (UWB) technology use for the Automated Mobile Agricultural Robot (AMAR) tracking system in real time. The following tasks are considered to be priorities to achieve the goal of this research: to find the suitable UWB device and software to understand the UWB data transmission processing capabilities for improvement of the AMAR tracking system, and to find an appropriate solution to separate the two “operational states” of UWB device such as Line-Of-Sight (LOS) and Non-Line-Of-Sight (NLOS), in order to use them like interruption speed control pointers.

The highest-level real-time robot tracking system can increase the safety, usability and reliability of the AMAR. The main tracking system regulator of the AMAR will be adjusted to react quickly and adapt to changing environments conditions due to a wide range of data transmission speed. This increases the predictability of the behaviour of the AMAR and reduces chances of system bugs. The previously stated assumption can be achieved through optimal use of LOS/NLOS identification/classification methods to find optimal solution for this system architecture (the harmonization of programme cycles).

Research methods include the following procedure: implementing a Single-Sided Two-way Ranging (SS-TWR) algorithm using calculation method of Time of Flight (ToF) [3]; UWB data process analysis and the UWB technology ranging measurement models inter comparison analysis (LOS, NLOS), by quantitative research methodologies (a statistical method).

Predicted results: increased safety, usability and reliability of the AMAR; completely adjusted the real-time tracking system for specialized agricultural tasks.

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# THE NEED FOR AN EARLY DRONE DETECTION SYSTEM

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In the past, there were different types of airplane detection systems. Most of them were invented because of war, to protect the country from air warfare.

There is a need to detect drones and prevent them from causing any damage to people or buildings, because the use of drones is rising very fast, and drone detection can be added to the guard systems. Drones are looked upon as being associated with major security issues, rendering them legitimate targets that are prone to various cyber-attack types. Drones operate at different wireless communication frequencies from 2.4 GHz to 5 GHz [1].

To command drone flight, there are numerous subsystems such as navigation and position information, speed and altitude measurements, and the ability to take pictures and videos. The flight controller is the brain of the drone. For autonomous navigation, some drones have autopilots which can be set up to fly preplanned routes, circle objects, or follow a remote pilot. [2].

Human privacy is also at high risk of being exposed to unwanted flying objects that can capture images anytime, and record their movements without their knowledge or permission. It is the most common problem in the world. [3].

Drones can watch and document security patrols in public venues, arenas, events, national laboratories and governmental buildings by hacking gear, spying cameras, and sensitive microphones.

Acoustic sensors are used to catch the buzzing sound of drone and give the direction and distance of the drone. These systems are cheaper than drone frequency jammers.

Drones fly low to the ground and are constructed of plastic, thus they are difficult to spot electronically and they do not have a transponder to signal their position. The acoustic detection method, which captures the ambient sound through the use of microphone ranges, can be up to 500 m [4]. The sound waves are filtered to analyze the target's frequency. This is possible since drones are noisy, and their rotary includes at least 2 rotors that buzz louder as it gets nearer. However, this method offers a high level of accuracy in quiet areas such as in the wild, and it is less suitable in noisy environments.

Drone detection systems are needed for people to respond quickly to threats, and prevent them from unwanted data collection. [5].

Drones will play a major role in the near future, by delivering goods and merchandise, or even serving as flying mobile hot-spots for broadband wireless access.

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## **LAND MANAGEMENT AND GEODESY**

# JUSTIFICATION OF UNIFIED GEODETIC NETWORK FOR RAIL TRANSPORT INFRASTRUCTURE PROJECT RAIL BALTICA

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A Geodetic Network is a system of points on the Earth's surface, the location of each being fixed in relation to the others by means of some unified system of coordinates and altitudes above the sea level on the basis of geodetic measurement. In fact, the coordinates of the geodetic points of the geodetic network are determined mainly by the method of triangulation or polygonometry. Data supplied by artificial earth satellites are also used to fix the coordinates of points of the geodetic network. The satellite is regarded as a traveling carrier of coordinates or as an intermediate point serving to transmit coordinates for great distances. The altitudes of points of the geodetic network are determined by methods of levelling. Accordingly, the points of the geodetic network are secured at their location by geodetic markers. The geodetic points are the basis for the mapping of the earth's surface and for measurements at sites in connection with various engineering surveys and economic undertakings [1].

The Rail Baltica is a greenfield rail transport infrastructure project with a goal to integrate the Baltic States into the European rail network. The project includes five European Union countries – Poland, Lithuania, Latvia, Estonia and indirectly also Finland. Rail Baltica is a new fast, conventional double-track electrified and ERTMS-equipped railway line with maximum design speed of 249 km/h [2]. The existing railway line in Latvia is able to provide a speed of 120 km/h for passenger trains and 90 km/h for freight trains.

The Rail Baltica project has the outstanding situation regarding the different coordinate and altimetry systems in each country. Currently Lithuania is using the coordinate system – LKS94 and the height system LAS07; Latvia's coordinate system is LKS92 and the height system is LAS2000,5; Estonia's coordinate system is L-EST97 and height system is EH2000 [3].

To resolve the existing non-compliance with the different accuracy of existing geodetic networks, the quantity and existence of existing geodetic network points should be identified and those points should be used to develop a new geodetic network by connecting it to the World's Geodetic system WGS84.

For now, there is no geodetic network for implementing the Rail Baltica highspeed railway global project in different countries with the same accuracy. Each country has its own geodetic networks, which are not developed by taking into account guidelines and accuracies with other countries. Therefore, it is necessary to develop a unified geodetic grid for the Rail Baltica: to make sure that the Rail Baltica highspeed railway construction accuracy is in accordance with all applicable legislation and standards in all Baltic States and to ensure that all parties are working in the same reference system.

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# METHODS AND REASONS TO DETERMINE DEFORMATION OF BUILDINGS

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Buildings are structures for individual use with a roof that are accessible to people and that are suitable or intended for giving shelter to people and animals or for storing things. If buildings do not have walls, they must have a roof projection or otherwise marked boundary which determines the area of an individual building. A detached building is any free-standing building; in the case of connected buildings (terraced houses or semi-detached houses), any designed building separated from other building by a fireproof wall that complies with the requirements of regulating construction is considered an individual building [1].

The Latvian construction standard “Geotechnical design” determines the requirements that must be observed when designing foundations and engineering structures. The effect of foundations and loads on the substrate is determined by considering the interaction between the foundation and the substrate. For the determination of deformations, a calculation scheme shall be selected which takes into account all the most important factors, including the static scheme, the peculiarities of the construction work, the structure of the subsoil and the physical and mechanical properties and their possible changes during construction and operation of the structure. The foundation and its design shall provide for measures that ensure normal operating conditions of adjacent structures during the construction and operation of the designed structure. When designing new structures in the vicinity of the existing structures, it is necessary to determine the foundation of the existing structures – the parameters of the foundations and possible additional deformations of the foundation caused by cause loads and other effects of the designed structures. Deformations of structures occur when the situation in the foundations of the structure changes; for example, such deformations of the foundations of structures can be mentioned – landing, sinking, rising and landing, sediments and horizontal displacements [2].

The purpose of building supervision or inspection is to determine the compliance of the building with the following requirements – mechanical strength and stability; fire safety; environmental protection and hygiene, including safety; safety of use and accessibility of the environment; acoustics or noise protection; energy efficiency; sustainable use of natural resources. In cases where a periodic inspection of the structure is required during the operation of the structure, the mechanical stability and strength of the structure, as well as existing fire safety solutions must be assessed during the inspection to ensure preservation of the structure throughout its operation and prevent danger. The inspection task indicates the scope of the survey work to be performed at the facility and, if necessary, their degree, the materials to be developed in the course of the survey, as well as, if necessary, proposals for the elimination of the identified deficiencies. If the potential danger of the structure is established, an inspector is entitled inform the building department and an owner of the building within five days. When informing about the possible danger of the structure, the address of the structure and the identified damages that may endanger the mechanical stability or strength of the structure must be indicated [3]. To conclude, a certain procedure must be observed to determine and monitor the deformation of buildings.

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# ASSESSMENT OF GEODETIC SUPPORT SYSTEM IN RIGA CITY TERRITORY

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The geodetic support system has an important role in urban planning, geodetic engineering projects, and construction. Physical geodetic reference points, i.e., ground signs, wall signs and base stations located on the rooftops, are situated in order to create a comprehensive and homogeneous geodetic support system. With the help of national and municipal geodetic reference points, a unitary coordinate system of Latvia – LKS-92 TM – is ensured.

The geodetic triangulation network of Riga city was created in 1880–1882 during the time of expansion of the city. Nowadays, with an ongoing construction of buildings and roads, Riga city has changed; however, 2,601 (55%) or more than a half of the 4,712 geodetic reference points have a satisfactory condition. In addition to triangulation and polygonometric geodetic points, GNSS base stations were distributed in Riga in 2005, providing global positioning measurements [1, 4].

The fixed local physical geodetic network has to be improved in order for it to function in construction of buildings, roads, railways, pipelines, telecommunication and sewerage systems.

Due to the usage of different tools and change of height systems in vertical (height) and horizontal (coordinates) parameters of the geodetic network, errors and inaccuracies have appeared in the geodetic control measurements.

The original geodetic network of Riga did not satisfy the needs of surveying industry specialists. A polygonometric network was damaged during different construction and improvement works. In addition to the local geodetic network, Riga city has developed a stationary GNSS network based on the EUPOS network [3].

Global positioning measurements are easily obtainable; however, in an urban environment, fixed geodetic reference points have to be provided as a datum point for measurements. There are three main directions in the local geodetic network maintenance and improvement: recognition, methodology in case of destruction of geodetic points, as well as improvement of them.

The condition of geodetic networks of cities and regions depends on decisions of the local geodetic specialists and their cooperation with Latvian Geospatial Information Agency. Local geodetic specialists have to maintain the local geodetic support system in accordance with legislation of the Republic of Latvia [2].

Society should be informed about geodetic networks, because usually people do not know about the importance of geodetic points, which is one of the reasons for the disappearance of them due to carelessness.

Geodetic support systems operate homogeneously if the visibility between the geodetic points, precision of the geodetic parameters, access of data and data updates are provided.

The rapid growth of the city creates the need for new geodetic network points, as well as for the improvement of the already existing ones.

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# **INFLUENCE OF DESIGN DECISIONS ON FORMATION OF CADASTRE CASE**

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Design solutions have a significant impact on the formation of the cadastral file. Architects and designers create, design drawings, implement them together with construction managers, and surveyors measure and assess their compliance with the design and the actual condition. With the rapid development of the real estate market, rational design solutions and cadastral measurements of buildings are becoming increasingly important.

In this article, we will review the main issues of design and building cadastral data and file compilation, which affect the formation of the cadastral file and its compilation.

The analysis of cadastral measurements of buildings in the period of 2013-2021 showed that the main technical errors were made calculating the main areas of a building, determining the main purpose of the building, the influence of stair structures, niches, height of sheds 1.60 m for the area, and other minor careless technical errors [1]. Data, reports, errors in the calculation of premises provided by the SPC occur due to carelessness and, as for 1.60 m, inaccurate estimation. The aforementioned 1.60 m height parameter has a significant influence on the calculation of the area of rooms and building, which affects the sale price and value of the building or room [2]. According to the data provided by the Registers, the most common technical errors are in the conclusions of the preliminary inspection of the building cadastral data file, determining the size of buildings and premises of buildings (over 500 files per year).

To conclude, it is a surveyor's duty to determine building permit data for a building, the purpose of the building, and to present it properly in the cadastral file.

In order to avoid technical errors in determining the areas of buildings and their premises, it is necessary to analyse the construction project, permit, compliance with the above documents and pay attention to the stair constructions, niches, and shelter area, taking into account the height of 1.60 m

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# DIGITAL TERRAIN MODEL APPLICATION FOR LONG-TERM MODELLING OF EARTH CRUST MOVEMENTS IN LATVIA

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Observation of the Earth's crust movements and creation of future surface models are essential long-term planning tools for marine-mainland boundary territories.

Several Baltic Sea region research activities of precise levelling and GNSS station data show similar map models for post glacial crust deformation called Fennoscandia uplift, where vertical crust movements show that height differences in Latvia mainly increase from north-west to south-east [1].

Precise data sources for a territory of Latvia are as follows: the first class state levelling system, LatPos GNSS base station system observations and the sea gauges monitoring system.

The levelling data of the first-class state geodetic network has been obtained in several campaigns for the territory of Latvia. Accessible data are for periods: from 1929 to 1939, 1967 to 1974 and the latest levelling period was from 2000 to 2010. Relative elevation values can be examined for marks that have sustained untouched for all these periods. Many benchmarks from the levelling campaign 1929-1939 have been destroyed although many new benchmarks were created during period 1967-1974.

The LatPos GNSS base station system consists of 27 base stations of the Republic of Latvia, 5 of the Republic of Estonia and 4 base stations of the Republic of Lithuania, which operate in continuous mode, store received signal data and distribute corrections to users via the mobile internet network [2]. The detailed analysis of precise levelling data and LatPos station data show an overall correlation with crust deformation models made for Fennoscandia uplift.

To get the reliable data and a visualization, several data sets should be used with precautions as the research of a vertical crust movement from various sources in Poland showed how the method of combining data sets (interpolation, network adjustment) affected the final cartographic model and co-kriging was found to not be a suitable method for modelling the vertical movements of the Earth's crust based on the data from various sources, such as permanent GNSS stations and data acquired with the use of precision levelling techniques [3].

The usage of digital terrain model (DTM) may give useful data for the long-term planning. Taking into account river drainage system, continental water storage, the sea level change and Fennoscandia uplift, we may model future impacts such as new wetland formation where the sink is observed or new land formation near the coastline where uplift is observed. A 3D model may be visualized in a time scale of past reconstruction, nowadays and the future prediction.

