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ANALYSIS OF POSSIBILITIES TO DEVELOP HYBRID-SIMULATION TRAINING IN VILNIUS JERUZALE LABOUR MARKET TRAINING CENTRE AND PANEVEZYS LABOUR MARKET TRAINING CENTRE (LITHUANIA)

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Project partners

The project “Development of hybrid training in VET" is funded by the European Union programme "Erasmus+"

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Abstract

This country case study is part of the Study of the specificities, context and perspectives of VET in Lithuania, Latvia, Estonia, Spain and Portugal. At the same time, the readiness and potential of **Vilnius Jeruzale Labour Market Training Centre (VJLMTC) and Panevezys Labour Market Training Centre (PanLMTC)** to undertake the development of a specific VET new program or module or the adaptation of an existing program through hybrid simulation training will be analyzed.

This case study from Lithuania will form the basis for an agreement between the "Development of hybrid training in VET" project (No. 2020-1-LT01-KA226-VET-094679) partners on the next phase of the project and for the assignment of specific responsibilities to each partner.

This case study will answer what is the most relevant profession in Lithuania and which competencies in this profession will be most important in the future.

Accordingly, VJLMTC and PanLMTC will also be able to identify key selection parameters and form a preliminary team of VET teachers who will be trained to use and manage the hybrid simulation training as well as to prepare hybrid simulation training materials.

1. Problem, object and purpose of the analysis

The problem of the research is whether the VJLMTC and PanLMTC has the right conditions, resources, sufficient abilities, measured need and high motivation to apply the hybrid-simulation training method in its activities.

The object of the research is the portfolio of vocational training programs implemented by VJLMTC and PanLMTC.

The aim of the research is to identify the most promising (most significant) economic activities (sectors) of Lithuanian economy, for which the required specialist training programs (or their parts) could be implemented in the future using the applied hybrid-simulation training method.

2. Assumptions of the analysis

In order to select the areas of vocational training (programs or parts thereof) that have the greatest potential to contribute to the training of specialists most needed in the future Lithuanian labor market, it is appropriate to review the structure of the national economy and the impact of certain economic sectors on the national economy. The latter factor is extremely significant, so in Part 3 of this analysis we will evaluate several aspects:

1. the number of employees in a given sector of the national economy and the share of employees in the country as a whole (a detailed analysis of this aspect would show the scope of training of the specialists in greatest demand in the future, as well as the scope of the need to improve the qualification of existing specialists; accordingly, the analysis would reveal the need to develop a hybrid training content that will improve the efficiency of the vocational training process and significantly reduce the training time);

2. how much taxes are paid by companies in a certain sector and what part of the Lithuanian economic portfolio they make up (this would strengthen the arguments for choosing a particular sector, as it would show the relative scale of companies' activities and turnover of products / services produced or sold)

3. what is the labor productivity of persons working in enterprises of a certain sector of the Lithuanian economy (this would reveal the tendencies of enterprises to modernize and the dynamics of implementation and development of innovations in them).

The results of the review of the listed aspects will provide a basis for distinguishing the Lithuanian economic sectors (Part 3.4 of this analysis), for which the training of the required specialists will be the most relevant in the future. Accordingly, it will help to decide which vocational training content hybridization or the development of completely new hybrid training content makes the most sense.

3. Analysis of the Lithuanian economic trends and prospects

3.1. Analysis of the number of persons employed in a certain sector of the national economy

The table below provides information on one of the most significant parameters - the number of employees - in fifteen sectors of the Lithuanian economy.

Table 1. Employees in 2014-2020

	Employees, thousand						
	2014 4th qtr	2015 4th qtr	2016 4th qtr	2017 4th qtr	2018 4th qtr	2019 4th qtr	2020 4th qtr
B. Mining and quarrying	3,4	2,1	3	3	3,3	3,2	2,4
C. Manufacturing	**194**	**196,2**	**201,8**	**192,9**	**206,2**	**209,9**	**196,9**
D. Electricity, gas, steam and air conditioning supply	8,8	10,7	12	12,8	10,1	10,8	10,2
E. Water supply, sewage treatment, waste management and remediation activities	14,5	15,5	15,9	15,8	17,6	18,9	14,7
F. Construction	**92**	**86,9**	**83,3**	**82,6**	**86,2**	**87,9**	**78,7**
G. Wholesale and retail trade; repair of motor vehicles and motorcycles	**209,4**	**191,6**	**205,1**	**205,2**	**209,2**	**193,4**	**192,4**
H. Transport and storage	**97,3**	**93,7**	**89,3**	**95,3**	**86,6**	**105,1**	**99,3**
I. Accommodation and food service activities	**28,7**	**32,6**	**30,9**	**30**	**33,7**	**36,6**	**30,0**
J. Information and communication	**21,2**	**23,5**	**27,8**	**24,6**	**28,3**	**34,0**	**36,6**
K. Financial and insurance activities	19	18,2	19,9	17	15,5	19,9	26,4
L. Real estate activities	12,6	11,8	9,6	13,4	10,9	8,8	7,9
M. Professional, scientific and technical activities	41	43,1	46,6	49,4	52,7	45,0	53,2
N. Administrative and support service activities	41,6	48,6	51,6	56	49	50,3	53,9
R. Arts, entertainment and recreation activities	24,2	25,3	25,9	22,4	22,4	20,4	24,8
S. Other service activities	15,4	16,4	15,5	19,2	20,6	19,1	19,0

Source: Official Statistics Portal of the Republic of Lithuania https://osp.stat.gov.lt

