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The Bridge BIM
architecture
engineering
construction

Deliverable D1.1

Background Context

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Document information Table

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Deliverable title	Reports on background context according to the survey / study visits		
Description	The document in the English language containing the final needs analysis, the analysis of the teaching offer on BIM Technology in Architecture-Engineering-Construction (AEC) in Ukraine, and the composition of the UA teamsin charge of developing the master programmes.		
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Executive Summary

The present document constitutes the Deliverable D1.1 “Reports on background context according to the survey / study visits” in the framework of the Project named “Bridging the gap between university and industry: Master Curricular Supporting the Development of Green Jobs and Digital Skills in the Ukrainian Building Sector” (Project Acronym: The BRIDGE; Grant Agreement No.: 101127884).

The document presents the final analysis of the needs of key regions of Ukraine, the institutional needs of higher education and the results of the analysis of stakeholders in the field of BIM Technology in Construction and Civil Engineering.

Key challenges and opportunities were identified as a result of detailed research. They are related to implementing BIM Technology in Construction and Civil Engineering for development of Green Jobs and Digital Skills in the Ukrainian Building Sector and ensuring its sustainability.

The presented document outlines the key positions that modern BIM specialists need to know and be able to do. Ensuring the appropriate level of knowledge in this field will contribute to the rapid implementation of innovative solutions and increase the efficiency of the construction process.

The basis of the document is a regional analysis of needs and institutional needs of higher education. The regional analysis includes information on Dnipro, Lviv, Kyiv, Odesa and Chernihiv regions. Each of the above has unique features related to geographical location, climate, history, culture and economy. The above regions are characterised by the presence of a large number of buildings from the Soviet period, which require reconstruction, radical modernization, renewal in order to improve relevant indicators, such as energy consumption, social and environmental consequences. In addition, improving the quality of construction and the efficiency of management of both the construction process and the buildings put into operation is an urgent need.

The document also describes the institutional needs of higher education. The existing achievements of higher education institutions of Ukraine in the field of BIM Technology in Construction and Civil Engineering, which are part of the BRIDGE project consortium, were presented, as well as highlighted the key needs in educational activities and the rationale for the design of new Master programmes or deep innovation of the existing ones in AEC sector.

Document is containing the results of the survey of interested parties, through questionnaires about the content of the proposed courses and collecting feedback. This activity is necessary for the formation of proposals and recommendations related to the creation and development of an educational program and educational materials aimed at training specialists in BIM Technology in Construction and Civil Engineering.

The survey took place from April 12 to April 22, 2024. The project participants developed four types of questionnaires for four defined target groups, namely:

1. Employers, companies, organizations, state institutions (responsible developers KNUCA).
2. Teachers of higher educational institutions (responsible developers ODABA/OSACEA and ONEU).
3. Alumni of higher educational institutions (responsible developers CPNU).
4. Students of higher educational institutions (responsible developers PSACEA).

1. Building information modelling for housing renovation: Research into Ukrainian case

Building Information Modelling (BIM) is the latest software technology used widely by many construction businesses - big and small - particularly within the Architecture Engineering Construction (AEC) sector. Building Information Modelling (BIM) is currently considered as collaborative process in which AEC professionals involved in a project use an intelligent 3-7D (scheduling (4D), cost (5D), sustainability (6D) and operations and maintenance (7D) model-based design application that provides the insight and tools they need to design, construct, and manage buildings and properties throughout total assets' lifecycles (Siniak N., Źróbek S., Nikolaiev V., Shavrov S., 2019, Building Information Modeling for Housing Renovation - Example for Ukraine, Real Estate Management and Valuation, vol. 27, no. 2, pp. 97-107.).

Structurally, BIM is a structured representation of a building and is defines how it is organized, what parts it has, and how they work together. Ideally, the structure of BIM would be that of an object-oriented database with special requirements, which include sharing data in a multiuser system, support for multiple views of data, controlled data redundancy, enforced integrity, restricted unauthorized access, data independence, transaction processing, backup, and recovery (WATT 2014; BJORK, PENTTILA 1989). Functionally, BIM is a communication backbone during its entire life cycle, as well as a shared source and destination of information required, and the outcomes of BIM describe how such interaction can prove useful (What is BIM 2013).

Currently, BIM methodology and software solutions are in high demand in Western Europe, helping to enhance efficiency, productivity, and collaboration across the entire project lifecycle, reducing time, waste and cost and drive business competitiveness and new levels of digital business innovation. According to experts, design, construction, and facility management using BIM technology are more efficient and provide, in the EU countries, expected annual savings from the use of BIM-technologies at the design and construction stage of more than 20%.

Building Information Modelling is growing in popularity of implementation in Poland, and helping to facilitate and accelerate work, to organize information throughout the life cycle of the asset, to facilitate communication between designers of different industries working on the same object, to avoid collisions and to speed up the quantity takeoff process (JUSZCZYK et al.2015).

In Italy, starting from 2022, the BIM was introduced at full capacity, becoming mandatory for all ordinary works, except for residential work and not presenting any problems related to security. In 2025, the process will be digitized for all projects to amounts of less than one million euros (https://www.bimcommunity.com/news/load/540/the-use-of-bim-in-italy-will-be-mandatory-for-public-procurement-by-2019).

On 17 February 2021, the Cabinet of Ministers of Ukraine adopted the Concept of Implementation of Building Information Modelling Technology and its action plan (https://chamber.ua/news/ukraine-implementation-of-building-information-modelling-technology-to-be-launched/). The Concept defines principles, guidelines and mechanisms for implementing state policy regarding BIM technology for the purposes of further reforming, modernizing and digitally transforming the construction sector in Ukraine. Implementation of the Concept is targeted until 2035 with four stages:

- *Stage I* (2020-2022): Commencement of regular use of BIM technology, development of regulatory framework and technical support of BIM technology in Ukraine. Commencement of the implementation of pilot projects regarding facilities of various purpose.
- *Stage II* (2023-2024): Obligatory use of BIM technology within certain construction projects falling under certain parameters , including cost, complexity, consequence class (CC), among others, within state-supported construction projects. Continuing to implement pilot projects.
- *Stage III* (2025-2030): Extension of criteria for obligatory use of BIM technology within state supported construction projects. Operation of facilities using BIM technology.
- *Stage IV* (2030-2035): Full use of BIM technology when implementing construction projects. Obligatory use of BIM technology for all state-supported construction projects. Extension of criteria for obligatory use of BIM technology within privately financed construction projects.

Unlike many Western countries, Ukraine must still create the preconditions of such implementation. These preconditions must include the following actions: conduct extensive works on the alternative digital approaches regarding the transition of the construction industry in Ukraine to BIM-technologies, clear classification of all information on the environment of the construction industry and automated exchange of information and databases in an open format in line with international standards, ensuring the implementation in school curriculums for training and retraining qualified specialists for training and practical use BIM-technologies, interoperability of all public organizations and associations, business partners when implementing BIM-technologies in Ukraine. Implementation of these preconditions has no chance without proper attention being paid to professional associations and NGOs, investors, heads of design, contractors, manufacturers and suppliers of inputs for construction (Siniak N., Źróbek S., Nikolaiev V., Shavrov S., 2019, Building Information Modeling for Housing Renovation - Example for Ukraine).

In recent Ukrainian publications, attention is drawn to the fact that, first of all, BIM requires the transition of the construction industry to the principles of life cycle management and market pricing (KUBIDA et al. 2018). The latest attempts in developing the concept of the reformation of the construction industry have been confronted precisely with this first issue. BIM implementation barriers range from the lack of a BIM framework, low awareness of BIM benefits, high initial investment costs, staff's resistance to change and cultural misfits (Siniak N., Źróbek S., Nikolaiev V. et al. 2019). Providing players in the AEC value chain with the right motivation and understanding of BIM's benefits could serve as the foundation for faster adoption. The evolution of BIM in the direction of the needs of the housing renovation industry and its specificity is a promising approach to tackling and managing the complexity of the renovation and facility management process.

The consumers have had questions about the quality of the buildings, the unreasonable prices and the low efficiency of using real estate for a long time. Unfortunately, the future owners of these houses know only the price per square meter, without the costs of renovation, and see only the advertised image of the house. In reality, however, they do not know what they are buying and what they are paying for, e.g.: what materials the house is built from, who produces these materials and what their quality is like, the length of the service life of the house, its components and its engineering systems, and how much maintenance and renovation will cost or how often such works should be carried out. The owners of previously built houses and apartments are also unaware of the frequently critical condition their houses are in, the huge financial investments required to carry out urgent capital renovations, or the short remaining life expectancy of the buildings. At the same time, by reviewing the state of the construction industry abroad, consumers and authorities in developed countries show an interest mainly in the efficiency of buildings: how well the facilities are designed, their quality and price, and the conditions of facility management.

It is not difficult to see that the problem is not merely building design but the entire construction and facility life cycle. At the same time, it is not only the cost of construction which is determined, but all of the expenses, incomes and value over time for the customer or future owner. For this purpose, information accumulated over the years on the costs of such houses during the construction and management period is used. Such data finds its way into the information databases of reliable reports of builders and property managers.

It is not only architects and design engineers who take part in the design process, but also the investor (the commissioning party and, possibly, the potential buyer), the contractor and the main suppliers. This is a single team whose members can work online on a common information model using appropriate software products, some of which are known in our country as 3D design. The goal of the team is to create an object that will satisfy the customer and future users as much as possible, and hence to receive remuneration in proportion to their contribution to the outcomes. In the design process, the object is combined from components with known physical, price, operational and environmental characteristics. Products are designed, ordered and delivered in the form of pre-manufactured components, which minimizes work on the construction plot and construction waste. All information is provided by manufacturers and suppliers and accumulated in the industry information databases. It then is put to use by the owner and facility manager of the building. Thus, both the builder and future users can find all the

necessary data in the model for the effective construction, maintenance, and facility management of the building.

Compared with the international practice of BIM, with respect to planning, adoption, technology and performance, Ukraine is lagging behind the majority of developed countries. According to data provided by the experts in NGO ACU, in Ukrainian realities, the benefits of BIM can be 20-50% at the design stage, and up to 40% at the construction stage. This is possible, among others, due to the price transparency, the factory production of building components, the elimination of inconsistencies and alterations, and a clear timetable for the construction and delivery of supplies. In order to start the movement towards "information construction", we need to, on the one hand, legally ensure the provision of all the necessary data by all participants in construction and facility management as well as the accumulation of these sets of data in industry information databases. On the other hand, we need to include, in all the standards and rules of design, the requirements for the new composition and quality of documentation using modern methods and means of information modelling. Obviously, we need to think about the staff, because not a single domestic university prepares specialists in real estate management, engineering and surveying.

Under these conditions, local authorities in some cities offer financial assistance of up to 50-70% of the costs of house renovation, in particular those organized by building owner associations. To obtain this type of assistance, however, residents of each dwelling must provide project documentation and design and cost estimates. They, however, have no funds for this. There are also organizational difficulties in joint decision-making by co-owners of houses, which hold back the process of renovation. There is an illusion of low demand for renovation work and the adequacy of the necessary funds in local budgets. As a result of this situation, the condition of the housing stock is rapidly deteriorating. Under these circumstances, it is necessary to organize, at the expense of local budgets, surveys and designs for chosen standard dwellings. On this basis, it is necessary to identify and effectively use the limited financial resources of the population and municipalities, as well as identify the problems and the extent of ageing of the housing stock of cities to justify the need for state support. An obstacle to solving this problem is an imperfect system of design, pricing and management in construction and facility management, which increases the real need for funds. Thus, project documentation, design methods and technology are outdated, technical and organizational decisions are irrational, and the normative estimated renovation cost can be distorted and sometimes too high. During facility management, there may be no original project documentation for the residential building, which is required for restoration for the purposes of management. With the above scale of the required renovations, the artificially high cost can be measured in billions of dollars.