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# TERRESTRIAL LASER SCANNING FOR HERITAGE CONSERVATION: EXPERIENCE IN STUDIES

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Cultural heritage is people's national treasure and one of the most important spiritual and material values. It includes history, architecture and urban planning, archeology, art and other objects of intellectual and practical activity [1]. The protection of cultural heritage is one of the priority areas for action in many democratic and developed countries. Digital technologies play an important role in increasing the protection and accessibility of real estate heritage, including laser scanning, photogrammetry, photography, projection (3D). Digitization makes it possible to open up cultural values that are protected and provide access to them remotely. Professors and students of the Department of Environmental and Civil Engineering of Klaipeda State University of Applied Sciences contributed to the accessibility of Klaipeda County real estate heritage objects in virtual reality by conducting the research "Development of Real Estate Object Monitoring System and Deformation Investigation Using Remote Sensing Technologies". The research was carried out using remote sensing technologies with passive and active sensors. The "Stonex X300" terrestrial laser scanner was used to scan real estate heritage objects. The Italian company's device "Stonex X300" is an eligible, high-quality scanner. Scanning distance: 1.6 m to 300 m. The horizontal scanning angle is 360 °, the vertical angle is 90 ° and it captures up to 40,000 dots per second. It has two 5Mpx integrated cameras. The device was controlled by a smartphone using a WiFi connection. The scanned data was processed by "3D Reconstructor" software.

During the research, real estate objects such as "Dionizo Poskos Baubliu" Museum, Klaipeda City Sculpture park, Silutes Town H. Sojus manor building complex, and others were scanned. The building complex of H. Sojus manor in Silute town currently consists of a central palace, a restoration centre (the former barn (stables)) and an ethnographic-educational centre (the former servants' house). The stable building of the manor was scanned during the research. 24 workstations were selected to scan the building. The obtained data were processed by "3D Reconstructor" software.



The detailed three-dimensional (3D) model of the object of cultural heritage can serve as a form of digital preservation, a timeless virtual representation which is visually appealing to the public and researchers.

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## THE USE OF GPS COMMUNICATION IN PEOPLE'S DAILY LIVES

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The Global Positioning System (GPS) is a satellite-based navigation system, which gives information about geo-location and data about time to a receiver [1]. GPS is often associated only as a navigation system on the road or simply as a location search. GPS is not only for vehicle navigation or interactive mapping; the reality is, the advance of GPS technology in this day is becoming part and parcel of everyday life. Due to technological progress, there are more and more opportunities to take advantage of GPS connectivity. We did a survey to find out what purposes people use GPS for. GPS is an important tool in our lives these days. GPS is now available to everyone and has been for some time. Due to its widespread use, GPS technology is now well incorporated into our daily lives. It is used in your car to navigate traffic or by your smartphone to offer more accurate and customized web search results. GPS is a technology we have become so comfortable with, we often take it for granted. Using physical maps or asking strangers for directions is now a thing of the past. As many of us know, there are countless satellites flying in space. GPS satellites circle around the Earth. A GPS receiver, or other equipment with GPS receiver, listens for these signals. Once the receiver calculates its distance from four or more GPS satellites, it can figure out where you are. For every different purpose, there are different satellites with different features. Satellites are classified according to these functions: Research satellites – to gather information about universe, Earth exploration satellites – to obtain information about the Earth, satellites of communication – for telephone, radio and television connections and GPS satellites – for navigation and coordinate systems [2]. Today, people probably can not imagine life without a GPS connection. Now we use smartphones and smartwatches. In them we observe what distance we have run or count the steps of the day. We can also send our location to another device and many more things we use today. To know how people use GPS in daily life we asked 76 random respondents to answer some questions about GPS use. 55,3% respondents use smart watch/band. 40,8% use smartwatch or phone to follow their sport progress (running, walking). Respondents use GPS on their phones for social networks and navigation, which is as much as 80%, the rest of respondent use it in agriculture or to record a sports route. 94,7% respondents allow some apps to know their location. 63,2% uses GPS at work. With the help of GPS we can avoid congestion or even risk factors on the road, so 53,9 respondents use GPS to avoid situations like these. 63.2% use GPS to find places of interest or recreation. From the results of the research, we could make a conclusion that about 70% people uses GPS in their daily life. GPS has revolutionized our daily lives. GPS or Global Positioning System provides satellite tracking services that are useful in a variety of commercial and personal applications. All in all, the main reasons why people use GPS system is because it makes daily life better. With GPS we can avoid traffic jams and save time, with GPS receiver to track personal sports result became much easier. GPS influences our daily life, and today, and it is hard to imagine a day without the impact of this system.

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## **ENVIROMENT AND WATER MANAGEMENT**

# ANALYSIS OF BOD<sub>5</sub>, COD AND SUSPENDED SOLIDS EFFICIENCY IN HORIZONTAL SUBSURFACE FLOW CONSTRUCTED WETLAND

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Uncontrolled discharges of domestic wastewater, especially in rural areas, result in pollution of surface waters and groundwater, which makes them unsuitable for drinking water, crop irrigation, fish production and recreation [3]. Constructed wetlands can be used to treat contaminated run-off, such as domestic sewage, agricultural run-off, and other types of contaminated water [2].

The decomposition of organic matter, mainly by aerobic bacteria, nutrient transformations and other processes related to biological water treatment [1] in constructed wetlands, depends on various operational and environmental factors, such as hydraulic loading rate (HLR), hydraulic retention time (HRT), temperature, dissolved oxygen, pH [3].

Constructed wetlands are classified by design into surface flow and subsurface flow wetlands, and subsurface flow wetlands can be subdivided depending on the direction of water flow in the following way: vertically upwards, vertically downwards or horizontal [2].

Since June 2014, water quality monitoring in surface and subsurface flow in constructed wetlands has been carried out in the farm "Mežacīruļi", Zaļenieki parish, Jelgava region, intended to reduce diffuse and point agricultural pollution and surface runoff from the impermeable pavements [1].

As part of this study, subsurface horizontal flow wetlands were studied in order to evaluate the changes in the efficiency of treatment depending on biological factors. The effectiveness of horizontal subsurface flow constructed wetlands was evaluated by comparing the the concentration of total suspended solids (TSS), biochemical oxygen demand (BOD<sub>5</sub>) and chemical oxygen demand (COD) at the inlet and outlet depending on temperature and pH.

Some studies show that there is a direct relationship between temperature and microbial activity and their effect on pollution abatement efficiencies [3]. For example, Tunçsiper found that the average nitrogen removal efficiency in artificial wetlands was by 6 to 11% higher in summer than in winter [3].

Wastewater pH is an important factor influencing the efficiency of constructed wetlands, mainly in terms of nitrogen and organic matter removal. Wetland water chemistry and biology are equally affected by pH; for example, a slower denitrification process is determined at pH 5, but denitrification is very limited at pH <4 [3].

The analysis of the data obtained in the monitoring allows conclusions to be drawn conclusions the influence of certain factors in the subsurface flow in constructed wetlands in the Latvian climate and environmental conditions.

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# AMMONIA EMISSIONS FROM APPLICATION OF DIGESTATE

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Reduction of ammonia ( $\text{NH}_3$ ) emissions is a challenge not only for Latvia but also for other countries. Agriculture is the biggest source of  $\text{NH}_3$  emissions in Latvia. Most  $\text{NH}_3$  emissions arise from livestock production or manure management. One of the manure management methods is anaerobic digestion. As a result of this practise, digestate is produced. Digestate can be used as organic fertilizer [5]. The aim of this study was to analyse the difference of  $\text{NH}_3$  emission pathways between application of digestate and that of non-processed manure after application to the field.

The European Environmental Agency Guidebook 2019 for preparation of national emission inventories states that the same emission factor should be used for slurry and digestate application to the soil. It is assumed that  $\text{NH}_3$  volatilisation from digestate does not differ from untreated manure after the application to the field. The difference is in estimation of the total nitrogen and total ammoniacal nitrogen that is applied as fertilizer [2].

Digestion increases manure pH and available nitrogen in the process of mineralization of the organic nitrogen and volatile fatty acids that increase  $\text{NH}_3$  emissions. However, the results of experimental researches are not conclusive. On the one hand, digestion of manure resulted in increased  $\text{NH}_3$  volatilisation by 81% (storage and application) in the study by Holly [3]. The study by Amon et al. determined the increase of  $\text{NH}_3$  emissions from the field application by 18% comparing to untreated manure [1]. On the other hand, the study by Neerackal et al. reported the decrease of  $\text{NH}_3$  emissions of digestate application that could be explained by increased  $\text{NH}_3$  emissions during storage of digestate [4].

Due to the risk of increased  $\text{NH}_3$  emissions of digestate, it is crucial to use application and incorporation techniques that decrease  $\text{NH}_3$  volatilisation — that has been stated in the mentioned research papers [3; 1; 4]. The most effective way to reduce  $\text{NH}_3$  is deep injection in a closed slot and immediate ploughing of manure.  $\text{NH}_3$  abatement could be implemented in all manure management stages. Loss of nitrogen could be prevented from storage by use of cower [5] that influences available nitrogen and its potential to increase  $\text{NH}_3$  emissions in the next stage of the application to the field. In future studies, an impact of the soil type on digestate  $\text{NH}_3$  emissions needs to be analysed.

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# THE RISK ASSESMENT OF AIR POLLUTION CAUSED BY HEAVY METALS USING SPATIAL MODELLING FOR 2018 AND 2019

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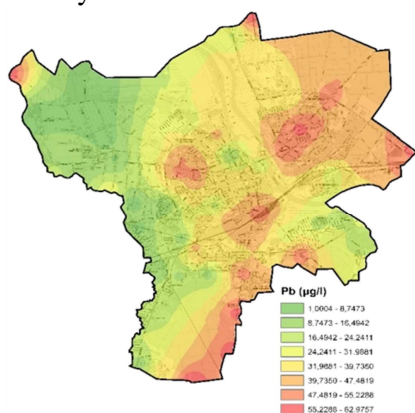
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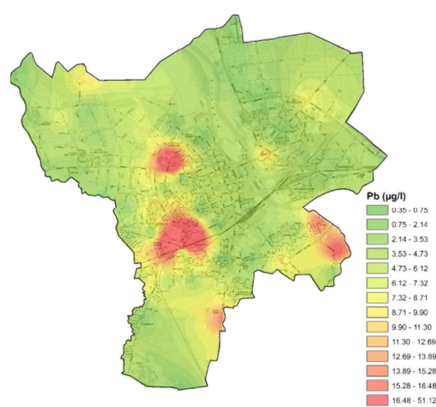
More than 70% of the world's population is living in cities now, and it is estimated that this amount will be 80% by 2030. Air pollution in cities is a major environmental problem that affects people in both developed and developing countries [1].

The aim of the research was to determine the causes of pollution and its distribution in different places of Jelgava city using spatial modelling. Several studies used snow as an indicator to detect air pollution in cities [2], and it is the world-renowned method for determining air pollution. Zinc (Zn), nickel (Ni) and lead (Pb) come from waste incineration and burning fossil fuels [3].

In total, snow samples were collected at 60 sites each year. The chemical elements were determined by an inductively coupled plasma optical emission spectroscope (ICP-OES). The results of the research confirmed that the greatest pollution is in the places of major streets and intersections, as well as the dense location of companies in certain parts of the city affecting the air quality in the city. The distribution of lead pollution in the city of Jelgava clearly shows the intensive traffic points in the city, such as Rīga street, Lielā street and the Lithuanian street/highway. The effect of traffic flow intensity on the distribution of heavy metals in the urban environment is clearly visible by analyzing the metals generated by the combustion of fuel and car wear.



Distribution of lead (Pb) in Jelgava (2019).



Distribution of lead (Pb) in Jelgava (2018).

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# TREE SPECIES FOR PHYTOREMEDIATION IN URBAN ENVIRONMENTS

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As the number of cars in urban areas increases, the proportion of heavy metals and other harmful elements in the air increases thus significantly reducing the air quality in urban areas. Living in cities with polluted air has a negative effect on human health. For example, increased intake of lead (Pb) can affect different systems of human body - hematopoietic, renal, reproductive, and central nervous system [2]. As for Zinc (Zn), although this heavy metalloid is considered relatively nontoxic, symptoms such as vomiting, epigastric pain, nausea, lethargy, and fatigue will occur if human body is exposed to its high doses [5]. Heavy metalloids such as lead (Pb), copper (Cu), zinc (Zn), etc., highly occur in the large cities all over the world. Source of these toxic elements in urban areas are mostly tied to fossil fuel consumption increase over the last decades. The aim of this study is to identify plant species and develop design of landscape elements for air purification in urban areas.

Phytoremediation is the inherent capacity of plants to absorb pollutants and to rehabilitate the environment through various mechanisms. Phytoremediation uses the ability of different plants to eliminate or convert (into less hazardous compounds) a high range of soil, water or air pollutants such as chemicals, heavy metals, petroleum products, chlorinated solvents, pesticides, explosives and radioactive compounds. The advantages of phytoremediation are not only low expenses and high effectiveness, but also an environmentally friendly, solar-oriented method [4]. The choice of plants for phytoremediation measures in the urban environment is mainly determined by factors such as: the spectrum of plant perceptual elements and efficiency in phytoremediation, plant resistance to external conditions and suitability for urban viability, regional suitability, life span, maximum height, root development and visual integration in the rural landscape.

When choosing plant species, it is important to observe dimensions of a particular street, the direction and intensity of the traffic flow, maintenance needs (cleaning, mowing, snow storage etc.), and their layout of both on surface and underground utilities (pipes, cables, etc.) [1].

Ideal low-cost candidates for phytoremediation applications are silver birch (*Betula pendula*) and black locust (*Robinia pseudoacacia*) due to their high production of biomass, fast growth rate after transplanting and high transpiration rates. Small-leaved lime (*Tilia cordata*) might, however, be the best tree species suitable for air phytoremediation due to its capacity of airborne pollutants and small particles in the air [3].

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## **CIVIL ENGINEERING**

# OPPORTUNITIES AND PROBLEMS OF ICF FORMWORK TECHNOLOGY IN THE CONSTRUCTION OF INDIVIDUAL HOUSES

**Karolis Baltrimas**

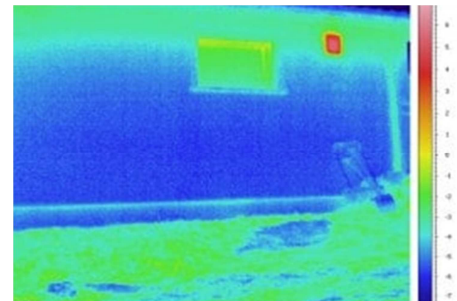
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ICF insulated concrete formwork is polystyrene foam block for walls which performs two functions: a concrete formwork and an insulating layer. ICF polystyrene blocks are attached to each other and then filled with fibrous concrete, so there is no need for additional insulation of the walls. ICF polystyrene foam blocks can be used in the construction of any purpose building, even swimming pools. The walls of the building are assembled from ICF without the use of any mortar or glue. The upper and lower parts of the ICF blocks have incisions and grooves, are thus interconnected like "LEGO bricks". In this way, the entire ICF wall is assembled [1].