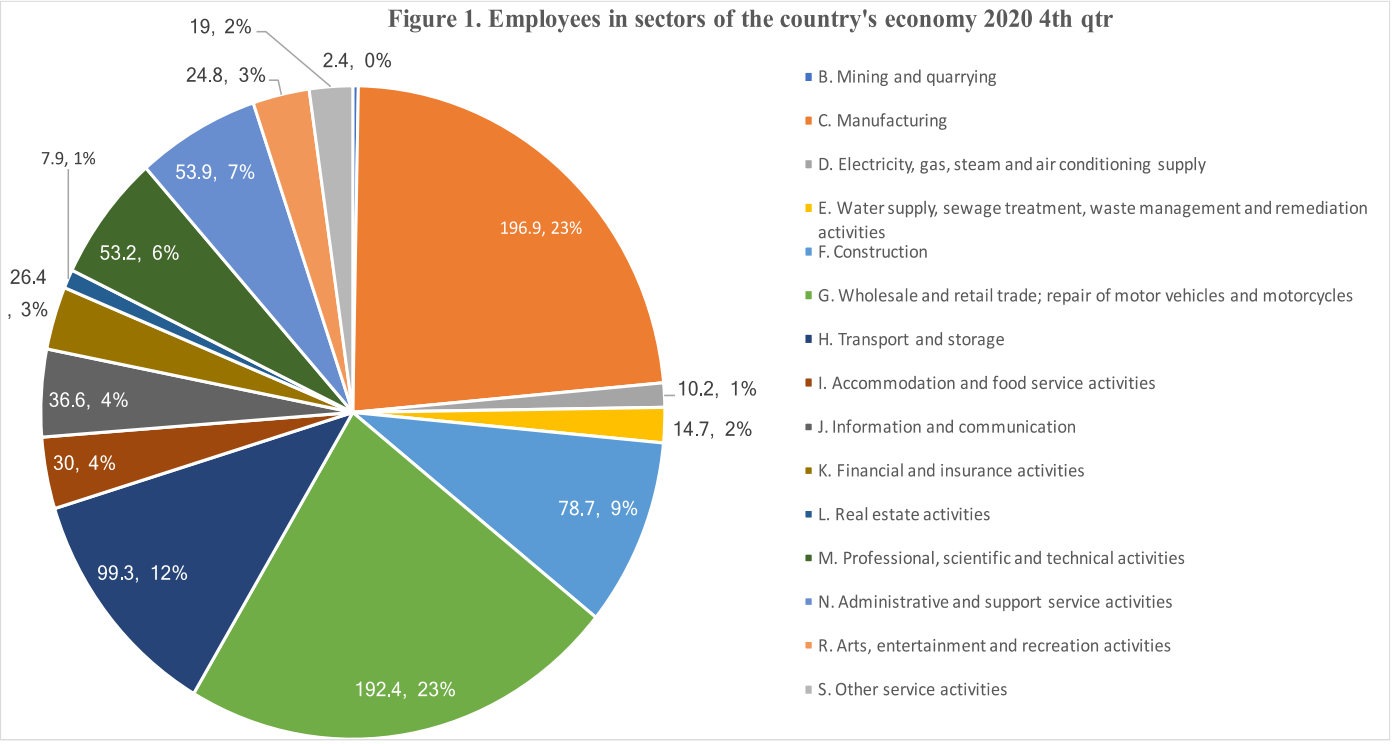
The first table shows that most of the country's economy over the past five years has been in six areas (in descending order of number of employees):

1. Wholesale and retail trade; repair of motor vehicles and motorcycles (G);
2. Manufacturing (C);
3. Transport and storage (H);
4. Construction (F);
5. Accommodation and food service activities (I);

Information and communication (J).

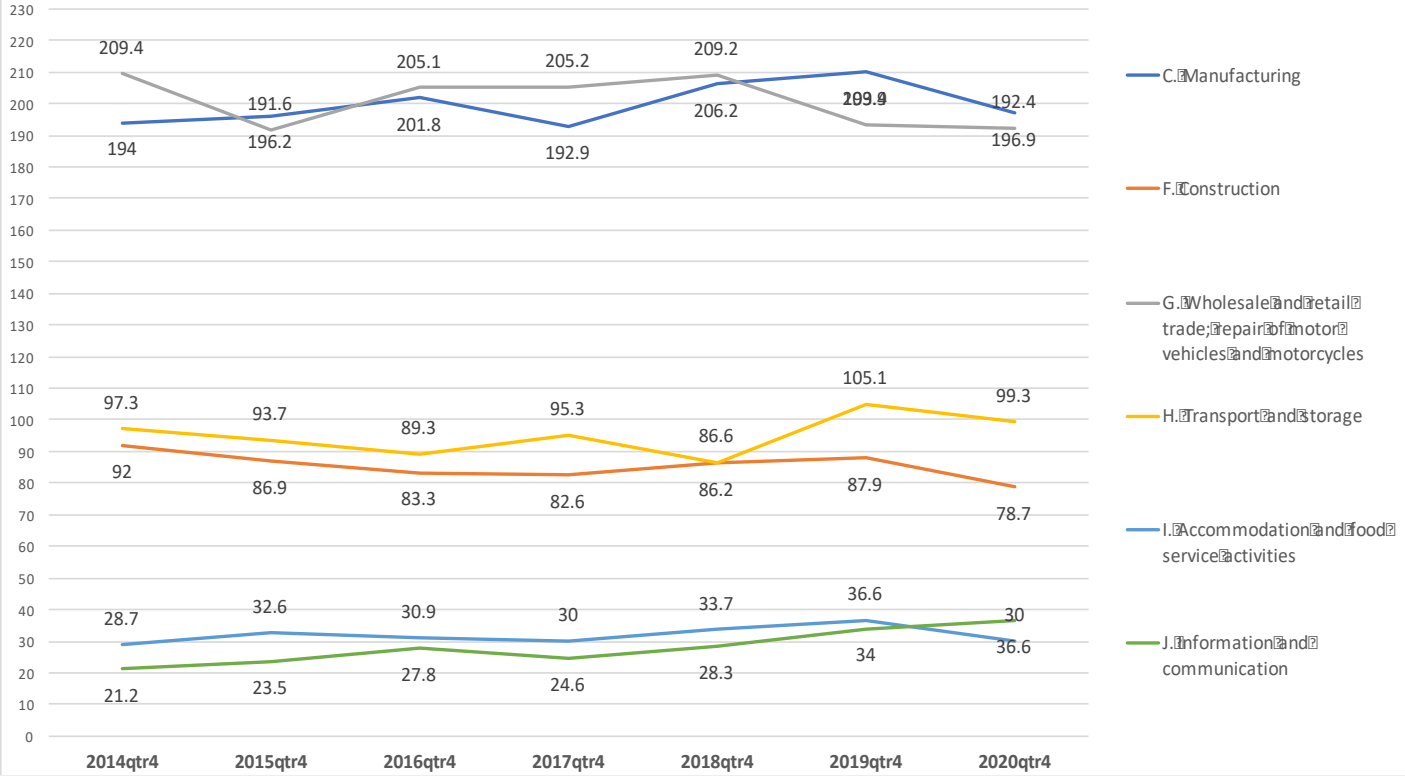
The first figure (see below) shows that in the last quarter, the three largest areas involved more than half (58%) of all employees in the country, and the six largest areas even accounted for four-fifths (80%). It should also be noted that in 2020, possibly due to constraints imposed by the COVID-19 pandemic management decisions, employment fell in four of the six largest sectors, with the accommodation and food service sector (I) suffering the most – at the end of 2020 in this sector worked even more than 18% fewer employees than at the end of 2019. The construction (F) sector was slightly less affected, with a fixed retreat of 10,47% (compared to the last quarter of 2019). The second largest decrease in the number of employees was in one of the largest sectors of the national economy – 13,0 thousand fewer people worked in manufacturing (C), but this led to a relative contraction of only 6,2% in this sector.