At the same time, the effectiveness of design decisions and management during subsequent facility management is not guaranteed. According to the results of the survey conducted by the Institute of professional qualifications, the qualifications of managers for the control of such works is insufficient. There has been a proposal to prepare standardized and effective design solutions for the renovation of standard buildings using innovative approaches and possibilities of BIM on the example of a city with subdivisions of buildings that were popular during the Soviet period. Electronic models of residential buildings, electronic passports and 3-D projects of major maintenance works will contain effective design, technological and organizational solutions, comments and methods for adapting them to specific buildings, as well as instructions for facility management companies on the use of the models in further facility management operations. Attempts to apply BIM to existing facilities began almost simultaneously with the widespread introduction of BIM, but continue to be underestimated. However, it is in the application of BIM to existing facilities that the advantages of BIM become even more obvious, including: the ability to simulate changes in the building structure, design the building with new equipment, bring its performance up to the present level of requirements, track the current state of the building and take timely renovation measures, and competently exploit the existing facilities, both technologically and economically. If there is an information model of the building, then the management company can be continuously aware of what the schedule of maintenance and replacement work on each structural element is, the quantity of materials needed for major renovation of the building, the cost of the work, where to find quality materials at a reasonable price, how long such works will take, etc. It is equally

important to be able to obtain accurate information in the event of possible accidents or failures. This clearly requires information databases and special computer programs.

As a conclusion to this chapter, it should be noted that for the construction industry, a major part of the Ukrainian economy, it provides a critical opportunity to significantly improve performance. Ukraine has all the prerequisites for the rapid and successful implementation of BIM-technology. The authorities should lead the way as the main developer, accelerating cultural changes in design and construction. Innovative project delivery approaches have built a collaborative environment for constructing new buildings where the designer, contractor, subcontractors and suppliers work for the overall benefit of the owner. Renovation of existing buildings requires the development of similar contractual agreements, which, in turn, encourages the usage of BIM tools. At the government level, BIM adoption requires adaptation of legal and organizational frameworks as well as long-term commitment and innovative financing to get the technology into the hands of stakeholders who need to standardize the implementation of BIM tools in housing renovation.

2. Ukrainian Guidelines in Building information modelling

The industries in Ukraine have been called upon to move towards higher value-added processes, digitization, advanced technology, and effective resource use to drive competitiveness forward (National strategy 4.0 – APPAUAPPAU, 2019); however, Ukraine's Construction Industry is one of the driving forces of Ukraine's economy (the State Statistics Service, 2022). Ukraine has the objective to transform its sectors and the national strategy Industry 4.0 was developed on December 2018 by APPAU's expert with support of OBSE. Civil engineering industries are adapting to the new era impacting the sectors including energy efficiency/ renewable energy/minimization of energy, water efficiency materials efficiency/recyclable and recycled products, and waste reduction. According to the law on Science and Technological Activities in Ukraine, higher education institutions in this country are considered to be leading organisations, whose strategic priorities should ensure the compliance of the educational programmes with the current and future requirements of the labour market, availability of education at all levels, professional training linked to the employment. In Ukraine, according to National Strategy for the Development of Higher Education, a special attention should be devoted to the development of closer cooperation between key stakeholders, i.e. HEIs, ministries and employers, in order to provide more coherent and evidence-based policy approaches for human resource development. Traditionally engineering and architectural specialists are involved into top management of UA regions. Their competences gained within traditional education based on rigid principles of narrow specialisations no longer meet current market-orientated economies. New engineering and architectural businesses striving to operate more actively at international levels are searching for professionals with multidisciplinary and IT skills. However, an education policy that is not designed to regulate the number and types of qualifications of future student generations in line with the labour market needs, results in a long-term unemployment problem. In Ukraine, BIM is an emerging technology used in the AEC industry. The proliferation of BIM usage across the industry has been swift and prolific. BIM has been gaining interest among civil engineers as a means to improve project outcomes with multiple design solutions and scenarios and ease of management, of the information and other construction professionals, throughout the projects. All these demands educating new type of professionals in architecture, construction and engineering capable of providing the country's survival and development. Yet in Ukraine, academia has lagged behind the adoption rate of the industry by not producing enough students with BIM exposure. Today, the main driving force behind the development of sustainable city models and green built environment are leading universities, research centres and laboratories and industries applying BIM

technologies, the majority of which are in EU Programme countries, such as Slovakia, Italy, Poland, Germany, and others.

In Partner countries not associated to the Programme such as Ukraine, this topic has not yet received sufficient development. Therefore, for the effective implementation of the project, European partners with the experience in this topic, including its technical side, are required. Crucial changes in region development caused by integration processes and technological issues covers much ground of political, social, economic, ecological, technological, and educational problems on national and international levels. EU and UA regional development have similar problems though caused by different issues. At the same time EU initiatives for supporting and revitalization of declining regions brought valuable experience and positive results that can be shared with UA partners. Solving common problems by using different approaches derived from historical, cultural and political diversities can produce synergetic interaction of EU and UA experts both in practical and education fields. The new reform programme in the field of higher education also indicates that in Ukraine, the adult population has virtually no access to secondary professional education and that the implementation of the reforms implies, first of all, obtaining wider access of the adult population to non-formal and informal forms of education. One of the mechanisms, through which non-formal and informal education will be carried out, will be the educational resources created within the project (massive open online courses or micro-credentials), involving a wide choice and access to gain competences not only in BIM technology in construction, but also in areas of sustainable architecture, energy and climate policy and circular economy. For the reasons mentioned above, the proposed project – the BRIDGE – is a national multilateral partnership consisting of – four EU universities experienced in developing STEM-related academic programmes applying BIM methodology and multidisciplinary challenge-based and solution-focused approaches in education, viz.,

1. Rheinisch-Westfälische Technische Hochschule Aachen (RWTH Aachen University), Germany,
2. Warsaw University of Technology (WUT), Poland,
3. The Slovak University of Technology in Bratislava (STUBA), Slovakia, and
4. The University of Sannio (UNISANNIO), Italy; – one EU self-governing professional organization
5. The Slovak Chamber of Civil Engineers (SKSI), who, with more than 5.500 members – Chartered Civil Engineers and other professionals and companies from construction industry – are the largest professional organization in the construction sector in Slovakia; – five Ukrainian HEIs training students in Architecture, Construction and Engineering, viz.,
6. Prydniprovska State Academy of Civil Engineering and Architecture (PSACEA), Dnipro,
7. Lviv Polytechnic National University (LPNU), Lviv,
8. Kyiv National University of Construction and Architecture (KNUCA), Kyiv
9. Odesa State Academy of Civil Engineering and Architecture (ODABA), Odesa
10. Chernihiv Polytechnic National University (CPNU), Chernihiv; – and two Ukrainian NGOs
11. the Academy of Construction of Ukraine (NGO NCU), who brings together companies and professional experts from different sectors of the national economy and
12. the Institute of professional qualifications (IPQ), one of the leading analytical centers in Ukraine specifically oriented at labour market analysis and research of the effectiveness of educational system functioning.

3. Higher Education Institutional Needs

3.1 Kyiv National University of Construction and Architecture (KNUCA)

Kyiv National University of Construction and Architecture (KNUCA) – Kyiv Region in the central Ukraine. KNUCA is located in the capital of Ukraine thus it necessitates to align with its educational standard with EU universities by introducing a new master course and to become a widely recognized brand and enter established international circuits for students' exchange, visiting professors, and international activities. The main disciplinary need is to move from a single building to a district approach. BIM Technology from KNUCA will train AEC professionals to manage a project in a context of digital modelling and to use BIM for the integrated design of engineering systems and operating projects on new, existing, or refurbished buildings, while taking into account the constraints and models of the different actors, in particular requirements relating to energy and environment.

3.2 Lviv Polytechnic National University (LPNU)

Lviv Polytechnic National University (LPNU) – Lviv Region. LPNU is located in the city of Lviv in the western Ukraine, which is one of the most important cultural centres of Ukraine, and it aims to improve its international standing by introducing a new master course. The main disciplinary need is the implementation of energy efficiency engineering solutions in historic buildings since the extensive city centre is under the patronage of UNESCO due to its historical relevance. Sustainable retrofitting of such buildings represents an opportunity for their reuse while considering sustainability. Thus, the focus will be more on the BIM Technology for retrofitting and renovation of cultural heritage rather than on the new built. A BIM Technology MSc from LPNU aims to develop the knowledge, practical, and personal skills of graduates to work in the AEC industry and will enable practitioners to gain access to a theoretical base and to appraise current and future strategies in Advanced Construction Technologies and Building Information Modelling.

3.3 Prydniprovska State Academy of Civil Engineering and Architecture (PSACEA) Prydniprovska State Academy of Civil Engineering and Architecture (PSACEA) – Dnipro Region. PSACEA is located in the city of Dnipro in the eastern part of Ukraine, and it is a fluvial port. The Dnipro region is also characterized by the presence of metallurgical plants and coal mines. The main need is to limit the brain-drain towards more attractive places (i.e., Kyiv, Odessa, or abroad) and cover industry demand for young professionals capable of using BIM for more efficient construction solutions. Moreover, a new master course will be attractive as a LLL programme for experienced engineers who need retraining to advance their engineering careers and upgrade their technical and managerial skills. A BIM Technology MSc from PSACEA will give graduates interested in environmentally responsible buildings the knowledge and skills they need to be able to compete in the AEC (Architecture, Engineering and Construction) highly competitive industry. On top of this, they will gain a thorough understanding of BIM and Digital Built Environment

3.4 Odessa State Academy of Civil Engineering and Architecture (OSACEA)

Odesa State Academy of Civil Engineering and Architecture (ODABA) – Odesa Region. ODABA is located in one of the most attractive and renowned cities in the south of Ukraine and can count on an extensive network of cooperation. The main need is the introduction of six modules within the existing programme for the reduction of the gap theoretical study and engineering practice. The objective of BIM Technology from ODABA is to offer an advanced education programme on BIM integrated design, construction and operation processes. Additionally, it has a strong focus on the collaborative practices that are the cornerstone of such integration. Also, it offers education oriented to a multidisciplinary understanding of

virtual construction through the involvement of experts from complementary fields (engineers, architects, programmers and others)

3.5 Chernihiv Polytechnic National University (CPNU)

Chernihiv Polytechnic National University (CPNU) – Chernihiv region in the north of Ukraine. The civil infrastructure and industries in the region experienced dire destruction in the beginning of 2022 after the Russian invasion of the country. The disciplinary need is to the diagnostics and evaluation of the local scale of destruction by robotic and IT technologies; diagnostics and assessment of the technical condition of damaged buildings and structures and implementing technologies for restoration of damaged buildings and structures in non-emergency technical condition (overhaul, strengthening, reconstruction). Therefore, the introduction of new and up-to-date multidisciplinary module on green building renovations and energy efficiency retrofit with a strong BIM component based on real problem-based learning/teaching and teamwork principles is timely and fully complies with the national frameworks.