The advantage of ICF technology in the construction of individual houses is energy efficiency. The ICF formwork system solves three basic requirements for a passive house. It is extremely easy to reach 10 m<sup>2</sup> K/W thermal resistance, and the house becomes extremely airtight as the concrete fills even the smallest spaces. The insulating layer is integral so there are no cold bridges in the constructions of walls. However, the disadvantage of ICF



technology in the construction of individual houses is conditionally higher cost of walls compared to masonry or wooden constructions. The work of concreting walls requires the highest qualification of concreters, as a wall up to 3 meters high should be concreted at the same time. Because the inside of the formwork consists of 5 centimetres of polystyrene, longer fasteners are required. To reach the perfect wall plane you need to use special struts, the rent of which is not cheap.

Although the first ICF formwork appeared in the world in 1960, in Europe this building system became relevant to people only with the requirement of the energy performance certification. In order to achieve the A ++ energy efficiency class, it is necessary to install extremely tight structures in the building. ICF technology provides such an opportunity. With the requirement of energy performance certification, there is a growing need for more sustainable construction solutions [2].

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# INSULATION IN BUILDINGS

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The purposes of insulation in buildings can be addressed with the following questions: What is insulation required for? What are the economic benefits? Why should insulation be made?

Building insulation is any object that is used as insulation for any purpose in a building. Although insulation in buildings is generally used for thermal purposes, this term also applies to acoustic insulation, fire insulation and impact insulation. Often it is more appropriate to choose an insulating material that is capable of performing several of these functions at the same time. Insulation can be defined as an energy saving measure that provides resistance to heat flow. Heat flows from a warmer place to a colder area. By insulating a house, heat loss in buildings can be reduced in cold weather or climate, and excess heat can be reduced in a warmer weather or climate. Insulating a home has several benefits, such as energy savings, cost savings, and increased comfort. There are several types of insulation against heat loss in cold climates, each with its own specific technical features and financial costs and benefits. Insulation measures are generally one of the most cost effective energy saving measures [1].

Wall, roof and floor insulation may be done by fixing insulation material to the wall, roof or floor, either on the inside or outside, e.g. by using insulation plates. Buildings may for example have cavity walls consisting of two 'skins' separated by a hollow space. This space already provides some insulation but can be filled up with additional insulation material, e.g. foam, to further improve the insulation effect. Roof insulation for flat roofs differs from insulation for steeper roofs. We can use roof insulation to obtain more durable and safe roofs against climatic events such as snow, rain and wind. We can use floor and soil insulation in terms of moisture and heat insulation [1].

Windows and exterior doors have a major impact on a building's heating and cooling requirements. New high-end windows can be six times more energy efficient than lower quality older windows. Attention should also be paid to the window frame, which can significantly affect the insulating level of the window [1]

Fire insulation (or more generally fire resistant insulation) is a term that includes insulating materials that have insulating properties but are also non-flammable or limited flammability. As passive fire protection elements, they do not need to be activated to provide fire resistance and can therefore help prevent the spread of flame between areas and components within and between the building [2].

As a result, insulation in buildings provides a comfortable and healthy life comfort. It provides high energy savings. It creates a healthy environment by reducing the emission of harmful substances (spread to the environment). It reduces the initial investment and usage costs in buildings [3].

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# **THERMAL INSULATION MATERIALS OF INORGANIC ORIGIN**

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Insulation of a building is a very important part of construction work. Therefore it is very important to know the properties of thermal insulation materials and to be able to choose the right products.

Thermal insulation materials are materials that should reduce heat flows through themselves; that is, they should insulate warmer indoor air as much as possible from colder outdoor air or soil [3]. The most popular inorganic thermal insulation materials are polystyrene foam, foam glass and mineral wool.

Polystyrene foam is a closed-cell porous plastic thermal insulation material obtained by foaming raw polystyrene foam granules which differ from other materials in price, production and efficiency. Its production is very simple compared with other thermal insulation materials; it has low production costs and excellent properties [1]. Foam glass is a porous building material (blocks and bricks) made by sintering powdered glass (glass waste, mica) mixed with a gasifier or foam. Granular foam glass is an artificial, inorganic, lightweight, porous material of mineral origin produced from simple finely ground glass scrap and waste [1]. Mineral wool (rock wool) is the name of the heat insulating material consisting of artificial glass like fibres made from molten rock or metallurgical slab. Mineral wool is used as a heat-insulating material for surfaces at a temperature reaching 600 °C [2].

Thermal insulation materials of inorganic origin also have disadvantages, such as when working with or during the production of insulating mineral wool products, dust can be generated, especially in cases when the wool fibre is exposed to various mechanical loads (cutting, shredding, pressing, sewing or wadding). Thus all mineral cotton wool species are identified as irritating to the skin. However, if the safety and health of workers are respected when working with mineral wool products, and mineral wool products are properly installed in the structures of buildings, there is no risk to human health and indoor air quality [1].

Inorganic thermal insulation materials have many good properties, but they need to be well understood before choosing them.

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# **WOOD AND ITS TECHNOLOGICAL PROPERTIES**

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Wood has been used for thousands of years for fuel, as a construction material, and for making tools, weapons, furniture and paper. In the construction industry wood is one of the most frequently used building materials, and it is inseparable from an everyday construction workers' routine. Wood has some unique technological properties. It decomposes well along the fiber, holds metal fasteners well, can be bent, and is resistant to wear. Wood screws hold very well in wood. Wood is also valued according to the width of the annual growth rings. Timber with narrow annual rings is stronger.

The most general feature of wood is its density. Higher density wood is more in demand. It is more resistant to bending, abrasion, and splitting. Wood taken from different parts of the log has different properties. Wood is stronger near the stump. In the direction of the apex, it deteriorates. The properties of oak and ash deteriorate from the core to the surface, while that of birch, aspen and linden, on the contrary, from the bark to the core [1].

However, using wood in construction works has its downsides. Wood is scalable, does not damage from shocks and vibrations, and is resistant to abrasion. It is quite flexible, and easy to process, but it is not fire resistant. Also, wood products change dimensions and shape due to moisture and temperature. Various insects and microorganisms decompose and damage wood. Any such damage or deviation that impairs its properties is called wood defects. When wood is soaked with flame retardants, it becomes more resistant to fire; wood is treated with antiseptics against rotting, with insecticides against insects. When wood is treated hydrothermally, it becomes technologically and operationally better [2].

Wood is an important natural resource, one of the few that is renewable. It is prevalent in our everyday lives and the economy, in wood-frame houses and furniture, bridges and railroad ties. Without wood, it would all fail.

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# FIBERGLASS REINFORCED POLYMER MARKET SITUATION IN LITHUANIA

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Fiberglass reinforced polymer is by far the most popular fiber reinforced polymer in the market, leaving behind its other common species: carbon fiber, aramid fiber and basalt fiber. It surely does not mean that fiberglass has the best properties amongst fiber reinforced polymer. But the quality – price ratio seems to be most suitable for nowadays market.

The main competitor for all fiber reinforced polymers is steel. The general superiorities of FRPs to steel, which is the traditional reinforcing material for concrete structures, include excellent corrosion resistance and electromagnetic neutrality; high ratio of strength to mass density; excellent fatigue resistance, especially CFRP and AFRP; cost-effective fabrication; low axial thermal expansivity, especially CFRP [1]. Properties of FRP are strongly dependent on the factors such as the matrix and fibre material and their volume fractions, the fibre orientation, the applied stress levels and strain rates, as well as the loading conditions and the nature of fibre polymer interface. Interface is said to be the heart of the composite. The local response of fibre matrix interface within the composite plays an important role in determining the gross mechanical performance [2]. Though FRP has proven to be better in many ways than steel, the situation in the market has not changed drastically; steel is still the main option for reinforcing polymers in Lithuania's construction industry.

There are up to 10 various companies distributing GFRP's production in Lithuania, most of them being just distributors, mainly importing FRP from Russia. Just 2 companies in Lithuania specialize in FRP production. One of them, UAB "Armatūrė" (Ltd), agreed on sharing its information on commodity circulation, customers and managing.

Starting their production in the end of 2016, UBA "Armatūrė" managed to make 10,000 € annual turnover in their first year. In next two years, the company grew stably, making 15,000 € in 2018 and 22,000 € in 2019 annual turnover with very little effort in advertising. Despite the pandemic, in 2020 the company decided to put effort in advertising and searching for commercial partners resulting in 40,000 € annual turnovers. As said by the company executive director Alfredas, there is a lot of room for improvement, having just 2 distributors of their produce. When asked about competition with another Lithuanian production company, "Ugira", Alfredas stated that "competition is weak, we took on 4 of their clients just by offering better customer service".

Another observation given by the owner of the company was stated that "nearly all customers are just individual people who themselves found alternative in reinforcing concrete and the advantages of FRP over steel, there is not much interest from construction companies". Another important reason for FRP not being competitive over steel in reinforcing concrete in Lithuanian market is caused by architects and construction planners as they do not see FRP as an attractive option despite its many advantages over steel. It requires additional recalculations over steel product, and that means more time and effort needed or it is just an outdated mindset.

Although UAB "Armatūrė" keeps growing, realising they are 1 of 2 GFRP production making companies in Lithuania encountering poor competition, it shows that there is plenty of space in GFRP market, and it should expand over steel in the future.

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# THE MOST FAMOUS ARCHITECTURAL BUILDING OF 19TH CENTURY IN EUROPE

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In the 19th century Europe, one of the most well-known buildings was probably the Eiffel Tower. It became very popular because of its construction style and grandeur. The Eiffel Tower was important and unique as regards the construction technology and construction features. The Eiffel Tower was unquestionably modern in its shape, which was distinct from the Neo-Gothic, Neo-Renaissance and Neo-Baroque styles that had been popular in the 18th and 19th centuries, according to Gudek Snajdar [1]. But it was its material, iron, that made the tower unique.

The foundation work for the Eiffel Tower was quite difficult [2]. A lot of building materials were used for this structure: about 1,000 tons of cement and 210 tons of lime and other other building materials accounting for about 12,493 m<sup>3</sup>. The construction of the tower was started. The main material was puddled iron. The pillars were mounted on the pedestals. The whole problem was the inclination of the crossbowmen. Indeed, the pillars were supposed to meet at the first level at the same altitude, but a tiny deviation at the start caused an unacceptable gap at the finish. A solution was therefore needed to incline each pillar to a certain extent. Two solutions were used at the same time. First, hydraulic cylinders were installed at the feet of the pedestals under each crossbow, they allowed to play on the positions of the pillars. The second solution was simpler but even more effective. On the wooden scaffolds which were used by the workers, sand boxes were laid. The joists were placed on the caissons and they were then enough to remove the sand from the boxes to lower the joist. After that construction of the floors began. The floors of each level were assembled in the same way as the first floor. The scaffolding was replaced by a single central scaffolding, and the crane was used to add parts to increase the height. The starting point was the floor of the first floor because the cables became too long to be used. A hoist was used to mount the rooms on the first floor. To mount the elevator and the top of the tower, mounting cranes were used. Mounting cranes were the most useful tools. Using the paths of the future elevators, they were used to easily mount the beams, joists and spacers at the desired height on the platforms of the work scaffolds. 1,050,810 rivets were used to build the Eiffel Tower [3].

This enormous and majestic structure is 324 meters high and consists of 18,000 pieces of puddled iron. It was Gustave Eiffel, an engineer and famous entrepreneur whose firm designed this building on the occasion of the celebrations for the centennial of the French Revolution and the World's Exhibition of Paris which was held in 1889. Today, it is the symbol of French identity and a global tourist attraction [4].

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# **CONSTRUCTION OF UNDERGROUND ENGINEERING COMMUNICATIONS BY THE HORIZONTAL DIRECTIONAL DRILLING (HDD) METHOD**

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One of the relatively seldom used methods of installation or construction of engineering communications in Latvia is construction of underground engineering communications by the horizontal directional drilling (HDD) method [1].

A brief description of the technological process is as follows. The horizontally controlled drilling process takes place in different stages. With the help of a specialized drilling rig equipped with a location system, a small diameter well is drilled from the ground surface according to a given trajectory. The borehole is then widened to the design diameter and a pre-prepared pipeline is drawn into the borehole. During the expansion process (from smaller to larger size), the borehole is filled with drilling compound, which cools the tool during the drilling process, reduces friction, and strengthens the borehole walls during pipeline installation. Once the borehole expansion is complete, the pipeline is laid. It takes a few hours to prepare and lay the pipeline.

During the research, 3 objects were analyzed and an assessment of the high-speed water drilling machine UNI 30 x 40 was performed in different soils and at different depths. The aim of the research was to determine the indicators, characterizing the drilling speed and drilling quality, and the factors that affect them. The tasks of the research were as follows: 1. to analyze soil drilling parameters and normative literature, describing them, 2. to determine the parameters of soil drilling in three construction sites, 3. to process and analyze the obtained measurement data at construction sites to compare the results with Latvian regulatory enactments, 4. to provide recommendations for supplementing the Latvian State Standards [2]. The applied research methods were: experimental, statistical data processing and analytical methods.

The conclusion summarizes the ideas expressed in the research. There are many advantages of using this method. HDD technology allows the customer to achieve the optimization of such basic indicators as: time (reduction of construction time by using high-tech drilling facilities at a high speed of penetration 5 times or even more); funds (reduction of the financial costs of construction due to a significant reduction in the number of earthmoving equipment involved in the process of building a pipeline as well as the reduction of the number of special equipment and labour-power); reduction of the risk of accidents; the fact that no external energy resources are required to carry out the works as the drilling systems are fully autonomous; the fact that no dewatering of high groundwater is required; the fact that some types of high-cost work are excluded, for instance, shore stabilization, underwater engineering, explosions, loosening of tight soil and others; the fact that no expenditures to restore the damaged sections of roads and railways, green zones and objects of urban infrastructure are required; ecology which includes preservation of a natural landscape and ecological balance in the places of work, no technogenic impacts on flora and fauna or erosion of the bottom of basin sediments are experienced.