Figure 1. Employees in sectors of the country's economy 2020 4th qtr



Source: Official Statistics Portal of the Republic of Lithuania https://osp.stat.gov.lt

Figure 2. Trends in the change in the number of employees in the economic sector (2014-2020).)



Source: Official Statistics Portal of the Republic of Lithuania https://osp.stat.gov.lt

Meanwhile, in the second figure (see above), a few moments are evident:

- There are two large, two medium and two small sectors among the six largest sectors;
- In both of the two largest sectors, the number of employees has declined or increased relatively slightly over the last year;
- In both medium-sized sectors, the number of employees has decreased relatively significantly over the last year;
- In both smallest sectors, the number of employees has decreased relatively slightly or increased relatively slightly over the last one year.

However, these trends in the number of employees and the growth or contraction in the next five years are rather insignificant, as the last five years show all six largest sectors of the economy to be sufficiently stable and continue to dominate - in terms of the number of employees - in the national economy.

3.2. Analysis of taxes paid by enterprises in a certain sector of the national economy

The table below provides information on taxes paid by businesses in the country.

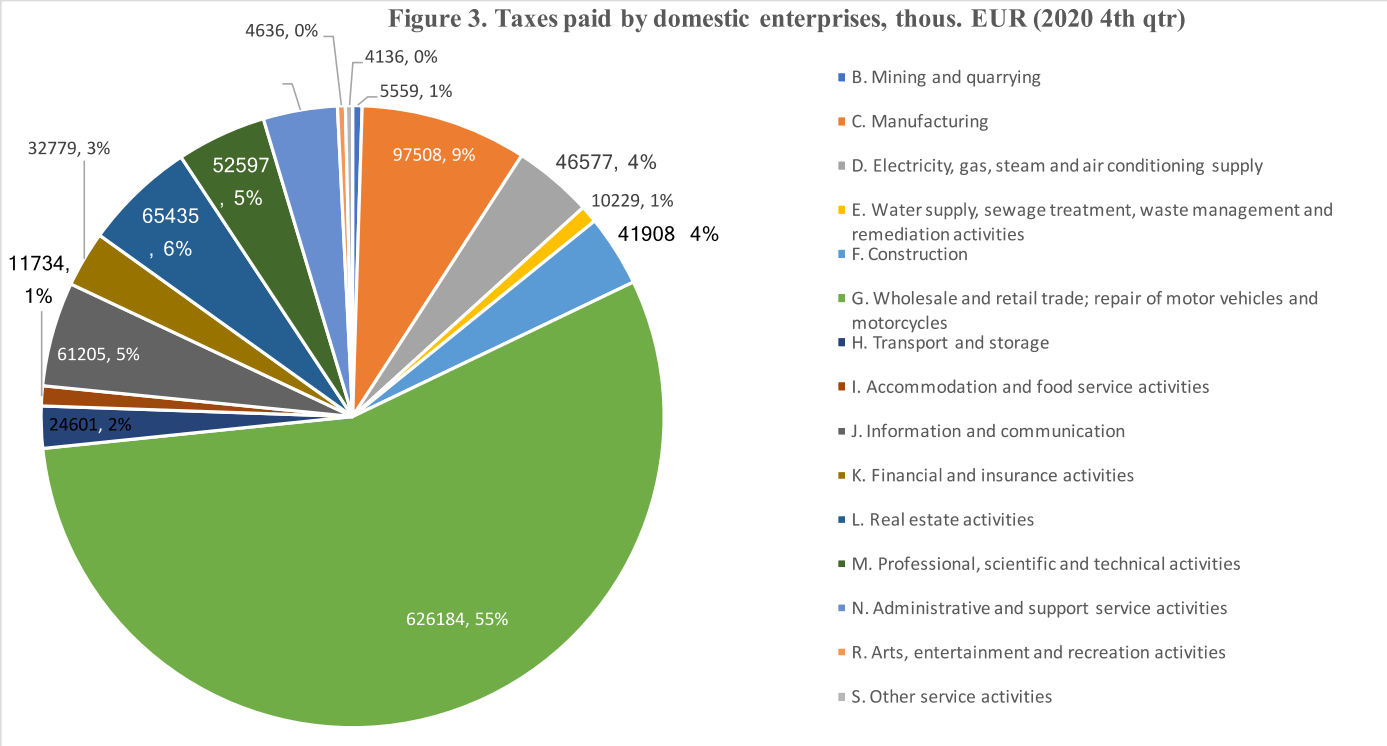
Table 2. Taxes paid by domestic companies in 2015-2020.

	Taxes paid by companies, thousand EUR					
	2015 4th qtr	2016 4th qtr	2017 4th qtr	2018 4th qtr	2019 4th qtr	2020 4th qtr
B. Mining and quarrying	2504	2678	2842	2883	2845	5559
C. Manufacturing	**57367,4**	**49756**	**69483**	**90798**	**99789**	**97508**
D. Electricity, gas, steam and air conditioning supply	37769,6	38953	34754	28942	42355	46577
E. Water supply, sewage treatment, waste management and remediation activities	8115,3	9910	9208	7880	7091	10229
F. Construction	6475,3	4671	-2610	-2545	-6214	41908
G. Wholesale and retail trade; repair of motor vehicles and motorcycles	**424967,9**	**467127**	**472407**	**547315**	**554221**	**626184**
H. Transport and storage	-3449	-7087	-7725	-17001	-1317	24601
I. Accommodation and food service activities	**13737,6**	**15653**	**18369**	**22648**	**24966**	**11734**
J. Information and communication	**31221,5**	**33976**	**38472**	**41624**	**46591**	**61205**
K. Financial and insurance activities	10614,4	11108	30441	30720	21559	32779
L. Real estate activities	38570,8	40282	41511	48627	49091	65435
M. Professional, scientific and technical activities	30642,2	32454	39491	36528	48788	52597
N. Administrative and support service activities	25222,7	27435	23661	22318	39310	43421
R. Arts, entertainment and recreation activities	3402,8	4378	4481	3839	5988	4636
S. Other service activities	4020,6	2591	3476	3837	4294	4136

Source: Official Statistics Portal of the Republic of Lithuania https://osp.stat.gov.lt