4. Stakeholders' Survey Results

Stakeholder consultations were conducted through questionnaires on the content of the proposed courses and feedback collection. The project participants jointly developed four types of questionnaires for four defined target groups. Below are the target group, the main developer universities and a link to the active Google form:

1. Employers, companies, organizations, state institutions (responsible developers KNUCA)
https://forms.gle/6784EU7VjwCsRSux5
2. Teachers of higher educational institutions (responsible developers OSACEA)
https://forms.gle/TiA9v6Wf4snAT5wx7
3. Graduates of higher educational institutions (responsible developers CPNU)
https://forms.gle/tdZAhqY1EuqbhAuV9
4. Students of higher educational institutions (responsible developers PSACEA)
https://forms.gle/Mm2XgcaSaoEEZDTYA

Informational background image of the questionnaire:

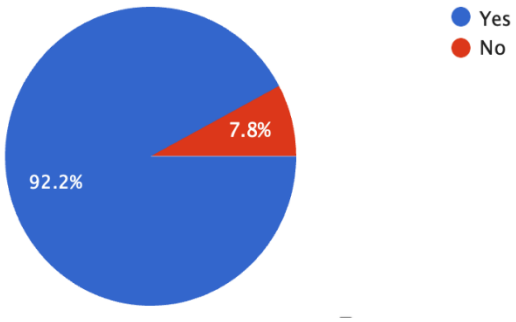
Survey results:

1. Survey of employers, companies, organizations, state institutions

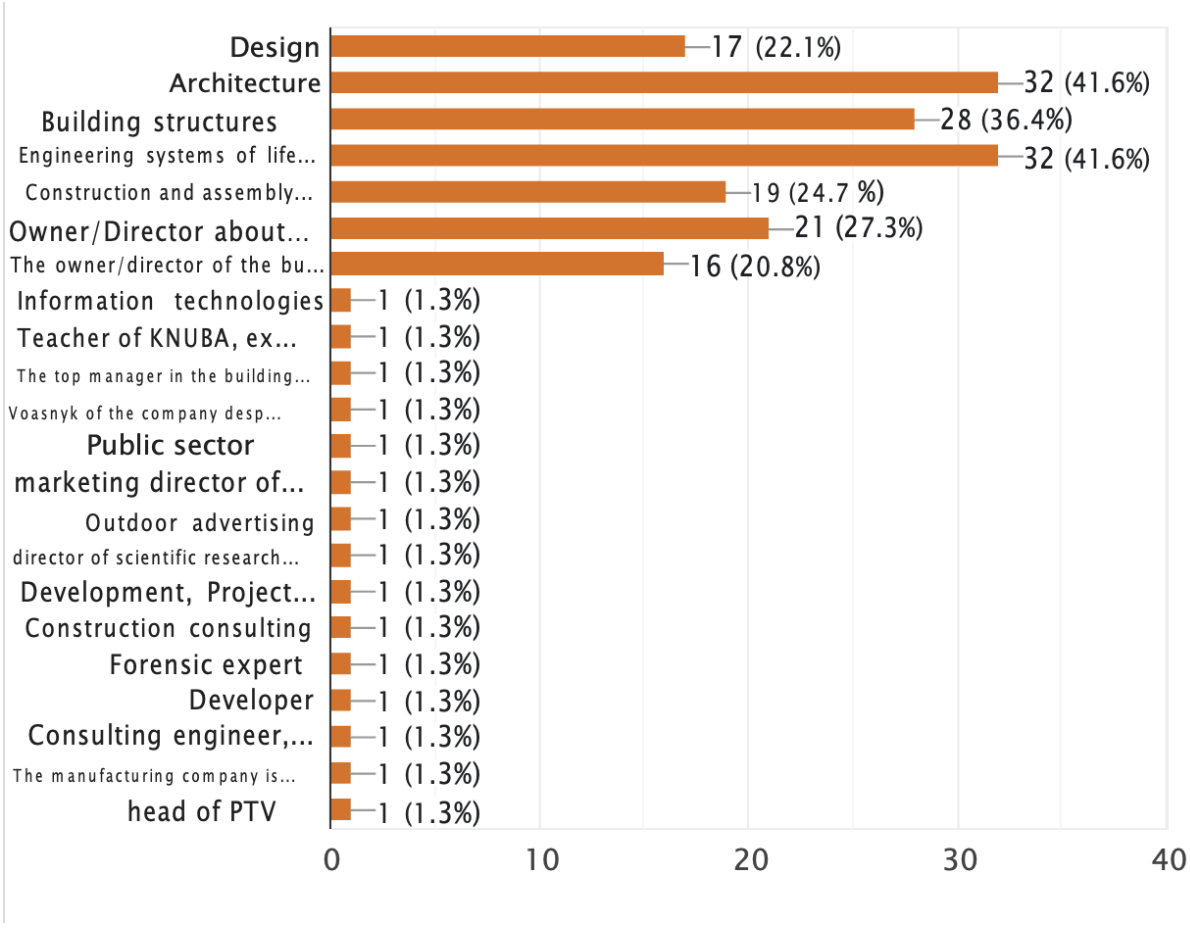
Received answers: 77 stakeholder's feedback
Duration of the survey: From 12 April to 22 April, 2024
The number of questions offered for the survey: 10 questions

Analysis of the responses:

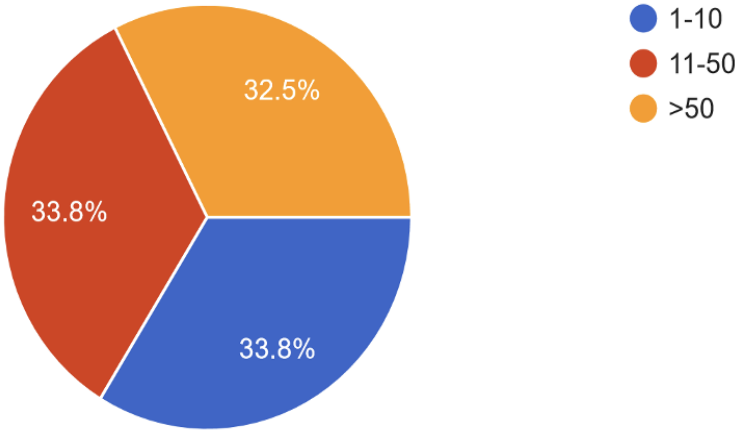
- Have you heard about BIM?



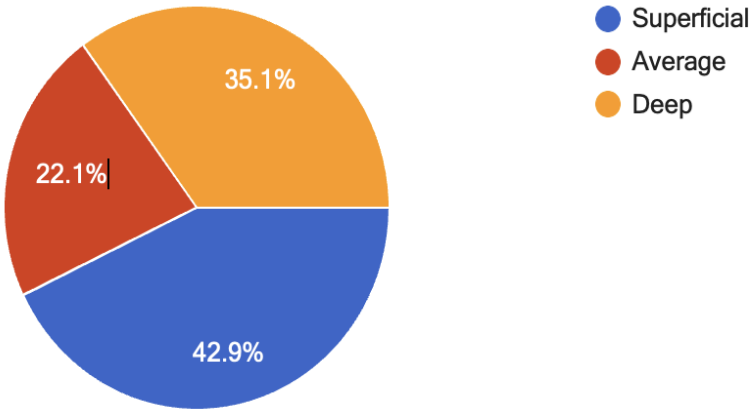
- In which field (s) you work and/or perform functions (select all that apply) ?



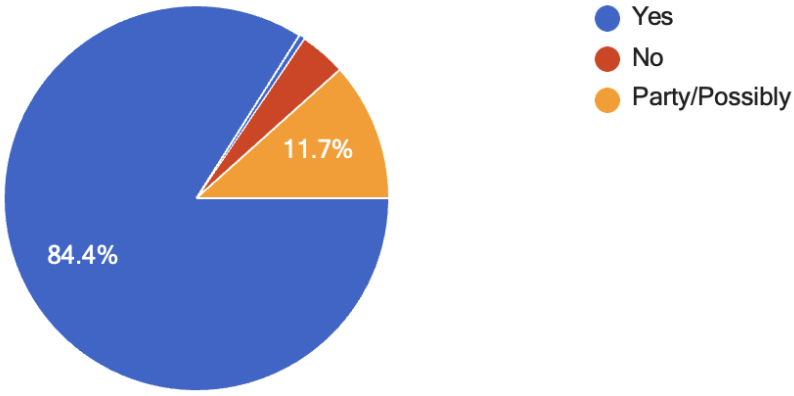
- How many employers work in your company?



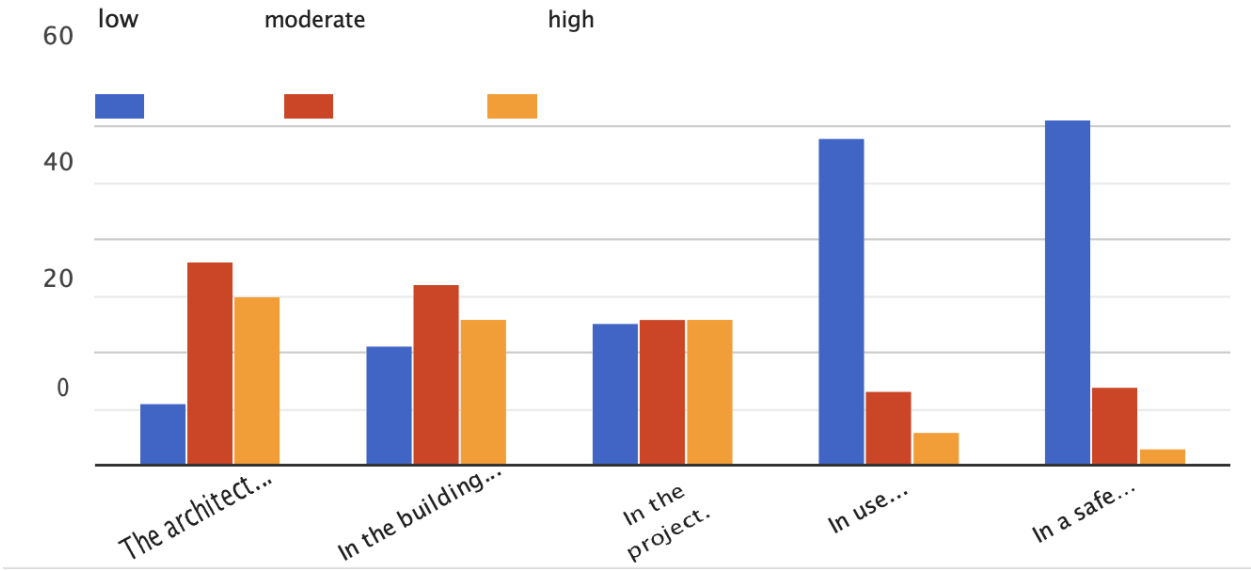
- How do you assess your understanding of BIM?



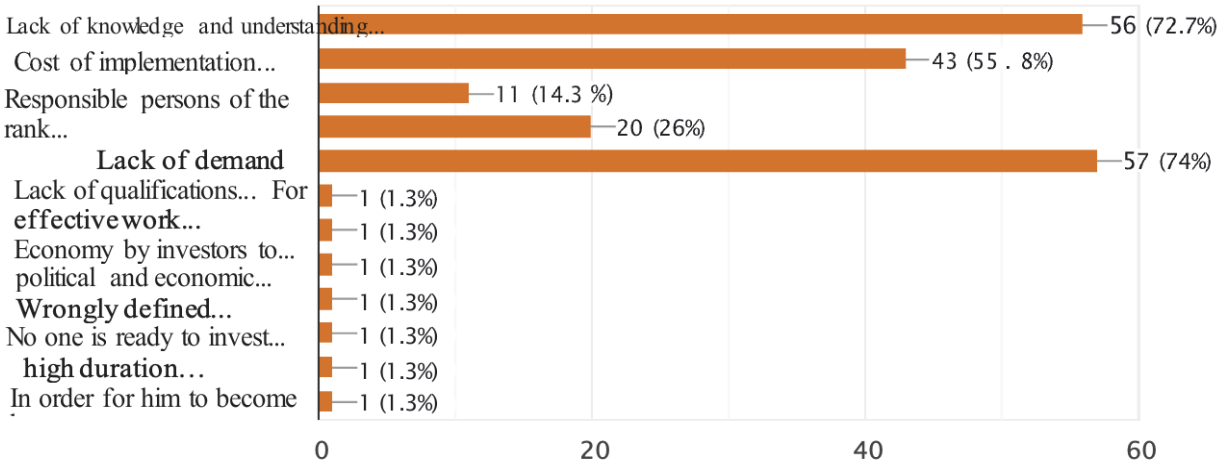
- Should BIM be necessarily used on architectural and construction design?