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# ADVANTAGES AND DISADVANTAGES OF BUILDING A HOUSE WITH STRUCTURAL INSULATED PANELS (SIP)

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Structurally Insulated Panel systems (SIPs) are solid sheets of building material constructed of a foam core sandwiched on each side by a layer of oriented strand board (OSB). They are used for walls and roofs but can also serve as floors and foundations [1]. In the last few years, SIPs construction has emerged as one of the most popular building systems [1, 2]. Interest in this building material has increased due to the fact that building with structural insulated panels has many advantages.

First of all, SIPs can be manufactured in large sizes and are faster and easier to install than other traditional systems because SIP building is constructed requiring fewer workers [4]. SIPs are environmentally friendly because the OSB outer skins come from replenishable, quick-growing softwood trees, and SIP components are recyclable [1, 4]. The SIP system has also proven its strong structural system [4]. Compared to a typical stick-frame house, due to an excellent thermal insulator a house built of SIPs are requiring about half the energy to heat and cool throughout the year in most climates [5].

Despite the advantages of SIPs, it suffers from several disadvantages. Firstly, when the panels are manufactured in the factory and cut to the size demanded by the individual design, there cannot be any design changes for SIP building on site. Secondly, rodents and insects can nest inside the spaces of SIP, particularly between the joint connections as the insulation, which is an ideal habitat. Finally, SIP structure, which is almost hermetically sealed, may affect the permeability of the members made of SIP, particularly wall [3].

In conclusion, Structurally Insulated Panel systems are simply better insulated, stronger and faster to build with the standard stick-frame construction. Moreover, it also helps to conserve forest resources, because they produce almost no waste. However, SIPs has some drawbacks, such as onsite unchangeable design, the possibility of insect nesting and lack of breathability that give direction to the improved further designs.

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## **METAL CORROSION AND PROTECTION**

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The construction industry is using more and more types of metals, which allows the implementation of increasingly complex architectural solutions.

Metal is one of the most widely used building materials. Metal is a material that, when freshly worked, polished, or fractured, shows a lustrous appearance, and conducts electricity and heat relatively well. Metals are typically malleable, so they can be hammered into thin sheets, or ductile so they can be drawn into wires. Metal may be a chemical element such as iron; an alloy such as stainless steel; 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 sulfide. [1] It is the gradual destruction of materials, usually a metal by chemical and/or electrochemical reaction with their environment. Corrosion engineering is the field dedicated to controlling and preventing corrosion. Preventing corrosion in metal parts takes consideration at all stages in the process, from design and manufacturing to finishing and maintenance. Corrosion types; Metal Type, Protective Coating, Environmental Measures, Sacrificial Coatings, Corrosion Inhibitors, Design Modification. Metal type is one of the most simple ways to prevent corrosion is to use a corrosion resistant metal such as aluminum or stainless steel. Depending on the application, these metals can be used to reduce the need for additional corrosion protection. [3]

Corrosion can be controlled effectively by cathodic protection or inhibitors, provided the chemical and electrical conditions are monitored in a scientific manner. The same can be said for all of the anti-corrosion technologies. The costs of stopping corrosion can be quite high, but these costs must be faced by many industries if they wish to achieve a high level of performance. The key factor is the scientific knowledge on which the technologies are based.

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## **ADVANTAGES OF USING THERMALLY MODIFIED WOOD**

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Thermally modified wood has been intensively used in recent years. It has many superior qualities compared to other building materials. So, what are the advantages of using thermally modified wood?

Thermally modified wood is wood treated by heat (180°C – 215°C) and steam. In the authors' opinion, the most important advantage is environmental friendliness because no chemicals are used during the treatment. Thermal treatment significantly affects wood properties. It becomes extremely durable, increases dimensional stability and thermal insulation [1]. This kind of wood almost does not shrink or distort, and it maintains an impression of novelty. For that reason thermally modified wood is widely used for terraces, facades, fences, saunas, pergolas, summerhouses, floors and so on.

Thermal treatment can be used as a protection against wood-destroying insects, mold and fungus [2]. Various pests die when exposed to heat, therefore terpenes disappear, which means that insects, mold and fungus do not have food anymore. Thermally modified wood becomes sterile and long-lived. Because of that, it has more than thirty years warranty.

One more advantage is colour. Although the colour of the thermally modified wood changes when exposed to ultraviolet rays, it is more stable than that of untreated wood. After some time it becomes grey. It is recommended to treat it with oil or paint to keep a nice appearance and beautiful colour. For decorative end-use, the colour stability of wood is a significant prerequisite [3]. It has very beautiful and even shade of brown, therefore the products and finishing look extremely stylish.

Because of the dimensional stability, longevity and great aesthetic appearance, thermally modified wood is suitable for both outdoor and indoor decorations. Furthermore, wood modification without using any harmful chemicals ensures that thermally modified wood harms neither nature nor humans. Thus, due to these advantages, it is the building material of the future.

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# RAMMED EARTH CONSTRUCTION

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Sand to make concrete is becoming rarer and rarer. The goal would be to use as little sand as possible or at least reduce it in the nearest future. We can think of ancestral methods like wood, cob or bricks but what if the next materials to build sustainable constructions are earth, chalk, clay, lime or gravel as it was since the dawn of time? Rammed earth constructions are cool in the summer and hot in winter [3]. They use local material so they have low carbon footprint. High humidity and moderate temperature are the best elements for rammed earth constructions. Adequate protections against rain and cold can be added [2]. The process is as follows: a plywood formwork is a mould filled with a layer of a moist mixture called subsoil made of concrete, gravel, lime, chalk and earth. This layer will be compacted to approximatively 50 % of its original volume. Other moist layers are added, compacted till the construction of the wall. Once dry the formwork is removed.[1] The earth extracted comes from the location of the construction or not far away. Proportions of each materials and stabilizers are calculated depending on the original soil. For example, cement stabilisation will be better for sandy soils, lime better suited for clayey soils. Each material will have its own purpose in the conception of the wall. For example, clay is durable, aesthetically pleasing, and has excellent insulation properties. Concrete has a low carbon footprint over the lifecycle of a structure, is durable, strong and resilient, doesn't burn, rust or rot, and is good for sound insulating. Lime helps stabilize the humidity of a building by absorbing and releasing moisture, and reduces surface condensation and mould growth. All of these advantages combined contribute to the performance of a rammed earth construction. Rammed earth construction has many advantages. The compressive strength of rammed earth depends on the soil type, the compaction and the stabilisers. More compressive strength ( $\sigma$ ) or load-bearing capacity would require more cement at the expense of the permeability of the walls. Rammed earth construction has a high thermal mass: it absorbs heat during the day and releases heat during the night. The clay in the walls makes the building "breathe" more than concrete buildings; that way, condensation problems and heat loss can be avoided. Rammed earth walls are suitable for soundproofing; they are fireproof and resistant to termites. Unfortunately, this method can have some disadvantages: prior to the construction, the soil must be rigorously analysed. Additional insulators in colder climates and roof protection in rainy climates are in order. The price could also be an obstacle. Finally, the wall cannot be easily corrected as a brick work can be [1]. Rammed earth construction is maybe a way towards sustainability in civil engineering.

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# COMPARATIVE ANALYSIS OF THE ROOF LOAD-BEARING STRUCTURES

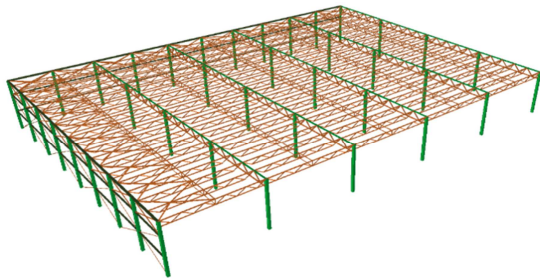
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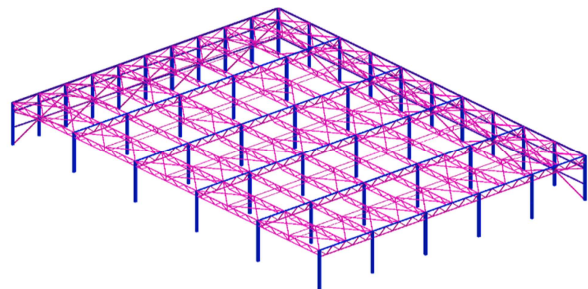
The main roof load-bearing structures in the design of large-area storage buildings are trusses. They are made of steel, which is characterized by strength, durability, and it is long-lasting. Steel trusses are a reliable and economical choice for installing roofs. In order to select a rational truss layout step, the comparative analysis was performed. The analysis was made for the part of the storage building with the length of 82.50 m and the width of 60.00 m.



In the first variant, the step of laying the steel trusses was 3.00 m. The column spacing step was selected according to the truss layout step, so the spacing was 8.25 m in the X direction and 15.00 m in the Y direction, doubling the columns around the perimeter of the building. The following elements were selected: upper truss elements – TUB1001006, the lower – TUB80806, the grid – TUB60605. The height of the truss was 1.00 m. The following elements were selected for the sub-frames:

160X5SHS (top chord), TUB1001005 (bottom chord), TUB80805 (grid). The total weight of the whole structure was 115.22 t. After preparing the model by STAAD.Pro programme, the results of displacements in X (21.92 mm), Y (64.72 mm), Z (14.26 mm) directions were obtained.

In the second variant, the step of laying the steel trusses was 6.00 m. The spacing in the X direction was 8.25 m, as in the first variant, and in the Y direction – 12.00 m, doubling the columns around the perimeter of the building. The following elements were selected: upper truss elements – TUB1401406, the lower ones – TUB1201206, the grid – TUB1001006. The truss was raised to 1.20 m. The total weight of the structure was 120.81 t. Additional connections were installed between the trusses, TUB1001004 elements were used for these.



180X5SHS (for the upper chord), TUB1401406 (for the lower chord), TUB1201206 (for the web) elements were selected for the sub-frames. After preparing the model by STAAD.Pro programme, the results of displacements in X (9.40 mm), Y (51.86 mm), Z (8.48 mm) directions were obtained.

After analyzing the designed models and comparing the obtained results, the main conclusions were drawn. First of all, installation of steel trusses every 3.00 m requires a smaller amount of steel (consuming 5.6 t less than installing trusses every 6.00 m). It is also planned to install less compliant load-bearing structures due to the arrangement of additional connections between the trusses. When trusses are installed every 6.00 m, steel truss structures are heavier. The results obtained by the STAAD.Pro programme models and their comparative analysis show that a more rational step of the layout of steel trusses is 3.00 m.

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# **BENEFITS OF USING SOLAR ENERGY TO POWER HOUSES**

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Residential solar power systems offer several benefits to homeowners. Among all the benefits of solar panels, the most important thing is that solar energy is a truly renewable energy source. Undoubtedly, the sun is a powerful energy source, and even though we are not able but to collect a fraction of this energy, harnessing this power by installing solar panels can make a significant difference to the planet. Solar energy will be accessible as long as we have the sun [1]. We cannot run out of solar energy, unlike some of the other sources of energy.

Installing residential solar panels requires a costly investment, but the long-term benefits of a solar energy source for a home outweigh the disadvantages [2].

How much you save on your bill will be dependent on the size of the solar system and your electricity or heat usage, and solar energy systems generally do not require a lot of maintenance. Solar energy sources help you significantly lessen your carbon footprint on the environment [3].

One of the solar energy advantages is that generating power for your home with solar panels does not pollute the atmosphere with harmful greenhouse gas emissions like using traditional energy generation sources. Traditional electricity is sourced from fossil fuels such as coal and natural gas. When fossil fuels are burned to produce electricity, they emit harmful gases that are the primary cause of air pollution and global climate change. Not only are fossil fuels bad for the environment, but they are also a finite resource. Because of this, the price is constantly fluctuating and can increase in a short period of time.

Renewable energy also improves public health. Coal and natural gas plants produce air and water pollution that is harmful to human health. Replacing fossil fuels with renewable energy sources, such as solar power, can reduce premature mortality as well as overall health care costs.

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## **TUNNELS IN TURKEY**

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In Turkey, there are highways, roads, railroads, tunnels, bridges, viaducts etc. Roads in Turkey have been improved by Turkish highway authorities from past to present. The education system also takes care of train engineers and technicians in this direction. Some of the tunnels in Turkey are free while others are charged. The fees are used in the construction of new roads or the development of roads.

In Turkey, there are 5 variations: highway tunnels, road tunnels, railroad tunnels, water and waste water tunnels, prefabricated tunnels. Turkey needs these tunnel types geographically. Turkey is like a bridge geographically. For this reason, Turkey prefers highway tunnels more than other types of tunnels [1].

Cut-and-cover is the oldest method of tunnelling. The basic concept involves the digging of a trench, the construction of a tunnel, and then returning the surface to its original state. As such, it is a disruptive technique, but it is also usually the most economical construction method [2]. For example, Alibeyköy-Cebeci tunnel in Turkey was made using this method. The road length is 3150 meters. There are 2 tubes and each tube has 4 lanes of road.

The drill-and-blast method is still the most typical method for medium to hard rock conditions. It can be applied to a wide range of rock conditions. Some of its features include versatile equipment, fast start-up and relatively low capital cost tied to the equipment. On the other hand, the cyclic nature of the drill-and-blast method requires good work site organization. Blast vibrations and noise also restrict the use of drill-and-blast in urban areas [3].

Turkey has one of the best examples for this method. Its name is Avrasya Tunnel. It passes under the sea. The tunnel boring machine (TBM), called "Yıldırım Bayezid" and carrying out the tunnel excavation ranks 1st in the world with 33.3 kW / m<sup>2</sup> cutter head power, 2nd place with 12 bar design pressure and 6th with a cutter head area of 147.3 m<sup>2</sup>. There are 2 tubes and each tube has 2 lanes of road. The road length is 14600 meters. The road runs from Asia to Europe.