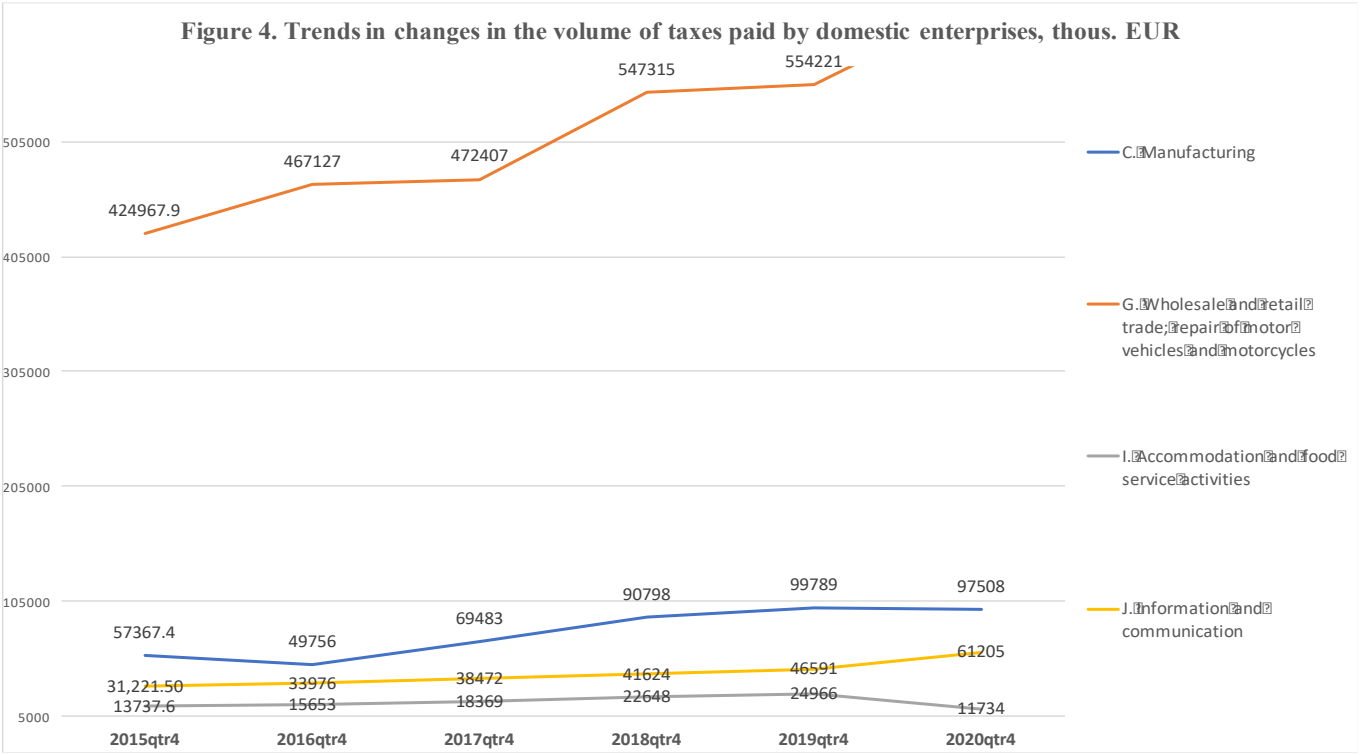
The data in Table 2 show that the largest taxpayer in the country over the last few years is the wholesale and retail trade and the motor vehicle and motorcycle repair sector, where companies account for more than half of all taxes collected each year, rising steadily despite global COVID -19 operational restrictions due to pandemic management. This shows that this sector of the economy, unlike most others, is highly flexible and adaptable, even finding untapped opportunities for business development (eg increasing online sales and rapidly setting up online stores and improving customer service conditions).

The second largest taxpayer in the country, the manufacturing sector, lagged behind the leader by more than six times in 2020, despite the fact that only slightly more people worked in this sector at the end of the year (192,4 thousand employees and 196,9 thousand employees, respectively).



Source: Official Statistics Portal of the Republic of Lithuania https://osp.stat.gov.lt

Figure 3 shows the volumes of taxes paid by the 15 economic sectors of the country in 2020, while Figure 4 shows the trends in the amounts of taxes paid in the case of the four sectors potentially analyzed in this study.



Source: Official Statistics Portal of the Republic of Lithuania https://osp.stat.gov.lt

It is clear from the figure that even the relative impact of the economic shock - the COVID-19 pandemic - was not decisive for the sectors potentially analyzed in this study. Thus, and according to this parameter - taxes paid - the analyzed sectors are quite stable and potentially reliable.

3.3. Analysis of labor productivity of persons working in enterprises of a certain sector of the national economy

Labor productivity is an important economic indicator, closely linked to economic growth and the competitiveness of different sectors of the economy. Labor productivity refers to the total volume of output (in terms of gross domestic product, GDP) produced per unit of work (in terms of the number of employees) during a given reference period. The indicator provides general knowledge of the efficiency and quality of human capital in the production process in a given economic and social environment, including other additional costs and innovations used in production. The table below provides a summary of labor productivity indicators of persons working in Lithuanian enterprises.

Table 3. Labor productivity in 2014-2019.