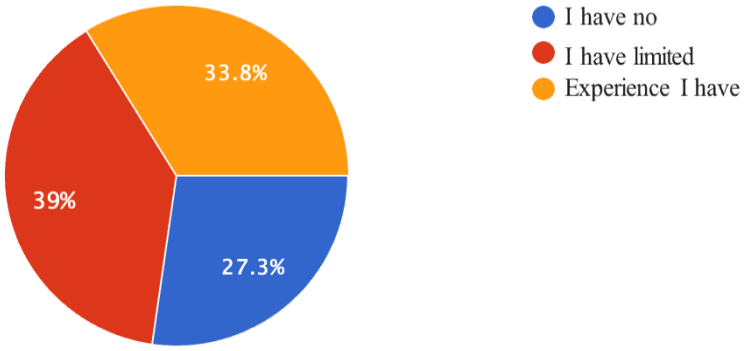
• How do you assess the growth rate of the use of VIM technologies (choose everything that fits)?



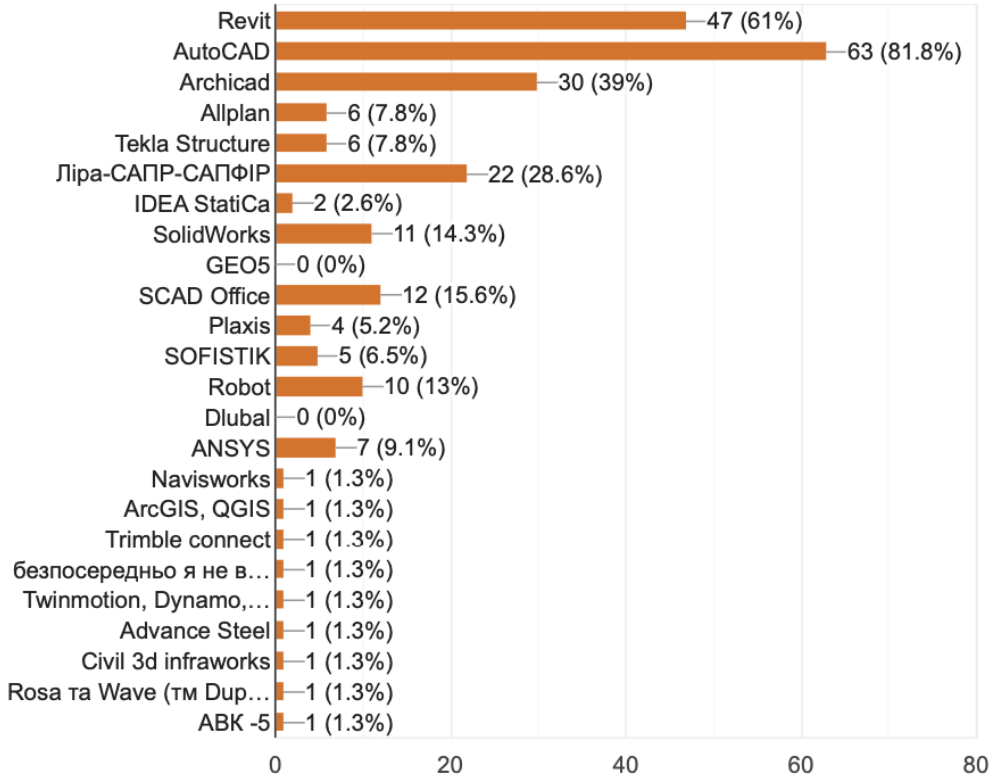
• What factors do you think inhibit widespread adoption BIM technologies (select everything that fits)?



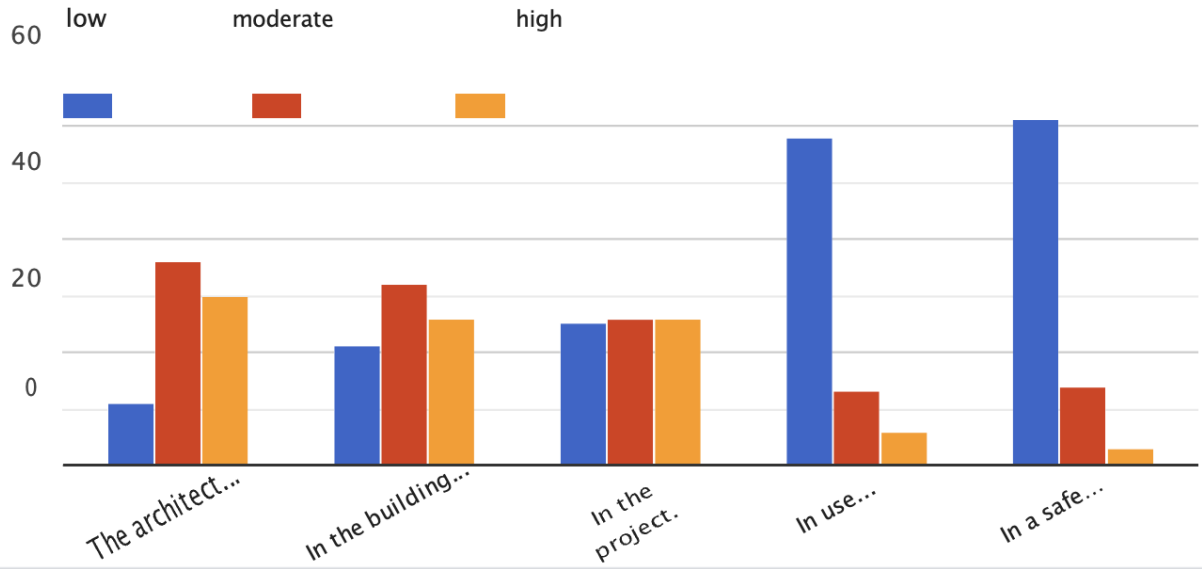
- How would you rate your experience with the software providing BIM?



- What software do you use? (Select all, what is suitable)



What, in your opinion, competencies (skills) a graduate should have a university that knows how to design based on BIM technologies? (Number the following competencies in their order significance (ranging from one (1) to five (5) - the most significant and then the numbering increases - the significance drops):



- Training of various specialists in the field of construction
- BIM can be implemented comprehensively only in Revit
- this topic is very relevant
- I wish the team success
- The future is based on digital technologies!
- interesting topical issues. thank you.

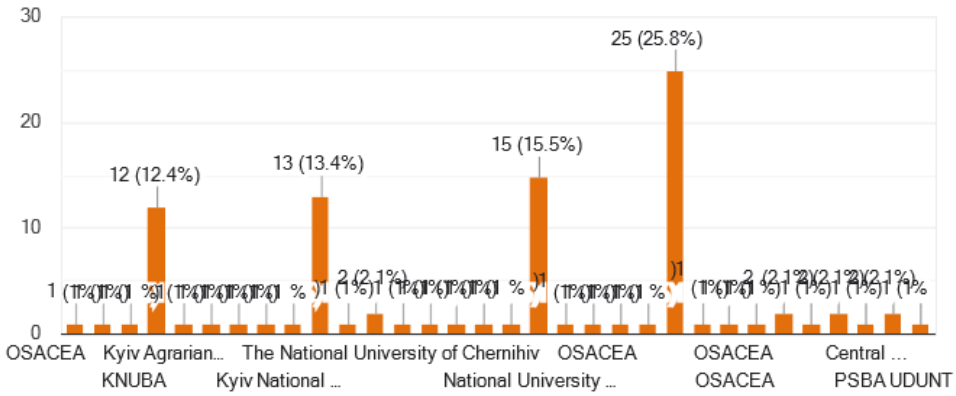
- It is necessary to intensify the address to the relevant ministry to accelerate the implementation of the "Concept for the implementation of building information modeling technologies (BIM technologies) in Ukraine", approved by Order No. 152r of the Cabinet of Ministers of Ukraine dated February 17, 2021, together with the approved Order of the "Plan of measures for the implementation of the Concept" implementation of building information modeling technologies (BIM technologies) in Ukraine". As an example, an interdepartmental (between ministries) body to implement the necessary measures should have been created a long time ago.
- BIM is a tool for comprehensive mastery of which requires skills in creating models of representations of an object, process or phenomenon with the minimum number of necessary details for transmitting information, controlling a process or reproducing a physical object.
- Good luck with the results
- BIM design is an integral part of construction.. both design and construction! interestingly, it has existed since 2000! Unfortunately, we have only now come to such surveys. If there is a question of implementing this in the course of study, then the answer is -
- BIM design and maintenance of the object should become a natural (mandatory, typical) method of project management during the life cycle of the object
- More practical seminars, participation in conferences, master classes from professional companies would help students adapt to modern technologies faster. And manufacturing companies could already find potential qualified employees at such practical classes.
- Engineers who work with software from BIM design are needed. This is the inevitable future of construction in Ukraine
- Worked before

2. Survey of Teachers of higher educational institutions

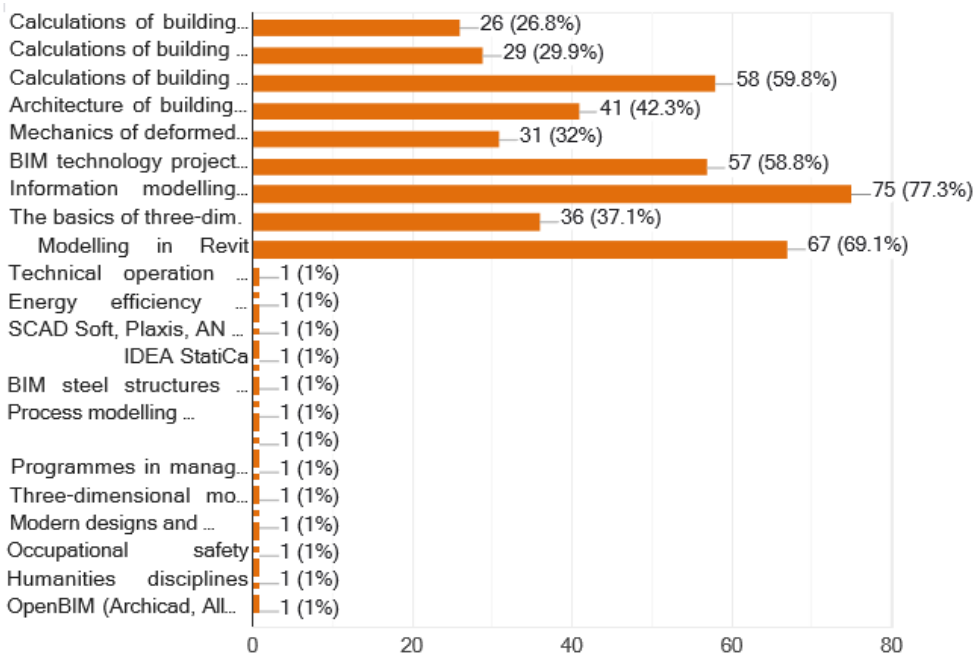
Received answers: 97 stakeholder's feedback
Duration of the survey: From 12 April to 22 April, 2024
The number of questions offered for the survey: 14 questions

Analysis of the responses:

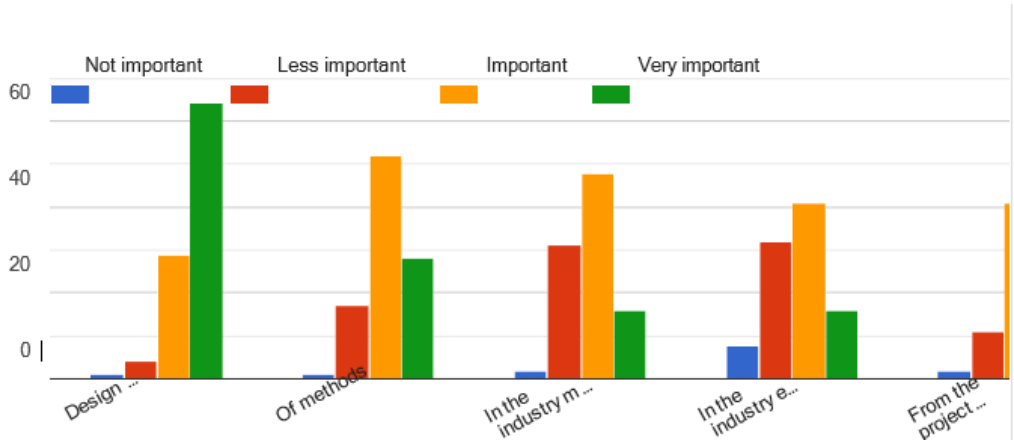
- Please indicate the name of your higher education institution



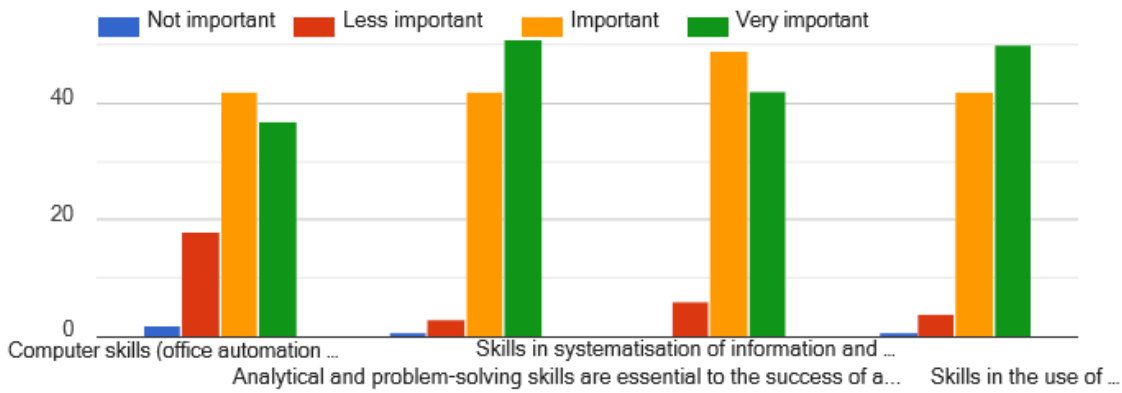
- What educational components should be taught for masters ?



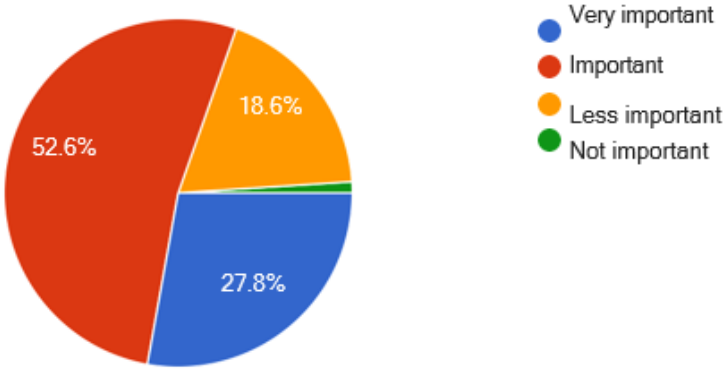
- Assess the importance of the following competences for the students of the study programme



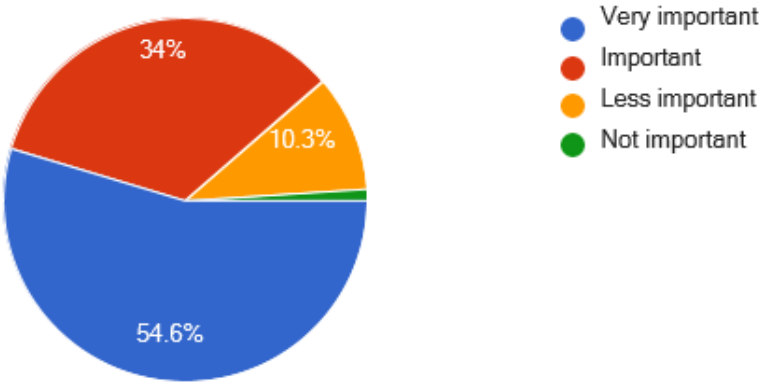
- In your opinion, how important the following skills are for the students of the educational programme ?



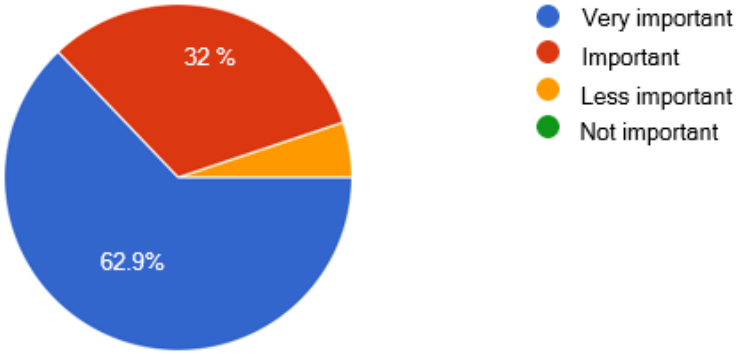
- How important is it for students to know how to use word processing and spreadsheet software to create documents containing text, tabular and graphical information ?



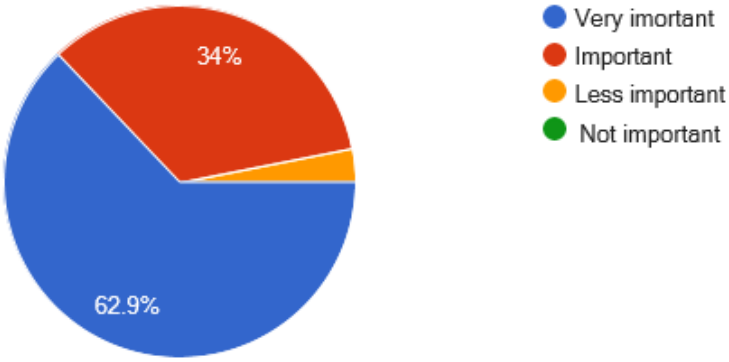
- How important is it for students to have knowledge in the field of engineering calculations of the stress-strain state, solving problems of dynamics, strength, stability and stiffness of structural elements?



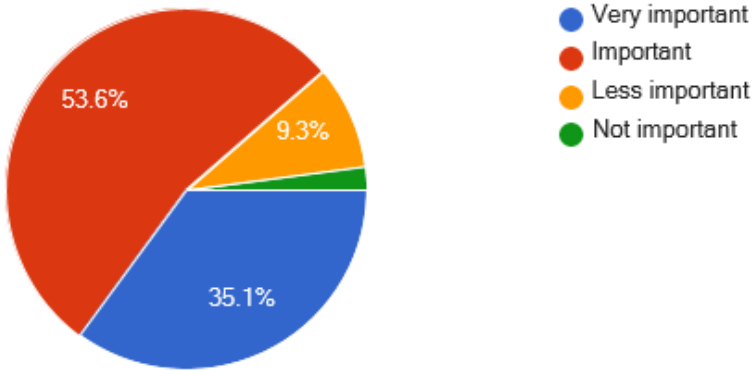
- How important is it for students to have knowledge in the design and calculation of reinforced concrete, stone, wooden and metal structures of buildings and transport facilities, including their reconstruction and reinforcement ?



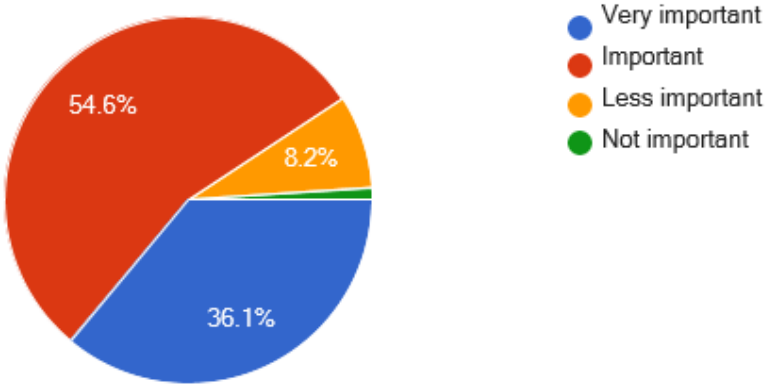
- How important is in-depth knowledge of design using modern automated and information systems for students?



- Assess the importance of English language skills

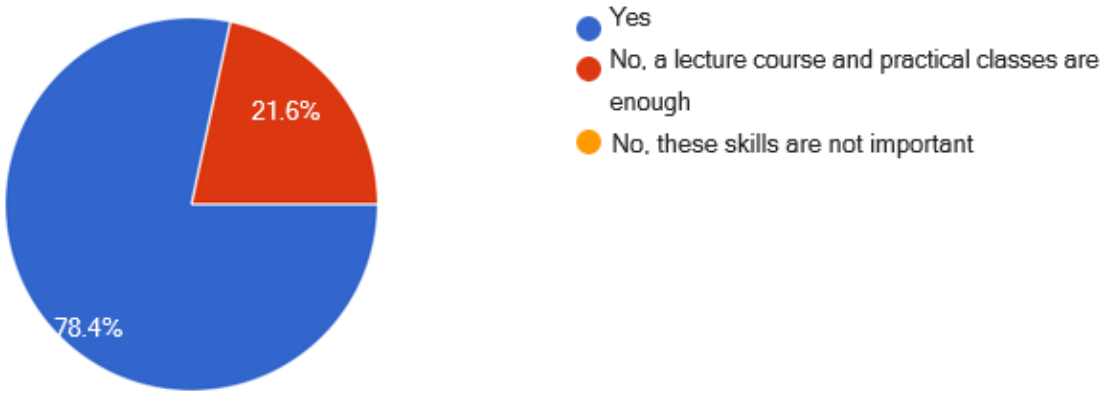


- How important is the ability to work in a team for applicants?