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## **OPTIMIZATION OF THE USE OF COMPOSITE MATERIALS**

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Construction materials develop along with the changes and advances of the civil engineering sector. With the help of cutting-edge technology, construction materials have improved and gained new qualities, e.g., there is a broader spectrum of the intended use of materials, there is a combination of a larger variety of raw materials, new manufacturing methods have emerged, the quality has improved and ways of applications have developed. Composite construction materials and products mark a new trend in technology. They are known to have stable mechanical properties, good thermal and sound insulation qualities, and it is possible to combine many construction materials whilst retaining their individual properties. Composite materials are a great alternative to such traditional materials as metal, wood and reinforced concrete. The manufacturing of composites requires high technological processes and large quantities of raw materials which result in minimal waste. Composite materials are heterophase systems consisting of two or more constituent materials, each retaining their individual properties. Many construction materials, e.g., concrete, reinforced concrete, fiber-reinforced concrete, chipboards, etc., are considered composites. In terms of a broader spectrum, composites are homogeneous materials; however, in terms of a narrower definition, they comprise a heterogeneous system (3). Composite products are widely used in aviation, vehicle industry, war industry, manufacturing of wind turbine housings, various tanks and pipelines; also, for composite structures in ships, various housings, roofing and sports equipment. Modern prefabricated composite structures are especially valued for their durability, cost-efficiency and simple and quick installation at the construction site (1). The key properties of composite materials are high hardness and plasticity, corrosion and chemical resistance, resistance to temperature fluctuations and ultraviolet rays, low thermal conductivity, durability, and a relatively simple manufacturing and maintenance process (2).

Thus, a conclusion can be drawn that composites and composite structures have a broad range of available applications in the market even though their manufacturing requires cutting-edge technology. They are known for versatile physical and mechanical properties and can be used effectively and conveniently to meet the contemporary standards and achieve energy-efficient solutions in construction. Composites are also durable, cost-effective and overall universal construction materials and products.

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# **THE INFLUENCE OF SOIL PROPERTIES ON THE INSTALLATION OF FOUNDATIONS**

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The foundation is very important in the construction of any building and structure. Foundations are used to transfer the loads from the dead weight of the building and also from people and equipment. The type and construction of the foundation depend on the physical and mechanical properties of the soil, the characteristics of the relief, the structural system of the building, and the size and nature of the loads [1]. Before starting construction work, it is important to evaluate all the above factors, because the strength, reliability and durability of the future foundation of the building depend on them. The physical and mechanical properties of soils are manifested when exposed to external loads. As regards soils, their physical and mechanical characteristics may change over time, for example, in the case of a rise in the level of groundwater. It is necessary to consider these processes when designing foundations. When designing the foundation of the building, it is necessary to ensure (provide appropriate measures) that soil under foundations does not get wet or freeze during construction works [2]. It is necessary to assess the level of groundwater under the future foundation. Since this process is accompanied by expansion and deformation of the soil, this can lead to the damage of the entire structure of the house. In order not to face this, insulation should be used that will prevent the soil from freezing. The mass of soil that can withstand the weight of a building with all its actions is called a natural foundation. If the natural foundation is weak and does not withstand the pressure of the building, it is strengthened by installing an artificial foundation [3]. In this case, weak soils are taken away, and a layer of sand or gravel is applied instead. This layer increases the bearing capacity of the soil.

To conclude, it is very important to investigate the features of the site on which the construction of a building is planned. Before starting construction, the condition of the soil and the level of groundwater should be assessed.

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# DETERMINATION OF THE GRANULOMETRIC AND MORPHOLOGICAL COMPOSITION OF THE HEMP SHIVES FOR THE FORMATION OF COMPOSITE MATERIALS

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Nowadays, a lot of industries worldwide are demanding more environmentally friendly material production and use [2,3]. New solutions are in research for the use of waste, by-products generated in the production process, as well as various alternatives for renewable resources.

Due to increasing CO<sub>2</sub> emissions and the resource consumption by several countries, the use of natural materials in construction, such as straw, clay, hemp, flax, is becoming increasingly popular [1]. Plants and their parts can be regenerated and used in various industries such as agriculture, textile production, construction, etc. Therefore, solutions are being sought to optimize the consumption of non-renewable resources.

Calculation modules, simulations and digital images are relatively simple (various calculations), but prevent the manufacturer from quickly selecting the required amount of materials. The implementation of optimization requires additional time to analyze the obtained results of calculation models. By applying two calculation models to one type of concrete, it is possible to obtain different results without common denominators [1]. For more accurate information, specific impact characteristics of the particles are required.

The study used hemp shives to research which parameters are needed to determine the optimization of raw materials and material quality characteristics. It is concluded that delivered hemp shives are dirty, and particles are elliptic with indefinite convexity and without expressed angularity. In literature there are no common guidelines for particle characteristics.

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## **CLASSIFICATION OF CONCRETE**

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The construction industry is using more and more advanced materials which allow the implementation of increasingly complex architectural solutions. Concrete is one of the most widely and frequently used building materials.

Concrete is a mixture of cement and aggregate, made into a paste with water. Aggregates form a substantial volume of concrete, and their properties have a marked effect on the resulting concrete. The mechanical properties of concrete are highly influenced by its density. A denser concrete generally provides higher strength and fewer amount of voids and porosity. The smaller the voids in concrete, the less permeable to water and soluble elements it becomes. Lightweight concretes are composed of light aggregates. The most common lightweight aggregates are clinker and coke breeze, and foamed slag. Lightweight concrete has better thermal insulation and fire resistance properties but greater shrinkage and moisture movement. Dense concretes are composed of heavy aggregates. The most usual heavy aggregate is sand and gravel, and in some districts crushed stone is prominent. [4]

In addition to the principal constituents mentioned above, admixtures are sometimes used to achieve particular properties in concrete. These include: water-reducing admixtures, air entraining agents to improve resistance to freezing and thawing, accelerators to speed up the hardening of wet concrete, and retarders to delay the hardening process. Design of a mix to achieve particular properties like density, strength, durability, permeability in fresh and hardened concrete is an important aspect of concrete technology. [1]

As concrete is one of the oldest materials still in use, over ten billion tons of concrete are produced worldwide each year.[2] Globally, the ready-mix concrete industry is projected to exceed \$600 billion in revenue by 2025. [3] Today, it is indispensable in the development of infrastructure, industry and housing. Without concrete, the built environment would fail to accommodate our modern and demanding lifestyles.

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# STANDARDS DEVELOPED BY THE *BUILDINGSMART* ORGANIZATION TO IMPROVE THE QUALITY OF DESIGN AND CONSTRUCTION IN THE BIM ENVIRONMENT

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Currently, more and more people around the world, such as architects, engineers, contractors and others, are beginning to use and operate in a construction environment called BIM. BIM means “Building Information Model” or “Building Information Modeling”. The BIM concept envisages the construction of a virtual facility which includes detailed information about the building elements before the construction work has physically started, thus providing a broad insight into the potential risks or problems that may arise during construction or operation of the building [1,3,4].

*BuildingSmart* is a global, international, open, non-profit organization that develops a variety of open digital standards, manuals, and other solutions for BIM processes to ensure, improve, and develop the exchange of information between different types of software in the construction industry. [2]

Digital workflows and standards help collaborate and communicate with efficiency at all stages of a project and throughout the construction lifecycle. They help to support the wider use of building information modelling (BIM) [1,3,4].

*BuildingSMART* develops and maintains industry standards such as IFC (*Industry Foundation Classes*), MVD (*Model View Definition*), BCF (*BIM Collaboration Format*), IDM (*Information Delivery Manual*), bSDD (*BuildingSmart Data Dictionary*), which allow the construction industry to benefit from a common language for exporting and importing data with these tools, manuals and standards [2,6].

In order to promote the use of BIM work environment in the construction industry, it is necessary that the software in which specialists work support the implementation of these set standards in their products.

## Purpose of each BuildingSMART standard and tool

Standard	Purpose
IFC - <i>Industry Foundation Classes</i>	Principles for data exchange
IDM - <i>Information Delivery Manual</i>	Data exchange process
BCF - <i>BIM Collaboration Format</i>	Communication in BIM environment
MVD - <i>Model View Definition</i>	Adapt processes to the required technical requirements
Bsdd - <i>buildingSMART Data Dictionary</i>	Mapping of similar terms

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# COMPARATIVE ANALYSIS OF GENERAL BUILDING DISPLACEMENTS

Egidijus Valantinas

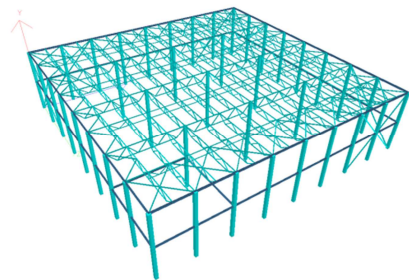
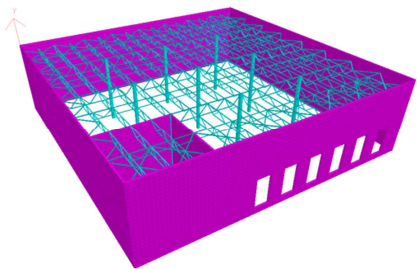
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The design and construction of buildings must be carried out in accordance with the essential requirements of the structures. After estimating dead and live loads, cross sections of load-bearing structures are selected. During modelling, a structure with the structural analysis and design [software STADD Pro CONNECT Edition](#) beam end forces and general displacements of the structure are determined. In this work, a comparative analysis of general displacements between two types of buildings with different exterior load-bearing vertical structures are presented. The first building is with external reinforced concrete tilting walls (Tilt Up technology), and the second building is with external reinforced concrete columns. The roof structures consist of steel trusses, beams and braces. The total area of the building is 1 971,36 m<sup>2</sup>, the height of the building is 11 m.

Tilt Up Technology is a job-site form of precast concrete construction. Concrete wall panels are poured in a construction site on a flat prepared base using formwork. When the concrete reaches its structural strength, wall panels crane are lifted and placed in the designed position using a mobile crane. After panels are positioned, they are temporarily braced until panels are tied into roof and floor system and become integral part of the completed structure. After analysis, the maximum horizontal displacement of the structure in the direction X is 15,62 mm, Z is 9,15 mm and in direction Y is 35,2 mm. Total weight of steel structures is 26,1 t. Steel grade S355 [1].



In the building with reinforced concrete columns, external columns are spaced every 5,5 m. Horizontal steel braces are modelled between columns for attaching sandwich panels and diagonal steel braces to reduce horizontal displacements of the building. Precast columns are transported to the construction site directly from the factory. Columns are placed in the designed position with a crane and then fastened with anchor bolts to foundations. After analysis of the maximum horizontal displacement of the structure, in the direction X it is 16,94 mm, in direction Z - 10,47 mm, and in direction Y is

35,8mm. The total weight of steel structures is 39,2 t. Steel grade S355 [2].

In conclusion, a model with external reinforced concrete tilting walls showed smaller general displacements and smaller required amount of steel than the model with reinforced concrete columns. The difference between displacements in the direction X and Z is 1,32 mm, Y- 0,6 mm. The difference between the required amount of steel is 13,1 t. All calculations were performed in accordance with Lithuanian Construction Technical Regulations.

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## **SOCIAL SCIENCES**

# TRENDS AND ANALYSIS OF BREAD INDUSTRY IN LATVIA

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Rye bread is a national Latvian food. Bread is included into the canon of the National Cultural Heritage of Latvia. The bread in Latvian traditional culture is valued as a sacred object, and some traditions and behaviours can be observed nowadays as well; for example, it is unacceptable to drop bread on the ground. If it happens, it is a custom to ask forgiveness to a fallen piece of bread or to kiss it [1].

In a discussion organized by the company “Hanzas maiznīca” in 2017, experts from fields of rye grain agriculture, bread baking and medicine discussed changing taste habits of people, the role of rye bread nowadays and in the future, and integrating rye bread as part of a healthy lifestyle [4]. The amount of produced bread in Latvia decreased from 90 thousand tons in 2010 to 75.5 thousand tons in 2019, thus by 16%. The biggest decrease in tons of bread produced was from 2015 to 2016, the amount decreasing by 4.6%. The trend of a constant decrease in bread production in Latvia was influenced by the fact that the population had been reducing every year, more substitute goods (rice cakes, corn cakes etc.) had appeared in the industry and trends of what was considered a healthy diet had changed [2]. Despite trends in produced amounts, the value of the bread market is growing. It emphasizes that consumers more often choose bread that has better energy value and raw materials with a higher quality instead of cheaper bread. Beneficiaries of this aspect are companies that concentrate on the added value and use their ancestors' methods in baking bread instead of the companies that are mass producers. The ordinary white bread will face a downfall in its amount produced, but burger buns and portioned bread due to the rapid pace of our time and the zero waste trends will become more popular because smaller portions can be eaten fresh and there is less food waste [5]. The research results in 2015 showed that the most important factors to Latvian students for choosing bread are taste, expiry dates, aroma, price and e-preservatives [3]. The bread industry is at the stage that requires companies to think innovatively and please a customer in order to maintain their revenues, mostly by being aware of the zero waste movement and other environment friendly trends that currently are and in the future will be important, as well as added value of their products.

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# ASSESSMENT OF PEOPLE'S HEALTH SAFETY DURING THE COVID-19 PANDEMIC

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Since the end of 2019, there have been significant changes around the world, and these changes have had an impact on society as a whole. The pandemic has exacerbated emotions, made the public opinion even more diverse and increased people's attention to the state of their health. The aim of the study was to clarify how people assess their health safety during the COVID-19 pandemic. The task of the study was to find out how people feel about their health safety in the conditions of the COVID-19 pandemic.

The results of the study "Characterization of Home Working Population during COVID-19 Emergency: a Cross-Sectional Analysis" [1] were analysed to find out exactly how people's mental and physical health status has changed. The impact on people's mental health state was examined. Regarding occupational stress, no significant change occurred in mobile employees, considering that 39.2% of participants declared a reduced stress level since they worked remotely, 27.5% reported an unchanged level, and one-third of respondents experienced increased stress. On the contrary, in the research conducted by the International Labour Organization and Eurofound found that about 41% of home workers declared that they felt stressed compared with 25% of their colleagues who worked in the office. The study found that stress levels in people did not increase while working from home during the COVID-19 pandemic [1].

