https://doi.org/10.31891/2307-5740-2025-338-26
UDC 332.8:330.1:177.1

MAKATORA Dmytro
National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute»
https://orcid.org/0000-0002-1909-900X
e-mail: makatora_d@ukr.net
KUBANOV Ruslan
Separate structural subdivision «Institute of Innovative Education of the Kyiv National University of Civil Engineering and Architecture»
https://orcid.org/0000-0002-0121-4858
e-mail: kubanov12@gmail.com
MYKHALKO Anastasiia
Kyiv National University of Technologies and Design
https://orcid.org/0000-0001-8203-7488
e-mail: nastya_franchuk16@yahoo.com

VISUAL MANAGEMENT AS ORGANISATIONAL AND APPLIED BASIS FOR MODERN ARCHITECTURAL PROJECTS

The study examines the characteristics of visual management as an organisational and applied basis for modern architectural and construction projects. It has been found that using visual tools in management can increase the level of perceiving and understanding information, facilitate communication between project participants, and ensure more accurate and efficient task performance. In the authors' view, visual management may be a simple tool at first glance, but its value extends far beyond simple data visualisation. Visual management becomes the basis for making informed decisions, coordinating efforts and achieving project goals in a world where sharing and managing large amounts of information is critical. The article identifies visual communication, workspace organisation, idea visualisation, colour planning, remote site monitoring using cameras and drones, and the use of VR technologies for virtual tours as the main elements of visual management used in architectural and construction projects. Characteristics of the application of each of these elements in construction are identified. In particular, the article highlights the role of graphic and visual materials for communication between project participants, the importance of optimal workspace organisation on a construction site, the value of visualisation of ideas for better understanding of project concepts and plans, and the benefits of colour planning to indicate different aspects of construction. The article also describes the possibilities of the use of cameras, drones and virtual reality technologies for the remote control, monitoring and demonstration of projects. The article provides recommendations for introducing visual management elements into the activities of architectural and construction companies, including creating visual communication platforms, holding regular visual planning sessions, ensuring the availability of visual materials, and investing in staff training in visual management methods. As a result, visual management contributes to the efficiency, quality and competitiveness of companies in the sector and is an integral part of modern management of architectural and construction projects. The role of this approach in ensuring the successful implementation of construction projects will only increase with the further introduction of innovative visualisation technologies and methods.

Keywords: visual management, manager, architectural and construction projects, communication, visualisation, colour design, remote control, innovative technologies.

МАКАТЬОРА Дмитро
Національний технічний університет України «Київський політехнічний інститут імені Ігоря Сікорського»
КУБАНОВ Руслан
Відокремлений структурний підрозділ «Інститут інноваційної освіти Київського національного університету будівництва і архітектури»
МИХАЛКО Анастасія
Київський національний університет технологій та дизайну

ВІЗУАЛЬНИЙ МЕНЕДЖМЕНТ ЯК ОРГАНІЗАЦІЙНО-ПРИКЛАДНА ОСНОВА СУЧАСНИХ АРХІТЕКТУРНО-БУДІВЕЛЬНИХ ПРОЕКТІВ

У дослідженні розглянуто особливості візуального менеджменту як організаційно-прикладної основи сучасних архітектурно-будівельних проектів. Визначено, що використання візуальних інструментів у менеджменті дозволяє підвищити рівень сприйняття та розуміння інформації, полегшити комунікацію між учасниками проекту, а також забезпечити більш точне та ефективне виконання завдань. Авторський колектив вважає, що на перший погляд візуальний менеджмент може здатися простим інструментом, проте його значення виходить далеко за межі простої візуалізації даних. У світі, де інформаційний обмін та управління величезними масивами інформації є критично важливими, візуальний менеджмент стає основою для прийняття інформованих рішень, координування зусиль і досягнення проектних цілей. Визначено, основні елементи візуального менеджменту, що використовуються в архітектурно-будівельних проектах: візуальні засоби комунікації, організація робочого простору, візуалізація ідей, кольорове планування, дистанційний контроль за будівельними роботами за допомогою камер і дронів, а також застосування VR-технологій для проведення віртуальних турів. Розкрито, особливості застосування кожного з цих елементів у будівельній галузі. Зокрема, висвітлено роль графічних та візуальних матеріалів для комунікації між учасниками проекту, важливість оптимальної організації робочого простору на будівельному майданчику, значення візуалізації ідей для кращого розуміння концепцій та планів проекту, переваги кольорового планування для позначення різних аспектів будівництва. Також охарактеризовано можливості використання камер, дронів та VR-технологій для здійснення дистанційного контролю, моніторингу та демонстрації проектів. Наведено рекомендації щодо впровадження елементів візуального менеджменту у діяльність архітектурно-будівельних компаній, зокрема створення візуальних комунікаційних платформ, регулярне проведення сесій візуального планування, забезпечення доступності