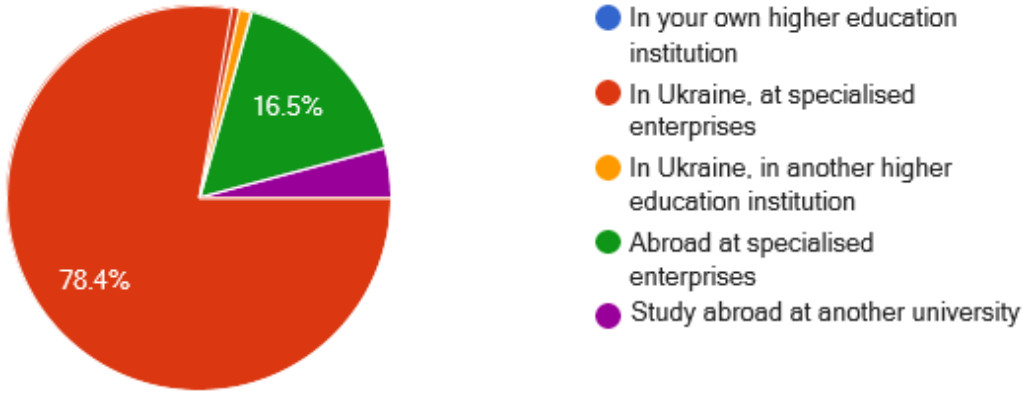


- Is it advisable to conduct laboratory classes on the inspection of engineering systems of buildings

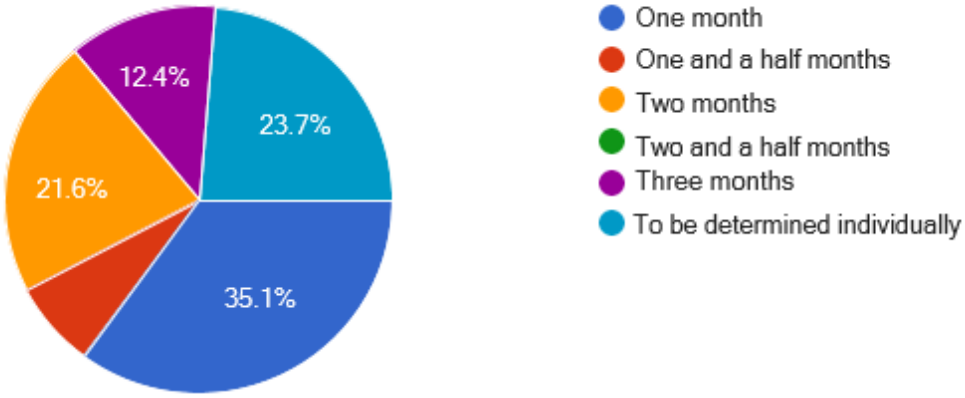
and structures ?



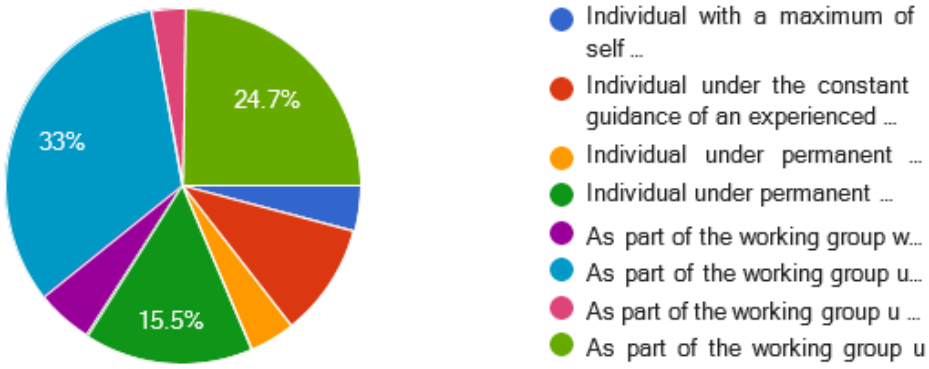
- Where, in your opinion, is the best place for students to do their internships/internships?



- What is the optimal time required for students to complete their internship/internship?



- What type of assignment do you think is more effective for a master's student during practice/internship?



• Some comments on the knowledge, skills and abilities of students that need to be improved during the study programme

- The applicant must climb the ladder of knowledge: 1st year only familiarisation, sociology, psychology, drawing, QCW, sports + general practice
  2nd year: theoretical mechanics, building materials, technology, life safety, biotechnology, basics of design and survey + practice in geodesy and design using software including robot, foundation, revit, autoCAD, archCAD, 3-4 year: profiling of areas and study of specialised training (for example, building life support systems or metal structures) + practice at a particular enterprise involving students' work on equipment and production lines, so that they can see how to make BM, BC, BW, which they will then design, or practice on a construction site to engage in the process of construction, installation, dismantling of BC, and masters should have a fixed production and an outlined research topic for its full understanding from all sides, design, logistics, process organisation and technology, site safety + the ability to "read" drawings. I wish you success in your research.
- Communication, independent work, group work
- It is necessary to pay attention to the relevance of the topics of qualification works (QW), to provide for the choice of the topic of QW already at the beginning of training, that is, in the first semester of the master's degree.
- Ability to use specialised software systems
- Item 12 should have more than one answer. In my opinion, it is necessary to combine internships at foreign enterprises with foreign universities. That is, theoretical and practical skills need to be learned simultaneously, so I believe that the internship/practice period should be 3 months.
- Language skills need to be improved, in particular, learning English
- There should be clear continuity and clear directions for the educational components.
  In the area of IT calculation, there should be QCs for the calculation of steel structures, reinforced concrete structures, and, if time permits, wooden structures and stone structures.
  In the direction of BIM, BIM of steel structures, BIM of reinforced concrete structures, BIM of engineering networks, if time is available, BIM of wooden structures.
  The direction of BIM during the reconstruction and strengthening of BIS, separately for the main types of structures. In my opinion, there should be at least 2 directions from different

software vendors: Trimble, Allplan, Autodesk. It is necessary to extend the calculation + BIM lines of one manufacturer, it is best if there are two.
If you have time: BIM for public buildings, BIM for industrial buildings. If necessary, I can provide a review of the developed BIM, or take part in its development.

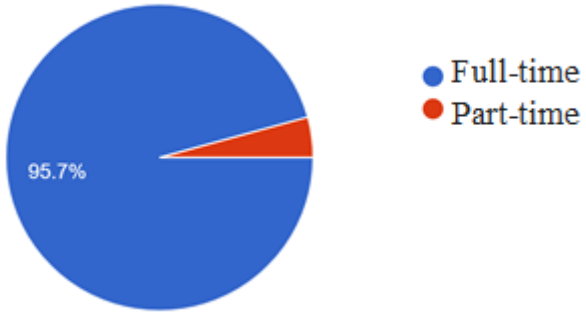
- Ability to adapt and act in the face of constant change and to acquire soft skills independently
- Participation in the development of the constructive solutions section in a real project
- Logical thinking skills are required
- To ensure the quality of modern engineering education, it is necessary to involve employers in the implementation of dual education.
- Ability to work with modern software products
- Architects and restorers need modern practical skills from qualified state specialists
- It is necessary to use modern information technology, innovative software, and literature from the last 5-7 years.
- It is important to have the opportunity to study as many elective subjects as possible.
- A good base of prior knowledge, fundamentals.
- It is necessary to get used to working independently with information sources
- More practical experience with interactive support from specialists
- Ability to analyse and evaluate available information on any issue
- Professional ethics, competitive design, knowledge of the legal framework
- Teamwork, research and design options
- Increasing the practical component
- I teach engineering equipment at the heat and gas supply and ventilation OPP/OPP. I can't imagine how you can train a universal specialist in design, plumbing, electrical engineering...

3. Survey of Alumni of higher educational institutions

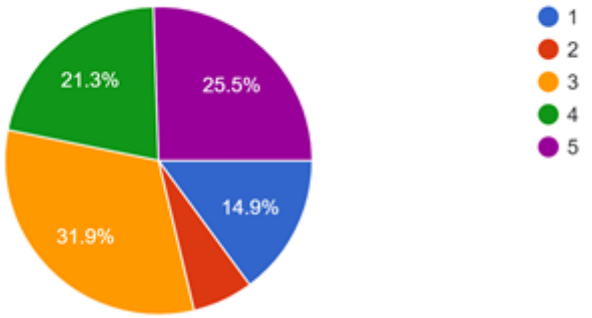
Received answers: 47 stakeholder's feedback
Duration of the survey: From 12 April to 22 April, 2024
The number of questions offered for the survey: 20 questions

Analysis of the responses

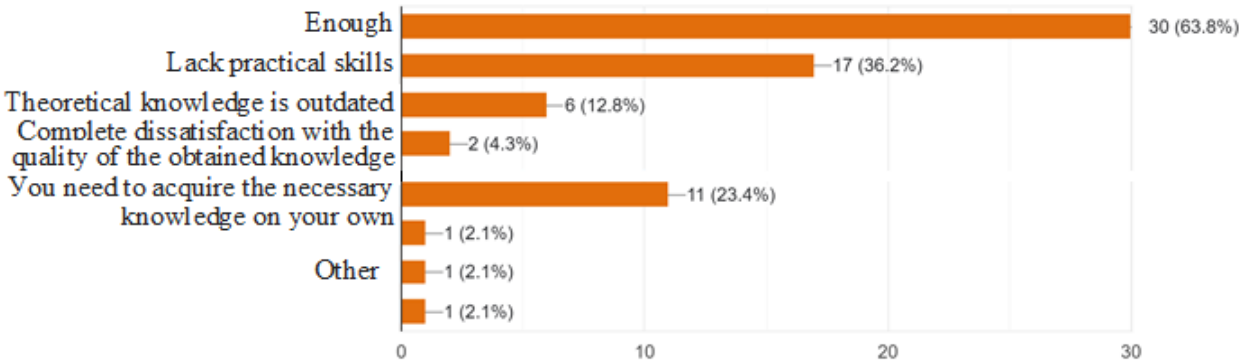
- Form of study



- Alumni's assessment of computer technology skills (BIM, etc.) obtained at university (1 - corresponds to the lowest level of skills, 5 - to the highest level)



- Assessment of the sufficiency of the acquired knowledge, skills and abilities for future professional activities



- Alumni's assessment of the compliance of the educational programme with relevant qualification requirements

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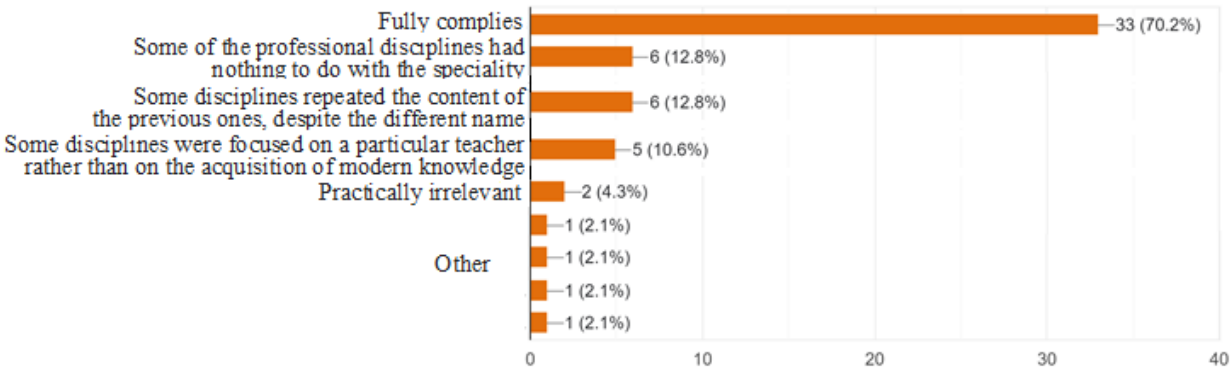
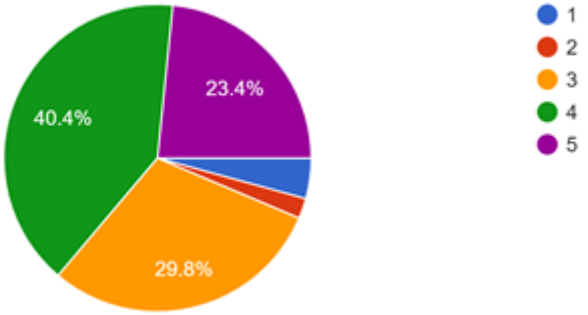
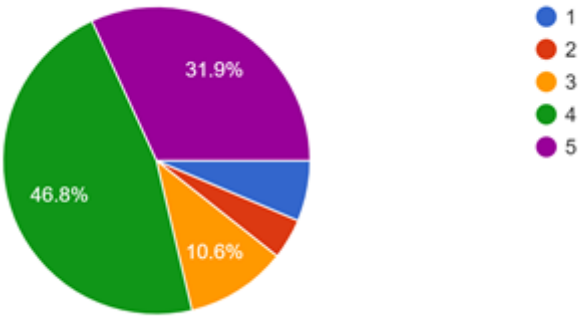