According to the Organisation for Economic Cooperation and Development (OECD), Latvia has a significant shortage of human resources working in medicine which has developed over numerous years. The number of nurses is almost half of the OECD average (4.6 per 1000 versus 8.8), the number of nurses since 2010 has decreased, and the nurse-to-population ratio is currently one of the lowest among OECD countries (1.4 nurses per doctor in 2016). It was concluded that the real situation in the medical sector is critical because in the circumstances of necessity, due to lack of personnel, it is not possible to provide full-fledged health care [2].

In cooperation with the rural partnership "Lielupe", within the project "Increasing Participation and Civic Activity in Jelgava and Ozolnieki Counties", from November 15, 2020 - March 31, 2021, a survey was conducted in the territory of Jelgava and Ozolnieki county. The main tasks of the survey were to assess the quality of life and participation opportunities in the development of their parish and county. 5.6% of residents in Jelgava and Ozolnieki parishes participated in this survey. The question "Assess your and those closest to you level of security in the neighbourhood of your place of residence: health safety rating" was chosen from the survey. In response to this question, out of 1,855 respondents 73.9% answered that they were satisfied, the satisfaction for 21.1% was mediocre, and 5% considered the level of safety as weak. From this we can conclude that the level of health safety in Jelgava and Ozolnieki districts was rated as good, but judging from personal experience, when administering the survey among residents, caution and care about their health was observed. Residents did not feel safe enough when in contact with an unfamiliar person. It is described as a logical response to maintaining one's own health safety - health promotion. As the Centre for Disease Prevention and Control informs, health promotion is a process that creates an opportunity for every person to strengthen control over their health by improving well-being and quality of life in general.

To sum up, during the COVID-19 pandemic, people feel safe about their health. Stress levels have decreased when working from home. The biggest problem is the lack of medical personnel, but among the public this factor does not affect people's assessment of the sense of health safety at their place of residence, because everyone is responsible for their own health, and the COVID-19 pandemic cannot be considered as a major factor in reducing the level of people's health safety.

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# OSTRICH FARMING IN LATVIA

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The ostrich or ostrich of Africa (*Struthio camelus*) is a large-sized bird with no ability to fly. It is a rare thing to meet ostriches in the wild. The main reason for their decreased population in the wild is ostrich hunting [2].

Ostrich farming as a business started in Africa in Karoo semi-desert and Eastern-horn south area around 1860. After five years the first “ostrich-counting” was held, and there were 80 ostriches which were tamed to be poultry. After 10 years, there were already 32,247 ostriches in South Africa. After decades, only the strongest and most suitable for breeding birds were left, and nowadays these ancestors of ostriches make up the new population throughout the whole world [3]. Around the year 1868-1869, the first ostriches were brought to Australia by locals. One of the most important ostrich herds in Australia was the “Yanco herd” (90 birds). In 1914 there was a huge fall in the number of ostriches in Australia due to different priorities for farmers [3]. Germany has concluded that most valuable aspect in ostrich farming is welfare of birds, and this only can be done by extensive farming [5]. Poland also should be mentioned in a positive way – they have developed agrotourism by raising ostriches [1].

Around the year 1997, farmers in Latvia showed interested in ostrich breeding and farming. The first birds arrived in 1998 [7]. There were few aspects that restrained local farmers from this type of farming, e.g., there were no special slaughterhouses for ostriches and there was no demand for ostrich meat as well [6]. The situation changed around 2003 when more farmers turned to ostrich farming. The economic crisis in 2008 changed the situation. After the crisis the situation improved, and in 2016 there were 18 farms (225 ostriches). Two unions and one association for ostrich farmers have been founded since 1998, but none of them are active now [4]. There are 19 farms and 174 ostriches in 2021, and an average number of ostriches are 9.2 birds per farm. The largest ostrich farm is in Kuldīga parish, called “Nornieki”, Ltd. Most of the farmers offer the same type of products to clients, which is why competition is strong, and innovations are required to keep business running. The main advantage is the bird itself – it has feathers, leather, eggs, meat, but only a few farmers remember the aspect of agrotourism. It is a completely new industry for Latvia; therefore, sharing experience is a very valuable aspect in this type of business.

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# **INFLUENCER MARKETING: DO WE TRUST INFLUENCERS MORE THAN WE TRUST THE COMPANY?**

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With the rise of the Internet and social media, new ways of communicating customer value have emerged. Companies can choose to own digital media tools (such as a website, their Facebook page and others) or use paid digital media (e.g., paid ads, apps, influencers). An increasing number of companies invest in influencer marketing, as this innovative marketing strategy brings higher engagement and return on marketing investment [1]. Influencer marketing uses an influencer to convey marketing and communication messages on behalf of corporations and brands. The terms "influencer" can be defined as the power to affect a person, thing, course of events. Influencer marketing is a new strategy that is increasingly adopted by companies [2]. It is a form of marketing that focuses on targeting key leaders like celebrities with followers to drive the brand, and most significantly, they can share thoughts and feelings, create and curate any online content that allows developing a unique persona on social media [2]. Influencers are present on social media, and their actions are carried out on social platforms, e.g. Facebook, Snapchat, Instagram and others.

Interest in influencer marketing is growing because the influencers use companies' products and services and tell about them to groups of followers, increasing brand awareness and contributing to product or service use [2]. Working with influencers allows companies to reach millions of consumers that the company would not reach otherwise.

The literature studies of previous empirical work show that a growing trend to believe and trust in influencer content more than company-created content is observed amongst consumers [1, 2, 3]. Moreover, studies found that followers are especially interested in content created by influencers that do not have a commercial orientation; instead, it is informative, as the commercial orientation has a strong negative effect on how it is perceived [1]. The influencers' credibility and seeing them as a "great big sister" [2], as well as the attachment with the influencer [3], is what builds trust and purchase intention of the products and services amongst the followers.

In conclusion, influencer marketing is a growing trend among companies, increasing awareness, visibility, and higher sales. However, companies need to pay attention to influencer selection because only those perceived credible and who develop an attachment with followers can ensure positive outcomes.

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## COOPERATION IN VOCATIONAL EDUCATION INSTITUTIONS IN ATTAINING OBJECTIVES OF AN ORGANISATION

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An organization operates to achieve objectives. By understanding the importance of cooperation in attaining the objectives, the organization can achieve better results, and this is important for Latvia. Vocational education institutions' (VET) prestige is not high among youngsters due to some stereotypes. The research goal was to explore cooperation between the administration and teachers to achieve the objectives of VET and develop proposals to improve it. The research was carried out in Latvia and Finland. Finland implemented the reform in VET in 2018. In the research, the authors have explored how Finland understands cooperation and what the key to a successful education system is.

Cooperation is described in three levels – coordination, cooperation, collaboration. In achieving the highest collaboration level, there are some obstacles and reasons why administration and teachers cannot reach it. The following hypothesis was proposed: ensuring the highest level of cooperation between the administration and educators in VET has limited resources. The authors analysed the Social Exchange Theory (George Homan) which is based on economic principles which affect people's behaviour. A rational choice is one of the main processes to research the cooperation between the administration and teachers in the process to achieve the goals of the organization.

Based on the definitions, we identified three interactional dimensions that are present to different extents in collaboration, coordination, and cooperation: attitude, behaviour and outcome [1]. The authors can relate that to the Social Exchange Theory which shows indicators for qualitative cooperation and the result which is the objective of organization.

To better comprehend – and ultimately promote – cooperation among teachers, conditions of successful cooperation, such as voluntariness, shared objectives, and trust, have been identified [2]. Based on the understanding that teachers are the main resource of education, Finland has obtained a status of prestige for the profession and a general trust from public. In Latvia it is still debateable whether a teacher is a prestigious profession and whether there is trust from administration and public which is crucially needed to achieve objectives of the education system. In the research the authors explored opinions of administration and teachers on the cooperation issue and found indicators of qualitative cooperation. In the research document, analysis of Finland's education system was carried out and the main differences between education systems of Latvia and Finland were described.

VET administration and teachers are working in cooperation which is the main resource to implement qualitative vocational education, but some improvements need to be made in order to achieve higher attractiveness to VET.

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## URBAN GROWTH THEORIES

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Living in urban areas may provide opportunities to residents in many areas such as labour market, such as having more job opportunities, social aspects, for example, higher incomes and accessible services, and businesses, such as lower input costs, innovation and collaboration opportunities. But living in these areas bring challenges, as the urban territory causes overcrowding, pollution and depletion of resources. The aim of this research was to explore urban area development stages in relation to urban growth theories and to study how human behavior changes when the level of urbanization increases. Historically, urban growth theories were more based on urban planning and site analysis, where the focus was on urban spatial planning, geographical urban placement and spatial planning. Today, urban growth theories and models, along with the increase in urbanization, are more based on studying population behavior in a given environment, as well as analyzing how the concentration of different sectors impacts people's behavior, how population habits and behavior change, increasing levels of urbanization. The most common theories about urban growth development are the theory of the central space, the theory of growth poles and the centre-left model. By combining the models and theories of all the above areas, it can be concluded that, overall, urban development and growth can be described by similar scenario in all of these three models - rural areas being developed at first. As areas develop, agricultural society slowly transforms into city-type society, as the need of regional centre becomes more evident. The establishment of a regional centre contributes to the migration of the population living in rural areas to the development centre, which forms as the main city of the region. Excessive population flow to the centre in time leads to overpopulation and overconcentration of businesses, which extends the boundaries of urban territory and increases the possibility that neighboring smaller areas will attract migrant populations from rural areas and create new, smaller central points, leading to the formation of agglomerations [1].

The expanded model of the P.Krugman centre - peripheral explains the reasons for the formation of agglomerations as more specific and determines that the cost of resources and their mobility is the most important driver of formation of agglomerations. However, the emergence of agglomerations is also explained by the authors H.Armstrong and J.Teilor, stating that the agglomerations are not only caused by a single resource mobilization, but also by the intensity of economic transactions and their concentration in one area [2].

Since their inception, theories of urban growth have developed into an interdisciplinary research and science field, which has changed from analyzing one influencing factor or a trade network, into complex models and system research.

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## **PERSONNEL MANAGEMENT IN WOOD PROCESSING COMPANY**

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Personnel management could be compared with art and science: from the point of view of art, it is an opportunity to lead people using various innovative, individual and creative approaches [1]. Personnel management is cooperation between the company's employees with the aim of ensuring efficient functioning, satisfying the interests of employees and supporting the individual needs of each employee [2]. Personnel management includes planning and selection, people selection, career, including growth, development and training, remuneration, the motivation system, bonus system, analysis and feedback, performance appraisal. According to theorists, a variety of methods are needed to assess staff [3].

The research problem focuses on the human resource management as a critical function of the organization and the workforce as one of the most important assets for achieving the goals of the organization. The subject of the research is related to the sector in which the company "SELVO" operates. The company produces qualitative furniture from pine: furniture for bedrooms, living rooms, corridors and children's rooms. The company exports its products to Germany, Finland, Italy and England. Wood residues appear as a result of processing of wood during the production process; therefore, fuel briquettes are made from them. In 2019, the company had 172 employees. The company has faced a problem of finding employees for the last five years; changes in the flow of employees have been observed in the company. The largest decrease in the number of employees took place in 2015. The largest increase in the number of employees was observed in 2016 and 2018, when the company increased its production capacity. It was necessary to recruit new staff, which was problematic due to the limited number of qualified staff available. The vacancies were completed, but the employees lacked knowledge of production technology processes. The company's turnover has grown since 2015 — there have been slight differences in the annual growth rate fluctuating between 4 and 6% by 2018. Comparing the increase in revenue in 2019 compared to 2015, the increase was 26%, which is 5.2% on average in the analysed period. The increase in the company turnover was related to the increase in the total number of employees; the more employees, the more ordered products were produced. The study found that the company's employees needed to improve their professional knowledge directly in the production premises. Although part of the company finances was directed to the professional development of employees, according to the employee survey and process research, quality deficiencies could be identified in the production process for some of the products, which indicated the need for professional development. Personnel management is an important point for every structure of the company, thus the professionalism of employees and the provision of the required number affect the financial indicators of companies. It is necessary to increase the number of personnel management employees, which would allow more efficient management of the company's main assets – the personnel.

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# LABOR TAX BURDEN IN LATVIA

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In Latvia, the tax burden on labour is particularly high because tax rates are significantly above the EU average, reducing the competitiveness of companies from Latvia and creating additional incentives for labour outflows. The Latvian tax system shows a disproportion of tax rates, which creates opportunities to avoid paying taxes, reducing economic efficiency and deteriorating the business environment. Moreover, the administration of the tax system is complicated and changes are often announced making business planning difficult and creating taxpayers' dissatisfaction, as well as a desire to avoid paying taxes [1].

Since 2018, the personal income tax policy in Latvia has changed by introducing the progressive tax rate. The rate of 20% is applied to salaries up to 20,004 EUR per year, but if the salary exceeds this amount, then the rate is 23%. In addition, a differentiated non-taxable minimum has been introduced with the aim of reducing income inequality in the country.

The above changes have been favorable for small-wage earners ranging from 430 EUR to 1,000 EUR per month for persons without children. On the other hand, as regards income above 1,000 EUR, the tax burden has decreased minimally. In Latvia, the tax burden on labour is lower for persons with children. For example, the average labour tax burden is 36.6% for an employee with two children with a gross salary of 1,000-2,000 EUR, while it is 42.5% for employees without children, which is by 5.9 percentage points (pp) higher. In 2019 the labour tax burden for employees receiving the average wage in Latvia was 42.5%, which is by 11.0 pp more than the EU average, where the labour tax burden was 31.5%, and by 5.3 pp higher than in Lithuania and Estonia, where labour taxes the burden was 37.2%, while the amount of tax charged against GDP in Latvia is lower than in neighboring countries [2].

In 2019 for an employee without children with an average salary in Latvia, income taxes represented 14.3% of the labour tax burden, the employee's social contributions accounted for 8.9% and employer's social contributions - 19.4% [3]. In Latvia, employees have a significantly higher income tax burden, and employers have a significant social contribution burden that prevents employers from recruiting new employees; therefore, a reduction in labour taxes could increase the demand for labour.