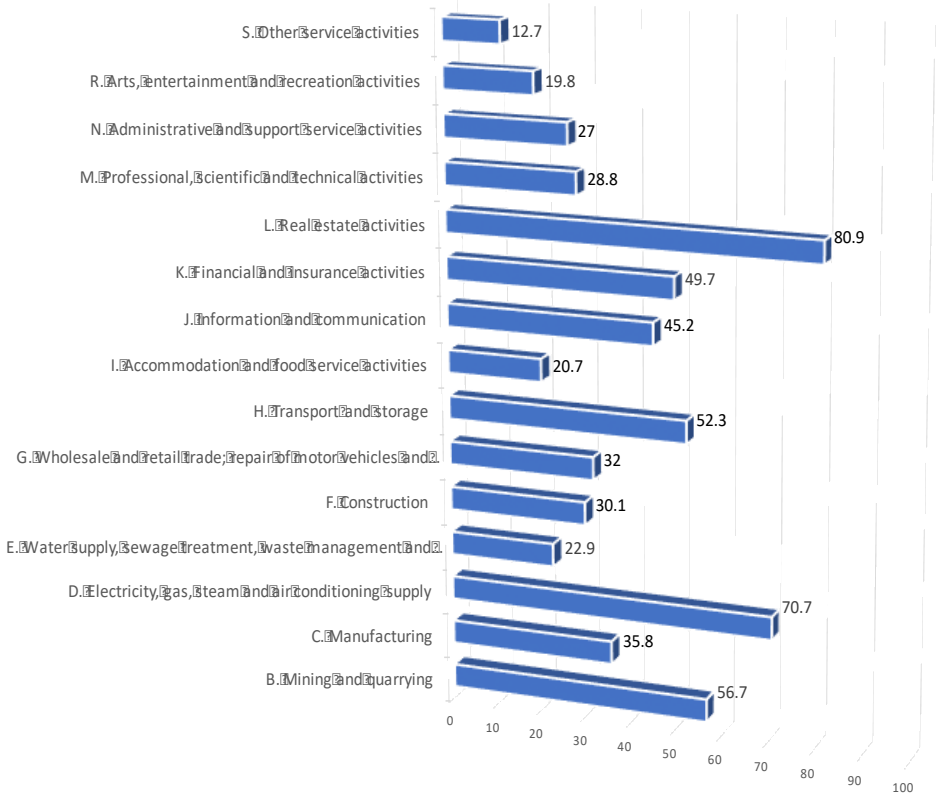
	Darbo našumas | tūkst. EUR vienam užimtajam					
	2014	2015	2016	2017	2018	2019
B. Mining and quarrying	31,8	43,5	34,6	41,3	39,8	56,7
C. Manufacturing	**31,9**	**31,6**	**31,2**	**34,3**	**34,3**	**35,8**
D. Electricity, gas, steam and air conditioning supply	72,3	57,2	60,8	48,9	57,3	70,7
E. Water supply, sewage treatment, waste management and remediation activities	27,5	24,9	26,2	26,5	24,7	22,9
F. Construction	**24,8**	**23,7**	**22,6**	**25,3**	**27,8**	**30,1**
G. Wholesale and retail trade; repair of motor vehicles and motorcycles	**26,0**	**27,0**	**27,2**	**29,8**	**30,8**	**32,0**
H. Transport and storage	**39,1**	**37,6**	**38,9**	**43,2**	**49,4**	**52,3**
I. Accommodation and food service activities	**14,2**	**15,7**	**16,7**	**19,3**	**21,6**	**20,7**
J. Information and communication	**43,5**	**42,4**	**43,9**	**49,4**	**47,2**	**45,2**
K. Financial and insurance activities	36,0	37,9	38,9	38,5	48,1	49,7
L. Real estate activities	56,5	62,7	68,3	69,0	77,9	80,9
M. Professional, scientific and technical activities	24,7	25,0	25,1	27,2	27,2	28,8
N. Administrative and support service activities	17,2	18,3	18,8	20,5	24,1	27,0
R. Arts, entertainment and recreation activities	11,0	12,9	14,0	15,2	16,2	19,8
S. Other service activities	11,8	13,1	12,3	12,7	12,7	12,7

Source: Official Statistics Portal of the Republic of Lithuania https://osp.stat.gov.lt

The information presented in Table 3 shows that labor productivity is very different in different sectors of the economy, while relatively small sectors of the economy are characterized by significantly higher labor productivity than large sectors. For example, in terms of the number of employees, the most abundant sectors C and G balance within the relatively modest limits of this indicator: during the last six years, the labor productivity of sector C averaged 33,18 thousand EUR per employee, and in sector G - on average 28,8 thousand EUR per employee. Meanwhile, in the relatively small number of employees in the real estate operations sector (only 11,1 thousand employees at the end of the second quarter of 2020), this indicator amounted to 69,22 thousand EUR per employed person and in the last six years has increased by as much as 43,19 percent from 56,5 thousand EUR per employed person at the end of 2014 up to 80,9 thousand EUR per person employed at the end of 2020.

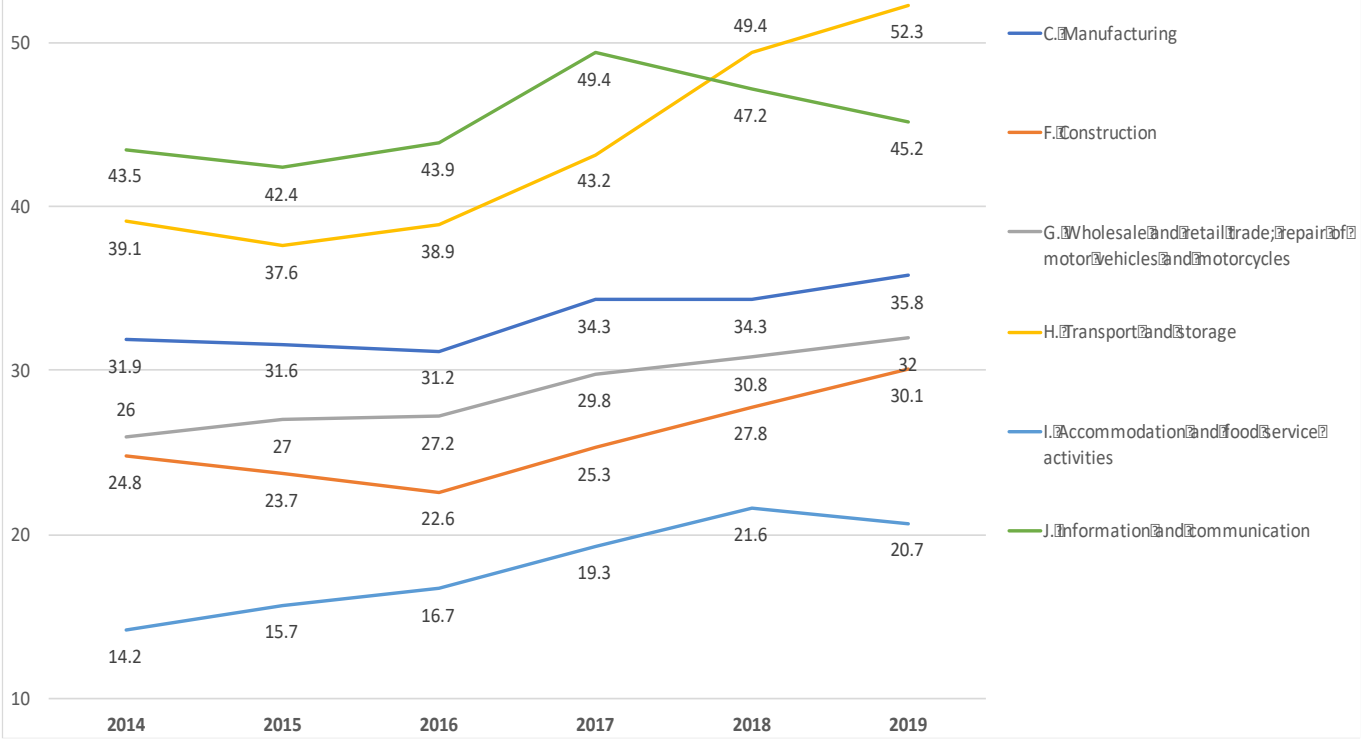
Figure 5 shows that at the end of 2020, the electricity, gas, steam and air conditioning supply sector (only 8,000 employees at the time) and the mining and quarrying sector (only 2,000 employees at the time) were among the productivity indicators leaders, while the economic sectors potentially relevant to this study were characterized by relatively moderate or low labor productivity.