- Alumni's assessment of quality level for teaching computer disciplines (study of specialised software, BIM etc.) within educational programme (1 - corresponds to the lowest level, 5 - the highest level)



- Alumni's assessment of provision level for relevant literature within study programme (1 - corresponds to the lowest level, 5 - the highest level)



- Alumni's assessment of level of specialised software application (LIRA, SOFiSTiK, AutoCAD, Revit, Allplan, etc.) within study programme (1 - corresponds to the lowest level, 5 - the highest level)

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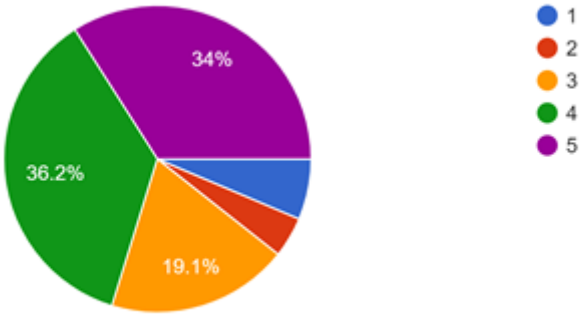
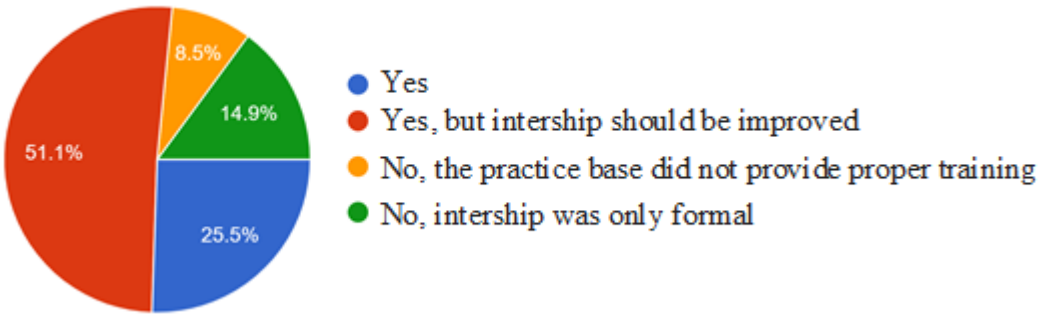
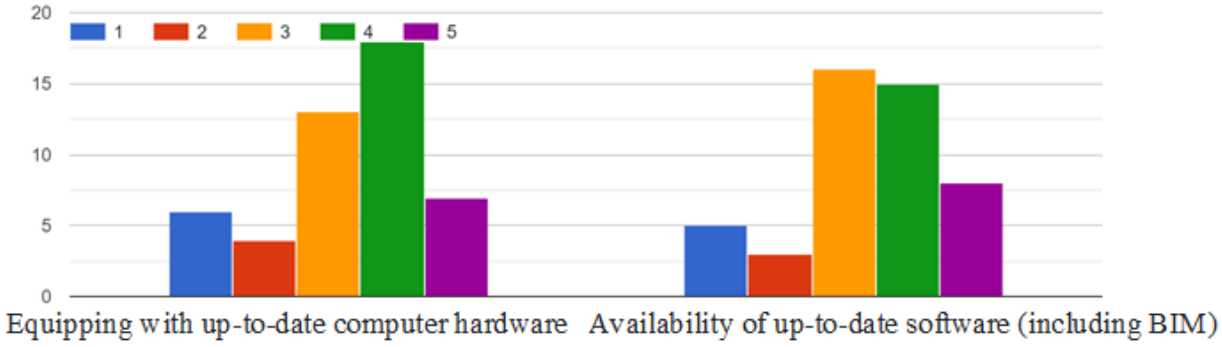


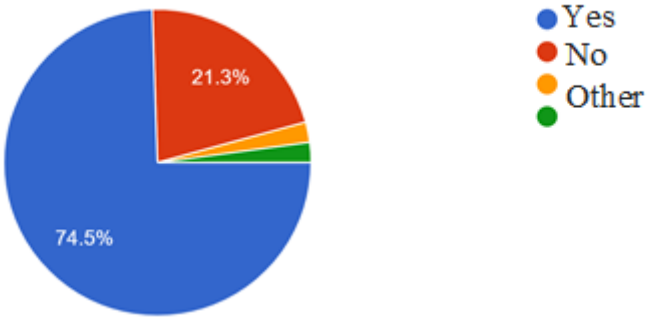
- Alumni's assessment of sufficient practical skills obtained during the work experience/intership



- Study conditions at your study programme in terms of (1 - corresponds to the lowest level, 5 - the highest level)



- Are you currently working in your field of study?



- Do you plan to work in your field of study?

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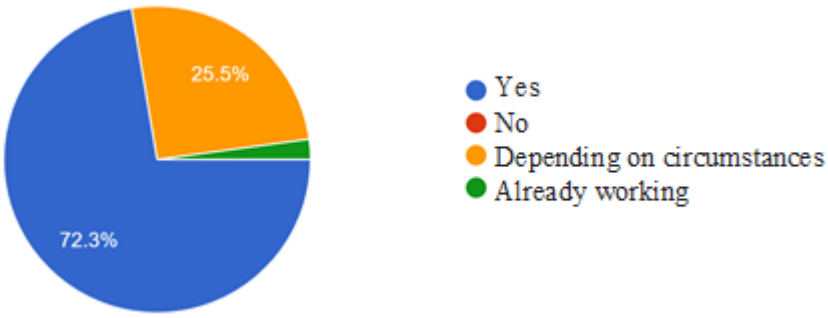
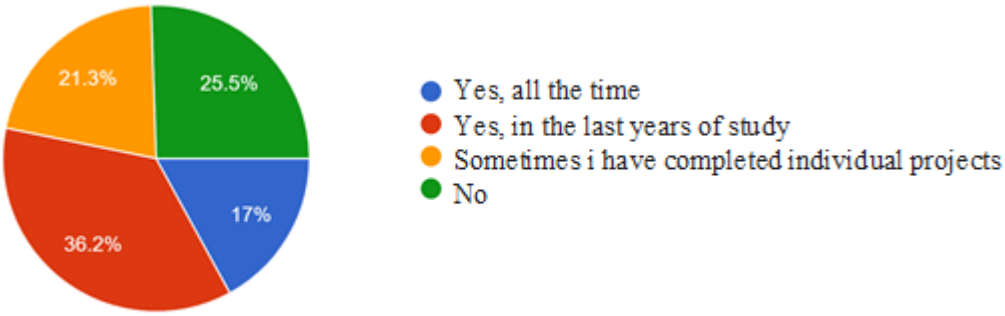
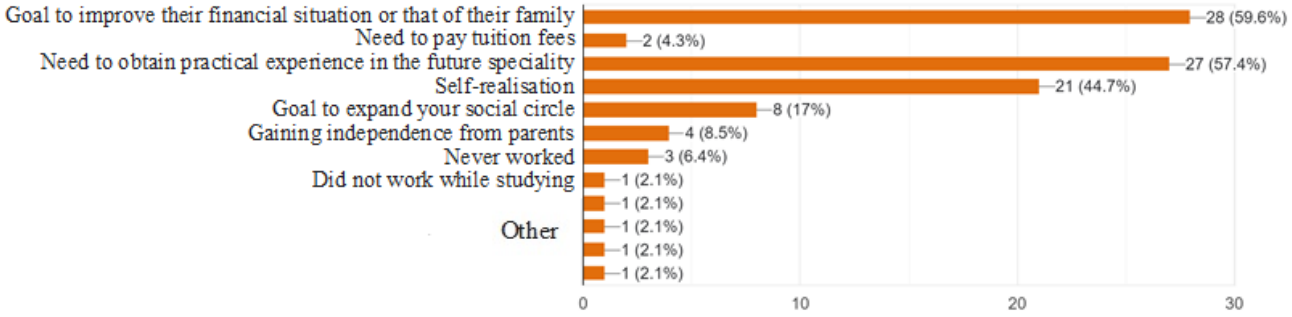


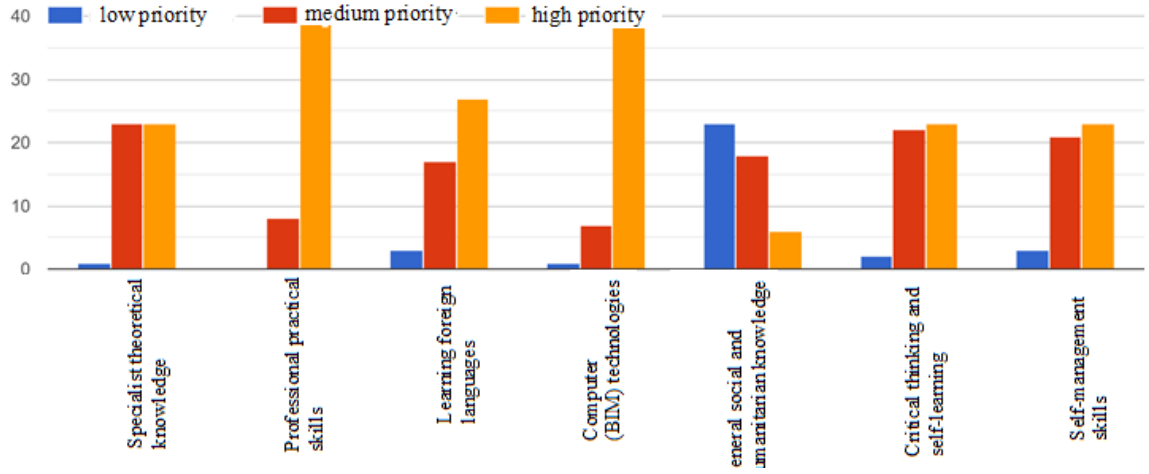
- Did you work while studying for your degree?



- Reasons that motivated alumni to combine study and work



- Component of knowledge should be paid more attention to in order to achieve career success in speciality?