Several EU member states have taken various measures to reduce the tax burden, such as lowering the social contribution rate, lowering the personal income tax rate, establishing stricter rules for self-employed contributions, raising the minimum wages and other measures that have a positive impact on employment and increases national productivity and competitiveness [4].

In order to reduce the labor tax burden on income to EUR 2,000 in Latvia, the Ministry of Finance should encourage a gradual and regular increase in the income threshold to which the differentiated non-taxable minimum applies, as well as to increase the income threshold by which the 20% tax rate applies.

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## FACTFULNESS RELEVANCE TODAY

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In the 21st century, which is considered to be an information epoch, there is a devastating ignorance in society that can be averted by renewing people's knowledge of the world. Factfulness means the ability to build a fact-based worldview that teaches careful comparison of averages, to understand that negative news spreads more and faster than positive. Factfulness is an ability to recognize erroneous trends, compare data, make overall sense of situations, and regularly update the knowledge of the world [1].

According to the survey, only 37% of respondents are aware of the United Nations projections that the world's population will increase to 9.7 billion by 2050, and to 11 billion in 2100, which already today highlight possible shortages of food, drinking water and other natural resources in the future [2].

It is important to understand human resource development trends in the world. As scientists emphasize, global population growth is causing social and environmental crises, but public attention is focused on demographic aging, which suggests that population growth should be stimulated, but the challenges of aging are exaggerated and efforts to avoid aging by promoting births or immigration are relatively ineffective [3].

In today's society, a significant increase in birth rate is not possible as more and more people in the world are increasing their income level which will lift them out of extreme poverty.

The share of the population at risk of poverty or social exclusion in Latvia in 2018, compared to the indicators of the European Union member states, was 28.4%, which is 16.2 percentage points higher than in the Czech Republic, where the situation is more favourable. The authors analysed the changes in the proportion of the population at risk of poverty and social exclusion in Latvia in 2010–2019 and concluded that since 2011 the situation has improved, and there has been a gradual decline to 27.3% in 2019, which is 12.8 percentage points less than in 2011 [4].

In low-income countries, children are one of the main resources of the workforce; however, child labour has a negative impact on reducing global poverty and expanding education. Child labour contributes to the cyclical intergenerational poverty trap, which requires an advancement of comprehensive development and strategic plans based on more research and more data. There are various problems and shortcomings in the world, but people may not notice future opportunities and significant threats if the worldview is not based on facts.

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# **COMPETITIVENESS ASSESSMENT AND DEVELOPMENT PROSPECTS FOR LAT EKO FOOD LTD**

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In a contemporary economic situation, a company, regardless of its size, constantly operates in a competitive environment that exists at an international, national, industry or company level. In the context of global competition, the factors for business success are a set of value-creating and specific resources or activities, providing uniqueness or competitive advantage which can be maintained in the long term [1].

Michael Porter, a professor at Harvard University, has written that companies, not countries, within international markets are competitors [2]. The authors of this paper agree with Michael Porter, but it should be emphasized that a company's competitiveness is significantly affected by the competitiveness of the industry, which directly depends on the competitiveness of the country. Competitiveness levels interact with each other, so they cannot be strictly separated, and when assessing the company's competitiveness, the analysis must also include factors influencing the macro-environment.

The company's competitiveness is based on the company's resources and skills, so they must implement strategic activities that increase their competitive advantage over competitors, but their creation requires knowledge of the local competition. Strategic activities must be planned and should be flexible in order to achieve high efficiency by interacting with competition in the market therefore the aim of this research is to assess the competitiveness of Lat Eko Food Ltd and to expand development perspectives [3].

Lat Eko Food Ltd operates in the food production sector. In 2018 there were more than a thousand companies, creating 1.7 million euro turnover, which is by 3.3% more than a year before [4].

In 2016-2018, the company's Lat Eko Food Ltd return on assets, which is an important indicator of competitiveness, increased by 0.10 percentage points. In fact, during this period, it was consistently higher than the return on assets of the industry and the state's median.

Competitiveness assessment of the organic baby food industry according to McKinsey's methods unit is measured at coefficient 3.40, but the competitiveness of Lat Eko Food Ltd business unit was evaluated 3.70, which means that in the future it is necessary to maintain or increase the market share and invest in the research to be able to offer new recipes with innovative packaging to consumers. Lat Eko Food Ltd has to develop competitive advantage potential of experience, quality, brand and recipes to ensure the continuous advancement of the company and increased competitiveness.

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# **CIRCULAR CUMULATIVE CAUSATION THEORY IN CONTEX OF REGIONAL DEVELOPMENT**

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Circular cumulative causation is a theory developed by Swedish economist Gunnar Myrdal more than 60 years ago, and it continues to be a powerful tool to describe and clarify regional growth and development. The main idea of the theory states that a change in one variable will lead to successive changes in other variables. These changes continue in a cycle many times and they persist in each cycle stronger than in a previous one. The aim of the study is to evaluate the impact of cumulative causation theory on the understanding of economic growth processes in the context of regional development and to try to determine the relevance of the theory in the 21st century.

According to Myrdal, traditional economic theory ignores non-economic factors and leaves them outside the analyses. These non-economic factors like social context and traditions are among the main boosters for circular causation in the cumulative processes of economic change. This ignorance represents one of the main shortcomings of traditional economic theory [1]. The fast development of various economic schools and theoretical models in the last decades facilitated some non-economic dimension in the process of analyses of regional development issues in developing countries across the globe.

Another contradiction with a traditional approach to economic analysis is an argument that the spread of wealth from development centres to the rest of a region or country is weaker than the polarization effect which contradicts not only to the theory of international trade, but also broader traditional beliefs especially in a neoclassical value system [2]. The failure of economic growth and development in African countries or chronic problems with economic stagnation in parts of Latin America indicate shortcomings of the free trade model which must be favourable for all included parties.

According to cumulative causation theory, economic growth is based on industrialization. There is a strong association across countries between the level of per capita income and share of industry in gross domestic product output [3]. The rise of the services sector in developed economies challenges this central argument of the theory. At the same time, it leads to discussion on methodology of new emerging services and products if it is a new form of industry or some kind of service.

The new approach in circular cumulative causation theory must be developed to coincide with new complex economic phenomena like social trading, block chains, mining of crypto currencies, funding platforms and other possible new economic growth mechanisms in the global and regional perspective.

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# **SURVEILLANCE CAPITALISM: THEORETICAL ANALYSIS**

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The first decade of the 21st century has brought new, unprecedented technological opportunities to connect everything and everyone. This creates not only an extensive amount of data but also an unprecedented interference with people's privacy. Zuboff believes that this new economic order claims human experience as free raw material for hidden commercial practices of extraction, prediction, and sales [1]. She calls it “surveillance capitalism”.

Zuboff's "The Age of Surveillance Capitalism" fits organically into the family of other modern sociological theories. In essence, it is a sociological analysis of the modern digital age. Its formation has been influenced by classical teachings on capitalism, the works of Karl Marx and Max Weber, as well as sociological theories of the surveillance society. Understanding surveillance capitalism is impossible without understanding capitalism, rationalization, surveillance theories, "big data" phenomenon, and privacy.

First, surveillance capitalism is capitalism, at least to some degree. It accumulates information, money, and power. Marx identified power with the ownership of the means of production. In surveillance capitalism, it is identified with ownership of the means of behavioural modification.

Second, all internet firms that Zuboff labels as "surveillance capitalists" are highly rationalized bureaucratic organizations, the XXI century's bureaucratic ideal type, so to say. Google (Alphabet Inc.), Facebook, or Amazon check all the boxes of Weber's theory. They explore the advantages of technology to eliminate human error and maximize their profits. Their management is based purely on merit and exclusive knowledge.

Third, like all surveillance theories, surveillance capitalism is partially based on Jeremy Bentham's panopticon concept. However, what distinguishes surveillance capitalism from theories about surveillance society is that surveillance is made to make a profit. Also, individuals' behaviour is modified so that it is more predictable for the same reason. The more accurate forecasts are, the greater the profit is.

Fourth, while it is possible to imagine big data without surveillance capitalism, surveillance capitalism would not be possible without big data. Today, a significant portion of big data consists of people's personal data and their experiences. Constantiou and Jannis call it everydayness data [2]. As a result, Google knows a lot more about its users than they know about themselves.

Moreover, finally, surveillance capitalism could be impossible without ubiquitous surveillance and free data surplus. People have always valued privacy. Therefore, it is almost beyond understandable how surveillance becomes tolerated and even widely accepted when a couple of startups from California started doing it on a massive scale. When surveillance capitalists persuade members of society to give up their privacy for the sake of convenience, they benefit from the phenomenon called the “Privacy paradox.”

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# THE NEW FUTURE OF LABOUR IN LIGHT OF RECENT PARADIGM SHIFTS

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In recent years, western industrialized nations have experienced a constant flux of disturbances in the political, social and economic spheres, which in turn have helped reassert the important role social science has in the research for answers these issues can generate, specifically in relation to the topic of the labour market and its general outlook over the next decade. Therefore, the main purpose of this article will be to collect and analyze the available data, develop a conceptual framework and finally derive a hypothesis.

In the world at large there has been a major shift from traditional workplaces to digital platforms, in part due to current public health policies placed in response to the COVID-19 pandemic, but not exclusively as a result of it [1]. In reality, this is a transformation that has progressively been taking place, the growing share of NSE (non-standard forms of employment) demonstrates that workers have been casualized globally for the last decades.

The first question asked regarding the future of work is whether technology and machines would displace people from the workplace. Less focus has been placed in the types of jobs that will be created. The rising types of work in digital platforms, crowd-work and on-demand work share several features with other NSEs. Platform workers are mainly hired as independent contractors who are supervised as employees (disguised employment) operate in a trilateral relationship with the platform and the requester of work (multi-party employment), or engage in short-timed fragmented gigs (temporary employment).

The other aspect to be considered is that automation will be displacing manual labour to a high degree [2]. One of the most influential predictions was published by Oxford University, concluding that up to 47% of jobs are susceptible to computerization within the next 13 years. Elsewhere, researchers have developed enhanced methods of research for the prognosis in other countries; with Bughin et al. (2018) estimating that there will be a 25% decrease in total hours worked using manual and basic cognitive skills in Western Europe.

Overall, we need to consider that the mentioned statistics estimated insofar as the experts were able to discern with a pre-pandemic outlook. COVID-19 has accelerated the rate at which these changes are occurring by creating incentives for corporations and individuals alike to automate and seek digital work in order to maintain production for the former and employment for the latter. Therefore, we need to determine not only for how many jobs will be replaced or destroyed, but total net job losses, as those impacts are simultaneously balanced by new forms of employment that technology will also create. Given these points, we can see that the current trend is heading towards casualization, thereby it can be argued that companies have primarily adapted their services to the convenience of customers' needs at the expense of employees' preferences which can have the consequence of lower quality of work.

Lastly, future economies must embrace the emerging technological framework in a way that ensures the freedom, health and well-being of people.

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# **CIVIC ENGAGEMENT IN JELGAVAS COUNTY AND OZOLNIEKI MUNICIPALITIES**

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Civic engagement is a fundamental principle of democracy. It involves various activities for the benefit of society, the protection of interests, and the interaction between citizens and local government to make the decision-making process more efficient, thus improving the quality of life of citizens. The current study explores the civic activity of the population in Jelgava and Ozolnieki counties, depending on the level of education of the population.

Salter, Kuemmerling, Bond and Sabates [3] emphasizes the role of education and evaluate the link between the level of education and civic participation. They note that people who have vocational or higher level of education are more interested in politics and are more likely to vote than their peers who have left education. According to the survey, active citizens with the primary education, secondary education and students have been involved in at least one activity of major importance for society in the last three years, while people with vocational education – in two, but with higher education – in at least three activities.

The link between the level of education of the population and in which important activities for society they participate was studied by A. J. Perrin and A. Gillis [1]. The analysis of the most common activities in Jelgava and Ozolnieki municipalities in each group of society shows that people, regardless of the level of education, first chose to participate in municipal elections – this activity was marked by 17% of the population with primary education, 31% of the population with secondary education, 25% of residents with the vocational education, and by one-fifth of the university graduates and students. Secondly, communication with the municipal employees was chosen; in this way, issues were solved by on average 15% of the population in all groups of society except students. Thirdly, in practically all groups of the population, 12% of respondents considered that voting for topical issues on the Internet was a related form of civic participation.

Public participation is critical not only for municipalities but also for national development, as it contributes to the mutual trust and trust of citizens in public institutions, and it is the instrument by which citizens can deal with important issues. The increasing level of education of the population increases their civic participation, as it was demonstrated by the high proportion of inactivity in the population with the primary education and by a relatively lower proportion of inactivity in the group with secondary and higher education. Generally, regardless of the level of education, most of the population participates in municipal elections, contacts local government employees, and takes part in the Internet votes.

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# **PROFESSIONAL QUALITY OF LIFE IN LATVIA: EXAMPLE OF LATVIA UNIVERSITY OF LIFE SCIENCES AND TECHNOLOGIES**

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Due to the constraints of the pandemic situation, the normal course of life has changed. Professional quality of life (PQL) has also been affected. PQL is widely used in medical research, but in other fields such research is less well presented. The study aims to investigate PQL in Latvia University of Life Sciences and Technologies (LLU).

PQL is a multidimensional concept whose definitions vary depending on professional sectors. Studies to date have highlighted an importance of individual's assessment of working conditions. The definition is defined as working conditions and their assessment, where the individual is the basic resource to define PQL [1]. To better evaluate PQL, it is advised to use both external (remuneration, work environment, workplace, equipment) and internal (career development, work relations, autonomy) factors.

The survey was carried out from 10 – 28 March, 2021; the survey sample was n=292 out of 1,115 people working in LLU. The current study hypotheses are the following:

- 1) PQL for different personnel groups in the LLU consists of different parameters;
- 2) work and family balance has different levels for the academic and scientific staff, science support and administrative staff, science technical staff;
- 3) engagement in work has different levels for the academic and scientific staff, science support and administrative staff, science technical staff.
- 4) satisfaction has no difference for the academic and scientific staff, science support and administrative staff, science technical staff;

To sum up, PQL parameters are equally important for all staff; however, results differ for each group of personnel. The obtained results support the second and third hypotheses. The fourth hypothesis shows that there are also differences between personnel groups.