Figure 5. Labor productivity, thousand EUR per employee (2019)



Source: Official Statistics Portal of the Republic of Lithuania https://osp.stat.gov.lt

6 Figure. Trends in labor productivity change, thousands of EUR per employee (2015-2019)



Source: Official Statistics Portal of the Republic of Lithuania https://osp.stat.gov.lt

Figure 6 shows that in the sectors relevant to this study, the labor productivity rate tends to increase steadily, with almost all six cases showing an increase from 12% to 42%. in the last five years. The latter fact proves that the companies in the sector are progressive, seeking to innovate both in the organization of activities and in increasing the efficiency of production processes. Meanwhile, the number of employees in each of the sectors, which is more or less stable and still slightly increasing, does not decrease, but shows that labor productivity is not increased by the decisions to reduce the number of employees. On the contrary, there is a likelihood that the qualifications of those working in companies in the sectors to be analyzed are steadily increasing, with the inevitable improvement in the skills required for the functions assigned to them, i.e. with growing mastery.

3.4. Selection of Lithuanian economic sectors necessary for further research

According to sections 3.1, 3.2 and 3.3 of this study and the analysis of certain parameters of the Lithuanian economic sectors, it is appropriate to state that the following six economic sectors are to be further analyzed:

1. Wholesale and retail trade; repair of motor vehicles and motorcycles (G);
2. Manufacturing (C);
3. Transport and storage (H);
4. Construction (F);
5. Accommodation and food service activities (I);
6. Information and communication (J).

4. Analysis of perspectives of training activities carried out by the Vilnius Jeruzale Labour Market Training Centre and Panevezys Labour Market Training Centre

4.1. Analysis of the portfolio of training programs implemented by the institutions

4.1.1. Vilnius Jeruzale Labour Market Training Centre (VJLMTC) is a non-profit youth and adult vocational training school that has been established in 1958. VJLMTC has more than 60 employees. Stakeholders: Ministry of Education and Science and JSC Arginta Group. VJLMTC provides more than 100 training programmes (formal and informal) through the 4 training departments: Metal Technologies, Construction Technologies, Energy Technologies and Transport Technologies. In addition, VJLMTC has Finance and Public Procurement Department, Project Department, Training Organising Department, Marketing Department and Personnel Department. VJLMTC trains around 4000 people anually.

Main activities of VJLMTC:

- Continuous vocational training and re-training (formal and informal);
- Qualification upgrade courses;
- Health and Safety training;
- Tailoring of new training programmes for the companies;
- Search and selection of employees and trainees for companies.

The training process is based on the apprenticeship format: 70 percent of practical training is carried out in companies and in the modern sector orientated practical workshops (which correspond to the real working conditions); 30 percent of training is held in the classes. Examples of the most popular training programmes:

- **Welders** (by electricity and gas), Metal Cutters;
- **Construction workers**: Bricklayers, Concrete Workers, Decorators, Tillers, Painters, Drywall Installers, Building's Cavity Workers, Roofers, Joiners;
- Construction machinery workers: Elevating Gear Operators (for overhead cranes, truck cranes, mobile cranes) etc.
- Electricity Cable Fitter;
- Tractor Drivers, Digging Machine Drivers, Drivers of various categories;
- Vehicle Repair Workers;
- Safety Experts.

VJLMTC annually serves a variety of clients who have a variety of specific needs: customizing curriculum content, adapting hands-on training sessions, coordinating learning and work schedules, ensuring student integration into the workforce, securing a workplace after graduation, etc. VJLMTC has already accumulated experience working with Ukrainians, Moldovans, Belarussians, Roma who traditionally have difficulties in integrating into the labor market or simply having trouble choosing the right profession.

4.1.2. Panevezys Labour Market Training Centre was founded in 1952. The organization is certificated by Quality Management Certificate ISO 9001:2015 (LST EN ISO 9001:2015). Panevėžys LMTC provides vocational training at formal and informal level. Its vision is focused on the following aims:

- to offer modern vocational training and high quality services both to people and to companies;
- to anticipate market demands;
- to effectively respond to the learners' needs;
- to pay attention to the development of the local area
- to use modern technologies in providing training;
- to employ high qualified and experienced staff.

This methodology allows Panevezys Labour Market Training Centre to implement and offer flexible vocational training programs, adjusted to the demands and needs both of the learners and the market. Panevezys Labour Market Training Centre trainers regularly participate to long life learning activities and projects to update and improve their knowledge and skills. Panevezys Labour Market Training Centre collaborates with Labour Exchange and business organizations and trains unemployed people, sent by territorial Labour Exchange; employees sent by employers; persons who come to learn on their own initiative. The institution has a big experience in preparing qualified specialist. Continuous trainings take place all over a year.

The Centre has good base of theoretical and practical training for a wide range of professions; the main activities of the centre are the following:

- professional training;
- qualification refreshing courses;
- re-skilling.

The institution consists of four departments:

- 1st learning department: catering, food production, trade, services, organization and administration training programs;
- 2nd learning department: beauty services, textile and handicraft, safety training programs; driver's' teaching department; vocational rehabilitation department.

More than professional 60 staff members are able to organize continuous trainings all over a year. In 2013 institution received the award for generating highest continual value and quality project. In 2019 institutions' mobility project was nominated for Quality contest.

4.2. Correlation of program implementation forecasts with the development tendencies of the national economy

4.2.1. WELDING systems are being transformed by the advent of modern information technologies such as the internet of things, big data, artificial intelligence, cloud computing, and intelligent manufacturing. Intelligent welding systems (IWS), making use of these technologies, are drawing attention from academic and industrial communities. Intelligent welding is the use of computers to mimic, strengthen, and/or replace human operators in sensing, learning, decision-making, monitoring and control, etc. This is accomplished by integrating the advantages of humans and physical systems into intelligent cyber systems. While intelligent welding has found pilot applications in industry, a systematic analysis of its components, applications, and future directions will help provide a unified definition of intelligent welding systems. This paper examines fundamental components and techniques necessary to make welding systems intelligent, including sensing and signal processing, feature extraction and selection, modeling, decision-making, and learning. Emerging technologies and their application potential to IWS will also be surveyed, including Industry 4.0, cyber-physical system (CPS), digital twins, etc. Typical applications in IWS will be surveyed, including weld design, task sequencing, robot path planning, robot programming, process monitoring and diagnosis, prediction, process control, quality inspection and assessment, human-robot collaboration, and virtual welding. Finally, conclusions and suggestions for future development will be proposed. This review is intended to provide a reference of the state-of-the-art for those seeking to introduce intelligent welding capabilities as they modernize their traditional welding stations, systems, and factories.