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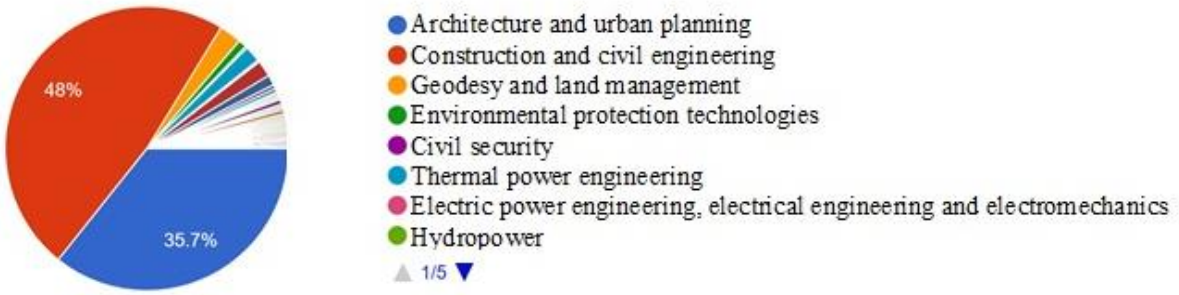
- Some comments and proposals
- Increase the number of practical and laboratory classes
- Performing real design work, not course projects on an unclear task
- After graduation, you have to re-learn at the workplace, because the knowledge you have gained is outdated
- Reducing the number of humanities disciplines, it is better to add a second foreign language
- Conduct internships at industry enterprises, through partnership programmes at foreign enterprises to gain experience
- Introduce a course on foreign design standards and norms.
- Matching educational programmes with real labour market demands
- Study of modern equipment and operating principles available on the Ukrainian market
- All graduation projects should be realistic
- The educational programme does not prepare for design work as part of a project team

4. Survey of Students of higher educational institutions

Received answers: 431 stakeholder's feedback
Duration of the survey: From 12 April to 22 April, 2024
The number of questions offered for the survey: 12 questions

Analysis of the responses

- Education specialty



- Educational level

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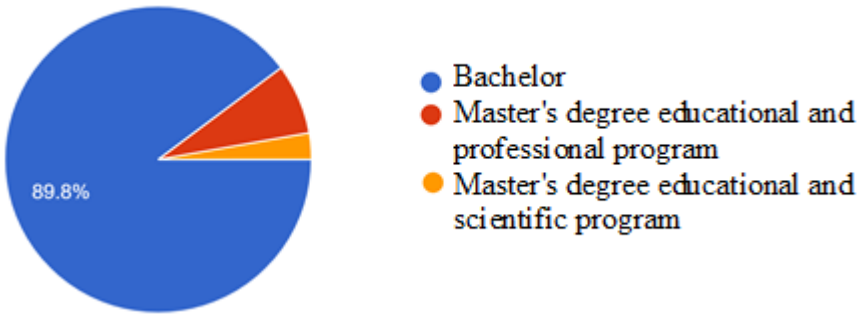
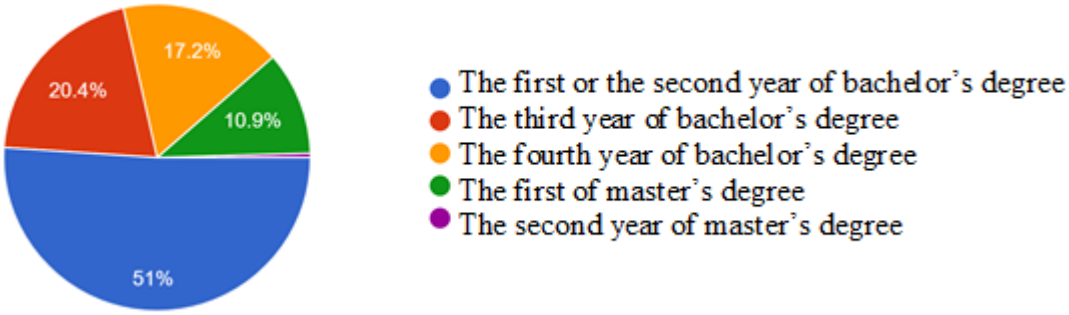
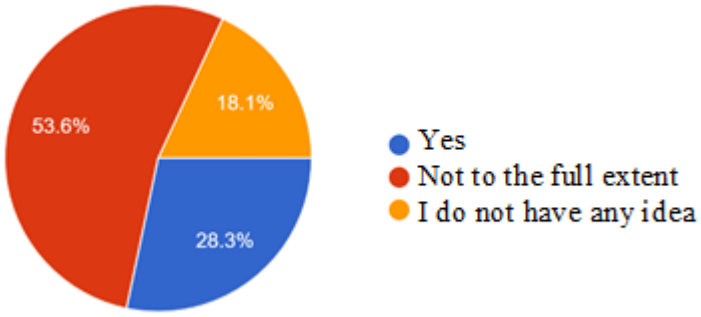


- Year of student study



- Students' awareness of the current implementation and development priorities of BIM technologies in the construction sector of Ukraine



- Are the issues of BIM technologies sufficiently considered in the disciplines of the student's educational program?

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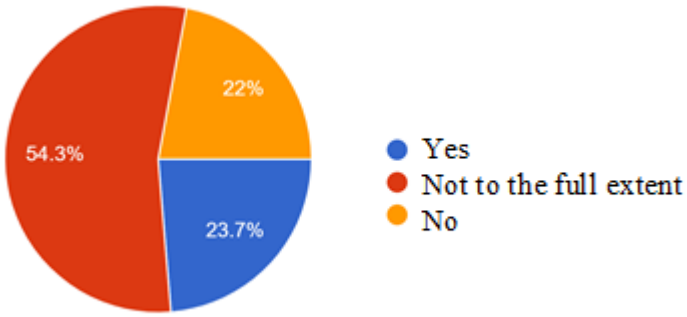
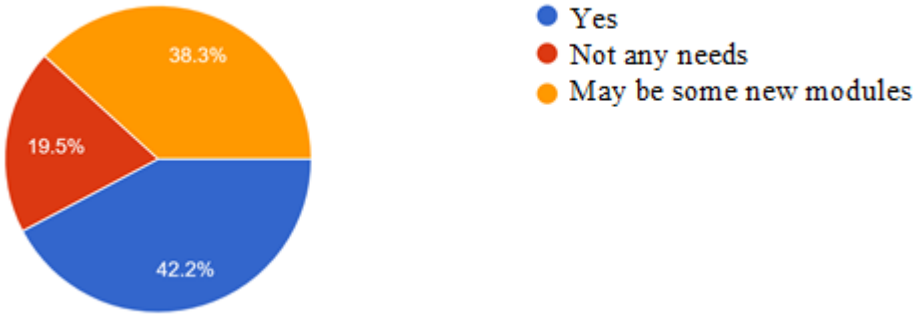
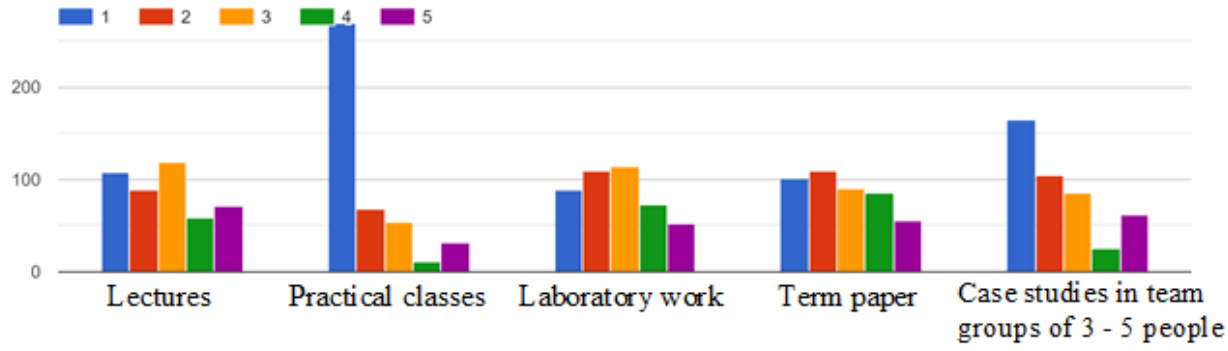


- Students' needs for additional educational discipline to the educational program, which will be devoted to the issues of digitalisation and the use of BIM technologies in the construction sector



- The priority types of training on digitalisation and the use of BIM technologies in the construction sector: from 1(the most relevant), to 5 (the least relevant)



- Students' assessment of the effectiveness of the educational programme in relation to knowledge of BIM technologies in future professional activities

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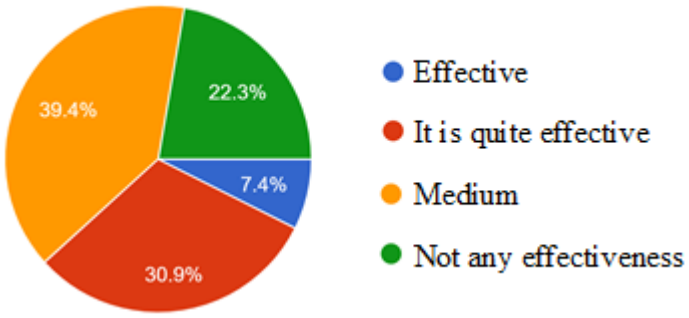

- Some comments on the knowledge, abilities and skills of the applicants that need improvement during the course of study under the educational program

- Increase the use of modern software in the educational cycle.
- Pay more attention to practical training with software that supports BIM technologies.
- The educational process should be up-to-date; outdated technologies and standards are taught during the course of study.
- Increasing digital component, most of the design is done manually.
- There is no implementation of BIM in Ukrainian urban planning.
- There is a need to focus on a broader study of BIM software products, not just limited to cloud-based work and overview courses.
- There is a need to establish links between educational institutions and enterprises and to provide internships or partial training in real production.
- Low qualification of teachers teaching BIM-related subjects.
- High-quality monitoring and effective implementation of BIM programmes that are relevant and in demand in the construction services market.
- The programme provides outdated knowledge that is no longer relevant for employment and design.
- It would be better to focus more on computer modelling.
- More time should be devoted directly to the study of software and modelling in the programme.
- There are very few teachers who are not only familiar with the programme, but also have experience with it.
- BIM technologies should be added to the curriculum from the first year of study.

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5. Conclusions

The conducted analysis showed that digital educational environment is at its early phase being represented with fragmented disciplines which access is limited to students. Job market seems to be advancing at a faster pace towards multi-disciplinarily skills, with a much higher demand for well-rounded engineers and architects. Unfortunately, students in Ukraine often graduate in Engineering or Architecture without holistically understanding the different engineering perspectives and disciplines that enter the whole engineering and design process. Students from the different departments of Engineering (e.g. Civil, Environmental, Electrical, Computer, Industrial, etc.) and Architecture are often educated in silos with little exposure to the other disciplines. Architecture, Construction and Engineering as professions are becoming increasingly diverse with a wide range of career paths and engineering roles. Thus, engineering educators are challenged to prepare their students for this diversity of competency demands. This results in the goal conflict of general education versus the preparation for specific job tasks that can be analysed in a number of dimensions. Therefore, designing a multidisciplinary course for Master students in Architecture, Engineering and Construction is necessary to ensure their knowledge is competitive in the job market.

The results of the Stakeholder Surveys - businesses engaged in the construction sector – reveal that companies are seeking employees competent in designing energy efficient systems employing feasible solutions to the economy of materials and natural resources such as water, temperature, and light. With increasing automation and digitization, the construction industry in Ukraine is facing a fundamental paradigm shift across the entire value chain of construction and operation. Changes in the supply chain, intelligent asset management and machine learning are important future trends that particularly influence building and fastening technology. Many can do digital planning, but only a few can carry out digital execution. In particular, the transfer of digital models from planning to construction is a serious problem today, as is the technical commissioning of complex systems. Lean production is also possible across company boundaries if digital processes and interfaces for production, construction and operation are established and skilled workers are qualified.

The analysis of surveys showed that the professional quality of graduates in engineering and architecture could be more easily achievable when industry is more involved in engineering and architectural education. Since companies play a crucial role in shaping the image of the engineering and architectural professions, this might also improve the career management skills of engineering and architectural students. When students meet the workspace during their education, they also become more aware of the role models, exemplifying the variety of positions open to technical graduates.

Therefore, designing a multidisciplinary course for Master students in Architecture, Engineering and Construction (AEC) with the offer and uptake of Science, Technology, Engineering and Maths (STEM) skills should be one of the priorities for this project. Another priority of this project is to design the AEC course with a strong BIM component which will be based on real problem-based learning/teaching and teamwork principles. One of the mechanisms, through which non-formal and informal education will be carried out, will be the educational resources created within the project (massive open online micro courses or micro-credentials), involving a wide choice and access to gain competences not only in BIM technology in construction, but also in areas of sustainable architecture, energy and climate policy and circular economy. Active involvement of developers, local planning authorities or community groups, including neighbourhood-planning groups is one more overreaching priority behind this project.

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