Regarding external and internal factors of PQL, the most satisfied was the science support and administrative staff, while academic, scientific staff and technical staff admitted being less satisfied. Academic and science staff felt that work/life balance possibilities were missing, as they were more engaged into work than other groups. Science technical staff has the lowest PQL according to their assessment of external and internal factors. This personnel group considered that they lacked better communication within the organisation overall and had rather slow growth opportunities.

To better understand the areas for improvement, PQL must be assessed for each group separately, as the overall evaluation could be misleading. Thus, the research emphasizes that it is crucial to consider the specific characters of different groups of employees.

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# **CULTURAL EVENTS AND SOCIAL INNOVATION: COMMUNITY BASED ACTION RESEARCH**

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Affected by many social and economic processes, the form of cultural events has experienced remarkable transformation in the past century. The 21<sup>st</sup> century is dominated by consumer society contrary to a society as initiators of ideas; thus, the forms of events have become homogeneous complying with trends of globalisation. At a time when economic resources decrease, culture is becoming a “central axis” for a place’s development. Therefore, it is necessary to consider the approaches for how culture can support the development of rural areas and boost capacity of small communities of Latvia. The research has the following objective: to study the process of developing innovative cultural events in cooperation with the communities of Saldus and Brocēni municipalities.

At the core of the action research there were focus groups of 18 communities that initiated the social innovation process in interaction with the first author. The research was carried out in the time period of 6 months within State Research Programme “Development of a sustainable and cohesive Latvian society: solutions to the challenges of demography and migration (DemoMig)”.

During the action research the communities formed working groups, analysed the current situation (events, visitor profiles), developed innovative event forms and participated in remote focus group interviews, thereby contributing to the active involvement of citizens in building up community capacity.

During the action research, the authors analysed the progress of social innovation in communities; composition of working groups and its members, the feedback from the project’s launching and closing phases [1]; analysed the fresh forms of events (size, type, interaction with visitors); studied the features of social innovation while maintaining close cooperation with the community’s work group [2]. The research showed that it is crucial for community groups to apply the bottom-up decision-making method at all stages when implementing the social innovation. This method contributed more effectively to the process of developing new events. Systematic cooperation and interaction between citizens can ensure the continuity of cultural processes in a community. The cooperation between municipality and community (both in terms of logistical and financial support) is a valuable aspect; it is an incentive and an opportunity to develop innovative forms of events to a wider extent.

Material benefits resulting from the research are as follows: the developed innovative cultural events will be implemented during the summer months of 2021. The research process will proceed as one of the authors is interested in community’s capacity to implement the innovative event. The follow-up to all events will evaluate the implementation of social innovation and analyse the self-assessments of community working group.

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# INTRODUCTION OF COMPETENCY-BASED APPROACH IN THE CURRICULUM: THE EXAMPLE OF OZOLNIEKI COUNTY SCHOOLS

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Changes in people's lives happen constantly because the modern pace is very volatile and constantly changing. We live in the time of globalization, characterised by the fast IT development and a change of values. The education system must also be able to adapt to various life conditions; it must be modern. The National Centre for Education of the Republic of Latvia has been implementing the project "Competency-based approach in curriculum", also known as "School 2030" since 17th of October, 2016. The aim of this research was to analyze Ozolnieki county teachers' attitudes and experiences about the implementation of the competency-based approach in curricula.

To increase the quality of education, there is a need for a different education policy. A variety of measures such as expenses, infrastructure, plan of education, textbooks, school management, teacher training, involvement of parents, student assessment and others must be taken into consideration. Improvements can help to increase the quality of education, and the reform program has to unite all of these elements [3]. The project "School 2030" was launched with the aim to do that.

To increase the options for human development, we need freedom, which is being given to people, so that they could truly develop their potential. According to the human development perspective, a gradual civil, political, economic, social, cultural and environmental respect of rights must be in place. They are crucial for social life to be fairer and more equal in the 21st century. An education that is oriented to human development is based on the potential of people [2]. The aim of a competency-based approach is to develop the potential of every student in addition to developing skills for everyday life. A competency-based approach promotes changes to the education system, where a teaching staff's resistance is emerging. In the process of changes, the school administration has a huge influence on the success of managing the changes. The better the management, the smaller the resistance from the teachers to the change. Barriers for change or the reason of resistance can be personal, organizational and specific to a change [3]. These resistance factors can be diminished if a school has developed a good communication system and teacher motivation system. It is harder for the management to influence a specific change's reasons of resistance, because they are dependent on the "School 2030" project implementation. The authors conducted a survey of Ozolnieki county teachers regarding the changes in education, and their attitude towards the changes and difficulties in implementing a competency-based approach. The survey results show that the biggest interference was made by personal reasons (the increase of the amount of work and lack of remuneration) and two specific changes (remote work and the lack of information about the changes) as resistance factors. Also, the teachers admitted that the hardest task was to find the potential of every student, which was a crucial aspect of the competency-based approach, and to guide more students in the process of learning, not just to teach. The authors conclude that the changes in the education system created new values and changes of accents. The main value of a competency-based approach are the students, their skill development under the guidance of the teacher. It is important for the changes to happen gradually, because the results will be visible only after multiple years. Changes should not be rushed, and the teachers should be allowed to adapt to the new conditions.

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## **EDUCATION**

# CONCEPTUAL FRAMEWORK FOR THE DEVELOPMENT OF LEARNING APPROACHES IN THE CONTEXT OF EDUCATION FOR SUSTAINABLE DEVELOPMENT

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The quality of education is one of key factors to achieve sustainable development. The aim of this study is to develop a conceptual framework of education for sustainable development for students. The concept of education for sustainable development is based on a strong interpretation of sustainable development, where the environmental pillar describes the world's total environmental resources, the social pillar describes the global community, which in turn forms the third pillar of economic models [2]. Such an approach to the graphic interpretation of sustainable development highlights the key role of society in ensuring sustainable development, since it highlights the public's impact on economic developments, which in turn have an impact on the quality of the environment, thereby putting society as a whole and each member of society at the epicentre of responsibility. The next layer of the conceptual solution is made up of seventeen sustainable development objectives [4], which on the one hand shows the multidimensional nature of sustainable development, but on the other hand poses risks for failing to achieve other objectives separately. The external layer of the conceptual solution forms a rolling set of skills to be developed in a student, and a set of skills and competences for these rolling skills is the result of a series of authors' works and the basic competences defined by the UN to be developed in the context of sustainable development of education [1].

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# THE STATUS OF BIOLOGICAL PAINTING IN THE EDUCATIONAL ENVIRONMENT

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The problem of the research is mainly related to the concept of biological drawing mentioned in teaching aids and in the context of the School2030 reform project. The significance of this drawing in educational sciences is not specifically described, and in teaching a target subject, a secondary school must implement teaching criteria at its own discretion and understanding. Different concepts are used in the world and there is no unambiguous use and meaning of the concept of biological drawing. Historically, biological drawing has evolved from the so-called botanical drawing, in which morphological drawings of plants were depicted, especially with the development of such branch of science as systematics, the founder of which in the binary nomenclature is K. Linney. The problem of the research is related to underdeveloped biological drawing skills of students dealing with micropreparations and microscopy. A need for the research is determined by the impetuous development of biology as a branch of science. Taking into account the main findings of educational science and the national education reform, it is necessary to evaluate and specify the status of biological drawings and development methodology, and to introduce a unified approach promotion of its acquisition by developing students' complex research skills in biology. Analysing the available literature issues on the topic, it becomes clear that there is currently a lack of consensus on the concept of biological drawing, e.g., in English there are such concepts as: biological painting, botanical painting, biological drawing, botanical illustration, scientific drawing for biology and so on. In Latvian, the term of biological drawing is not officially approved in the Terminological Dictionary (Edition of the Latvian Academy of Sciences). The same is true for the European Union's Common Terminology Reference Dictionary. From all the above mentioned, it can be concluded that it is necessary to encourage the recognition and implementation of this concept in the industry.

Based on the LR Cabinet of Ministers regulations no. 49, Regulations on Latvian Science Branches and Sub-branches, 16 sub-branches have been officially recognized as part of the biology branch, which is the main criterion for the formation of the structure of biology branches in Latvia. It is highly recommended not only to describe and recognize the explanation of the term 'biological drawing' by including it in the glossary of biology as a branch, but also to introduce a certain nomenclature appropriate to the specifics of this drawing and biology sub-sectors.

It is recommended to create a nomenclature based on the LR Cabinet of Ministers regulations no. 49, Regulations on Latvian Science Branches and Sub-branches, using for example such form as biological drawing in botany, biological drawing in zoology, biological drawing in ecology. Alternatively, it is recommended to use a form based on scientific names in the biological sciences, such as cytological drawing, zoological drawing, botanical drawing, ecological drawing, microbiological drawing, etc.

To sum up, it can be concluded that the concept of biological drawing should be applied in practice within the framework of primary, secondary and higher education in the field of biology and its sub-sectors. This concept is not officially recognized, as it is not included in the explanatory dictionaries of the field, but is used in target teaching and studying issues for primary and secondary levels, as well as biology programs for colleges and universities.

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# KNOWLEDGE AND ATTITUDES OF NURSING STUDENTS REGARDING ADVANCED PRACTICE NURSING ACTIVITIES

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Advanced practice nursing (APN) is a rapidly developing nursing profession worldwide. Advanced level education, expert knowledge, clinical competencies and complex decision-making abilities represent advanced practice nurses nowadays [1]. As the needs of health care services are increasing constantly (demographic aging, number of chronic diseases, the shortage of medical staff), countries have to meet these demands by implementing APN. APN is correlating with better access to health care, more rational provision of medical services, lower medical costs and greater patient satisfaction [2]. However, a diverse health care system and restricted autonomy for advanced nurses delay progress of APN in different countries. Lithuania does not have enough experience and information concerning this topic. The aim was to determine the knowledge and attitudes of nursing students regarding advanced practice nursing activities.

The methods of research are quantitative. A questionnaire survey was performed online. The study was carried out from December 2020 until February 2021 using a self-made anonymous questionnaire. The participants were last year nursing program students of Lithuanian University of Health Sciences. They were divided into two groups: constant (students after graduating school with no experience working as a nurse) and extramural (students who finished a college for nurses and already had some experience working as a nurse). Overall, 73 nursing students participated in this survey (response rate – 87 %).

Both groups of nursing students were evaluated with a knowledge test concerning APN activities. The average knowledge of nursing students was 8.41 ( $\pm 0.702$  SD) points (from 10 points). Only 42.50% of constant and 42.42% of extramural student knowledge was estimated as very good. We identified that only half of the students (50% of constant and 48.48% of extramural students) are interested in APN Master's degree studies in the future. A majority of participants (52.94% of constant and 55.56% of extramural students) would choose an intensive care APN speciality. The main reasons for choosing an APN profession in the future are higher salary (78.79% of constant and 87.50% of extramural students) and autonomy (75.76% of constant and 90% of extramural students). We have found that 50% of constant and 93.94% of extramural students agree with the necessity to expand competencies of the APN nurses. Both nursing student groups (90% of constant and 75.76% of extramural) agree that advanced practice nurses should take full responsibility for their actions. We analyzed the nursing students' view to the perspectives of advanced practice nurses' work. The study results showed that 75% of constant and 87.88% of extramural students believe there are not enough places of work available for APN specialists in Lithuania.

To conclude, constant and extramural nursing students have good knowledge concerning APN. Also, students assess APN affirmatively and agree with the need to expand their competencies. The only challenge which advanced practice nurses encounter is a difficulty in finding a job.

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# **DIGITAL LITERACY AND ICT COMPETENCE OF NATURAL AND SOCIAL SCIENTIFIC PROFILE TEACHERS**

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Nowadays, digitalization is making changes in the field of education. Consequently, a current task for teachers is related to advanced training in digital technologies. The main indicators characterising the readiness of teachers to use ICT technologies in the educational process is the level of digital literacy and ICT competence [2]. Thus, the purpose of the research was to determine these indicators for natural and social scientific profile teachers of the Nevsky District of Saint Petersburg and study the main trends of their changes.

In the autumn, 2020, during the COVID-19 pandemic, SPbPU graduate students and employees of the Information and Methodological Center of the Nevsky District conducted a survey of the Nevsky District educational institutions teachers. The survey content and processing of obtained data were based on the methodological developments of the NAFI Research Centre [1]. In the general study of digital literacy and ICT competence of the Nevsky District teachers, 687 respondents took part. Herein we report on the part of those data related to 54 teachers of natural and social scientific profile.

The average digital literacy index rate for the teachers is 88%. The highest average value is demonstrated by natural and social scientific profile teachers under the age of 35 (92%), with pedagogical experience less than 20 years (92%) and experience of using digital technologies in teaching activities for over 11 years (91%). According to the NAFI Research Centre [1] the digital literacy index consists of 5 components. These are the results for the teachers related to each indicator: information (92%), computer (91%), communication (96%), media (88%) literacy and attitude to technological innovation (71%).

In determining the ICT competence index, the teachers scored an average of 51 points (out of 88), which corresponds to the level B2, "Expert." The most numerous groups in terms of ICT competence were the Experts (B2, 43%) and Integrators (B1, 39%). Great average ICT competence was demonstrated by natural and social scientific profile teachers at the age of 36-49 years (55 points, B2), with pedagogical experience in the range of 21-30 years (55 points, B2) and experience of using digital technologies in teaching activities for over 11 years (54 points, B2). According to [1], the ICT competence index consists of 22 competencies which are grouped into six blocks. Respectively, we identified six groups of teachers whose ICT competencies in each block are above average. Here is the percentage of teachers belonging to these groups out of the total number of respondents: professional duties (9%), digital resources (4%), teaching and learning (21%), student assessment (27%), empowering learners (17%), development of digital literacy of students (15%).

In conclusion, in order to increase digital literacy, we recommend natural and social scientific profile teachers of the Nevsky District of Saint Petersburg to develop their skills in the field of technological innovation. Furthermore, ICT competencies in the field of digital communication with colleagues and usage of digital resources in pedagogical activities also require attention.

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