The essence of intelligent welding is in using intelligent techniques and/or machine

intelligence to mimic, strengthen, and/or replace human intelligence. By integrating the advantages of humans and physical systems into intelligent cyber systems, welding systems can be greatly enhanced, especially in computational analysis, precision con-trol, and sensing capabilities, as well as in improving the efficiency of human knowledge management, transfer, and application. Then, work efficiency, quality, and stability of the welding system can be improved by transferring relevant human experience and knowledge to the cyber-physical system (e.g., through software and the knowledge base).

Future perspectives

The processes and systems in intelligent welding systems are very complex, driven by practical applications, and are still evolving. From the review of the state-of-the-art in transforming welding stations, systems, and factories into intelligent welding systems, several directions for further development have emerged.

• An interesting area of IWS is the development of autonomous welding systems that combine welding robots with welding tools and power sources. Better integration of welding simulation models and machine-readable expert knowledge into the process control systems will improve the ability to react autonomously to changes in process conditions. Autonomous welding systems should not only enable online or real-time adaption in dynamic environments, but also be capable of self-optimization based on quality criteria.

• This literature survey found many machine leaning algorithms have found applications in IWS, including design, monitoring, control, prediction, and inspection. However, selecting the best machine learning techniques for each application is still unanswered. More effort should be made to improve the generalization, robustness, and repeatability of machine learning algorithms, including hybrid combinations of different algorithms, to maximize the potential of IWS.

• Welding robots, as a foundational technology, are critical stationlevel integrators of IWS. Continued development and application of computers, sensors, communication networks, and artificial intelligence technologies as independent technologies will occur. However, greater effort should be made toward their holistic integration, optimizing the combined sensor, welding, and robot parameters with the objective of more adaptive and efficient welding robots.

• The limits of single parameter signals for welding performance monitoring and control has inspired research into sensor fusion, but this work's general application and transferability to new situations, its stability, and the fusion of information content of signals needs further development. However, the trend in sensors and sensing technology research toward three dimensional vision sensing and information fusion and intelligent modeling is enabling to intelligent sensing systems.

• Effective welding process models are the foundation for optimal decision-making and intelligent control in IWS. Although numerical and analytical models give scientific insight into welding process, they are inadequate to the high uncertainty, complexity, and time criticality necessary for IWS. Big-data driven models have a better potential to solve this limitation. Hybrid models based on in-depth integration of numerical or analytical models with big-data driven models could further improve IWS capability. More work in hybrid intelligent modeling is necessary, along with efficient storage, data management and processing, and sharing of historic data to provide the big-data necessary for hybrid/ AI model development.

• Several papers discuss the advantages and drawbacks of different approaches to IWS control systems used to monitor, extract, and understand the underlying welding physics in real time. More adaptive control techniques, such as reinforcement learning, digital twin, and cloud and distributed (fog or edge) computing platforms will help improve and refine physics-based models.

• A better understanding of human-computer interaction and humanrobot collaboration in welding systems will improve the transfer of intelligence to welding. Operators/humans should better understand machine status, and machines should better perceive the realtime status or emotion of humans. In the meantime, welder/technician training and learning for the coming intelligence age is necessary, so that new technologies such as simulators, virtual reality, and augmented reality can be effectively used by the workforce.

• As product design is moving toward mass customization and personalization, so must welding services in the future. Personalized / smart welding products and services based on platform technologies including CPS, IoT, and cloud manufacturing can help realize green, efficient, and humanized IWS in the context of Industry 4.0. Welding-based additive manufacturing technology will make it possible shorten production cycles and reduce manufacturing costs.

4.2.2. The future of the **CONSTRUCTION** industry is technology-based and green. That much is a fact. You need workers with job skills that allow them to slot seamlessly into this coming world. Artificial intelligence, software and technology packages, autonomous construction equipment, drones and more are becoming more commonplace in the industry, and that's only going to grow in the future. If you're holding off on adopting drones and construction management software packages because you think they're a fad, it's time to let your concerns go and adopt. The role of factories and off-site prefabrication is also rapidly growing, and factories that use advanced manufacturing systems for prefabricated modules that can be assembled on-site are the wave of the future. Construction activities will move more and more to factories and away from on-site fabrication of materials. We're also seeing a green building reboot. The environment is of ever greater concern to builders and businesses. Even as the current administration relaxes restrictions, the public perception is that green is good, and businesses want to be seen as responsible. That means you'll want to invest in sustainable technologies and green building materials to match up to the needs of your clients.

In a 2018 report to the World Economic Forum titled "Shaping the Future of Construction: Future Scenarios and Implications for the Industry," there are a number of enlightening predictions about the future of construction, some of which have already come to pass. The report concluded that in the future of construction, certain skills will be essential. Technology skills for the future include expertise in AI, computer programming and data analysis. Experts will also be needed who possess lean process skills and have experience with logistics and modular design. Finally, the industry will need experts in resilience, engineers trained in resource efficiency and specialists in a circular economy. To draw such talent, managers and company owners will need to look to new and untapped markets. Perhaps not surprisingly, the gaming industry is a field that is ripe for finding the next generation of tech-based construction professionals. There are, however, a number of resource pools for the industry that have yet to be thoroughly mined for the next generation of workers.

While construction work may seem straightforward, it is a physically and mentally challenging career. There are plenty of skills

and traits construction workers need to possess in order to be successful in their work. Construction jobs come with a wide range of tasks and working conditions, from navigating tight spaces and hazardous heights to operating heavy equipment in inclement weather. However, the rewards and pacing of this career can be rewarding for many professionals. Despite declining interest in the trades, those who work in the industry for many years can go on to manage entire construction teams and complete impressive projects that shape the livelihoods of other human beings. Construction jobs are expected to grow as much as 10 percent by 2024, placing it fourth in job growth among major industries like health and business. The modern construction worker needs a mix of technical knowledge, physical endurance, and effective communication skills. Here's our list of the most essential construction traits that workers and contractors need to acquire to succeed in the industry: 1) *Building and Engineering Knowledge*. Some skills you should possess include: masonry; surveying; ironwork, plumbing; HVAC; demolition; uilding and repair of structures, highways, and bridges; renovations; framing; roofing; knowledge of and experience with building materials; power tools; wallcovering. 2) *Experience with Technology*. To be competitive in the market, future workers are expected to adapt to new advancements in construction technology such as: augmented reality, virtual reality, BIM[1] (building information modeling), drones[2], mobile apps, construction management software.

4.2.3. The ongoing desire to transport goods faster and cheaper will lead to the rapid introduction of automation and other new technologies into the **TRANSPORT AND LOGISTICS** sector, reshaping its workforce in ways never seen before. New roles will emerge, some will disappear, and many existing roles will blend with each other and grow more complex, requiring enhancements to existing skills.

The introduction of digital systems and processes is driving the need for greater digital literacy across the entire workforce, especially as automation leads workers to move from hands-on tasks to systems management roles. Increasing complexity in supply chains is creating demand for systems thinking and problem-solving skills to enable workers and managers to quickly identify and resolve issues. The introduction of autonomous vehicle technology will free workers to perform new tasks such as remote piloting and vehicle management, supply chain administration, and equipment servicing , with each of these roles requiring significant reskilling in fields such as electronics, engineering and systems management on top of their current domain expertise. The introduction of warehouse automation and the need to fulfil orders in faster timeframes will lead to the reskilling of the existing workforce in technical skills for managing these automated systems. The introduction of artificial intelligence and machine learning into logistics management will create greater demand for specialists skills in these fields, while the increasing use of Blockchain technology to improve traceability

[1] BIM takes traditional blueprints to an entirely new level, allowing for a much more detailed and in-depth means of offering information about proposed building products. It allows interactive 3D modeling of architecture to help construction workers more fully understand the work that will need be done. This increases the efficiency of managing the tasks, and allows all members of the precut to efficiently collaborate on the project. In the future, 5D modeling will be possible, allowing for not just interactive physical models, but management of time, costs, quantities, rates and more into the project.

[2] When you're working on a very large site, it can be really tough to accurately gauge and map the terrain. That's no longer the case with unmanned aerial vehicles, more colloquially known as drones. These allow the collection of information regarding inaccessible areas, to improve the inspection and assessment of a site, to gather important details that couldn't be had from a manual inspection. They can monitor logistics, make deliveries, and aid in architectural planning.

in supply chains will also raise the need for systems architecture and software skills.

We have absolutely no doubt that emerging technology will certainly play a part in reducing the amount of people required in some areas of the logistics space, and it will be interesting to see how this evolves in the future. However, it is important to remember that no matter how much tech is adopted the fact remains that people will be needed to manage this process which will likely bring a new breed of skill sets that companies require. Consequently, there needs to be a focus on adopting tech running alongside a drive to attract emerging talent into the field. Failure to do so will only serve to exacerbate an already present talent deficit.

5. Description of the results of the round table discussion

In order to make sure that the assumptions made in the previous parts of this analysis are appropriate and correct, a round table discussion was organized at the beginning of the new 2021-2022 school year. Representatives of vocational schools and associations uniting companies of the country's economic sectors relevant to the research, as well as freelance experts were invited to participate in the discussion.

Representatives of the Lithuanian Builders 'Association, the Lithuanian Association of Engineering Industries and the Lithuanian Carriers' Union actively participated in the discussion. The position of the Executive Director of the Production Innovation Valley, which was recently established in Lithuania, and the thoughts expressed by freelance experts and vocational teachers who participated in the discussion were also very important. Some moments of the ongoing discussion can be seen in the photos.

During the discussion we have reached the widespread agreement that it is less useful to train people in skills to use specific technologies, than to **focus on helping the industry and its workforce develop the competencies that will help them adopt and adapt to technology.**

Individual technologies themselves could become obsolete. Meanwhile those that survive and become more widespread are likely to become increasingly intuitive to use.

However, the softer skills and competencies that are needed to underpin technology adoption and use go beyond individual technologies, and therefore bring wider and longer lasting benefits, to both individuals and their employers.

We have agreed, that there are two groups of competencies needed to push the industry forward: 1) **flexible mindset** (curiosity, problem-solving, creativity, emotional intelligence, communication) and 2) **understanding tools and data** (problem-solving; knowledge of how specific tech works; range of tech available/ being developed; how data can support tech development; collecting, storing, sharing, using data).

Having a flexible mindset is characterised by having and displaying skills, behaviours and competencies including curiosity, problem-solving, creativity, communication and emotional intelligence. An understanding of tools and data means knowing what technology is available and what it can be used for, as well as being clear about why and how to collect, store, share and apply the data that supports it or arises from its use. Bringing together the two sets of competencies detailed above creates the conditions for technology to be used well. What's more, the softer skills these competencies include would help address some of the structural and cultural barriers to wider adoption of technology. Better communication, problem-solving and creative thinking could reduce ine icient practices within companies and improve working relationships across supply chains.

In the discussions on the prospects and needs of the **construction sector**, the trends shown in the figure below emerged the most.

	Construction Specific Professional Skills	Personal Qualities	Future/Digital Skills
Most Cited	Quality Assurance, Inspection & Testing	Project Management & Site Administration	Building Information Modelling (BIM)
Least Cited	Conservation & Restoration	Equality, Diversity and Inclusion	Smart Materials

It is clear after the discussion, that **working in the world of welding** requires you to have great ability in handling tools and technology. Employers are looking for welders who can clamp together broken metal pieces, and melt and apply solder along adjoining edges of materials. Welders need to monitor the quality of machinery, repair leaks, and use grinders and other metal finishers. Other technical skills required of a welder include:

- Operate a brazing torch
- Operate robotic welding machines
- Set up fixtures and machine tools
- Use fillet and butt weld gauges
- Use hand tools
- Use a soldering iron

Most of the participants in the discussion agreed **transportation** will be one of the sectors most dramatically affected by coming waves of innovation and automation. The startling prospect of driverless vehicles traversing the nation's roadways has captured much public attention (and elicited much concern); but there are many other less visible, but equally important, ways in which new technology will affect transportation jobs.

Current innovations in computing and automation are capable of undertaking whole new sets of tasks that in the past were not amenable to machine-aided production. Traditionally, functions being automated had to be routine and precisely described by programming code. These could be manual tasks (involving the movement of objects) or cognitive (involving the manipulation of data), but in either case automation was only possible for routine and replicable functions. Thus, these moments will be important in the transport sector in the future: position, localisation, and mapping capacities and functions; monitoring and surveillance technologies to track vehicle and staff locations; assisted driving, sensing, and perception supports; partial automation of driving task; connected vehicle technology allowing better coordination/communication across eets; big data analytics, deep learning, use of algorithms (in planning routes, service, and customer contacts); extensive computerisation in data management, including by drivers (eg. paperless document systems); advanced data systems to enhance security and privacy standards in transportation.

Conclusions

Our analysis shows very good prospects in Lithuania with six economic sectors:

1. Wholesale and retail trade; repair of motor vehicles and motorcycles (G);
2. Manufacturing (C);
3. Transport and storage (H);
4. Construction (F);
5. Accommodation and food service activities (I);
6. Information and communication (J).

With this in mind, in Lithuania we would like to develop the content of vocational training related to the training of specialists in the following sectors:

1. **Manufacturing (C);**
2. **Transport and storage (H);**
3. **Construction (F).**