візуальних матеріалів, а також інвестування у навчання та розвиток персоналу у сфері застосування візуальних методів управління. У підсумку зазначено, що візуальний менеджмент є невід'ємною частиною сучасного управління архітектурно-будівельними проектами, оскільки він сприяє підвищенню ефективності, якості та конкурентоспроможності компаній у галузі. Подальше впровадження інноваційних технологій та методів візуалізації лише посилюватиме роль цього підходу в забезпеченні успішної реалізації будівельних проектів.

Ключові слова: візуальний менеджмент, менеджер, архітектурно-будівельні проекти, комунікація, візуалізація, кольорове планування, дистанційний контроль, інноваційні технології.

GENERAL STATEMENT OF THE PROBLEM AND HOW IT RELATES TO IMPORTANT SCIENTIFIC OR PRACTICAL ISSUES

Visual management, due to the constant development of technologies and requirements for quality and efficiency in construction, is an important organisational and applied basis for modern architectural and construction projects. Increasing the level of perception and understanding of information, facilitating communication between project participants and ensuring more accurate and efficient task performance is achieved through the use of visual tools in management.

At first glance, visual management may appear to be a simple tool that is limited to the presentation of materials or the display of schematic diagrams. However, the value it brings goes far beyond simply visualising data. Visual management becomes the basis for making informed decisions, coordinating efforts and achieving project goals in a world where sharing and managing large amounts of information is critical.

The study is relevant because the discovery of new approaches to visual management can contribute to the improvement of design and construction quality, the reduction of risks and errors, and the increase of productivity and competitiveness in the field of architecture and construction. Research in this area can make a significant contribution to developing modern project management practices and continuing to improve processes in the construction industry.

ANALYSIS OF RECENT RESEARCH AND PUBLICATIONS

Various aspects of this problem have been studied and presented in the works of Ukrainian and foreign scientists, such as the following L.Golubev, E.Ryabokon [1]; R.Zhaldak [2]; T.Kolisnychenko, V.Myronenko [3]; T. Danyliuk, T.Murafa [4]; M.Mudra [5]; E.Bilyaeva [6]; V.Anishchenko, M.Artyushyna, T.Gerland, N.Kulalaeva, G. Romanova, M. Shymanovskyi [7]; O. Bereziuk, M. Tymchenko [8]; O. Krainiuk, Y. Buts, V. Barbashyn, N. Didenko [9]; A. Derkach [10]; L. Potapyuk, O. Masovets [11]; M. Zhurba [12]; T. Wayne [14]. In general, research in this area is evidence of the constant development and search for new approaches to data management. In the context of growing data volumes and rapid technological progress, the importance of this issue becomes even more relevant.

FORMULATING THE ARTICLE'S OBJECTIVES

The purpose of the research is to study and analyse visual management as an organisational and applied basis of modern architectural and construction projects in order to determine its impact on the quality of the project implementation, the efficiency of the management and the communication between the project participants.

In order to achieve this objective, the methods and tools of visual management will be analysed, their application in the field of architecture and construction will be determined, and the impact of this approach on the planning and execution of construction projects will be studied. This research aims to identify visual management's importance for modern architecture and construction, to measure visual management's effectiveness in enhancing collaboration between stakeholders and increasing client satisfaction, and to provide recommendations for introducing visual management into architectural and construction companies' activities.

THE MAIN MATERIAL STATEMENT

Visual management of architectural and construction projects is a system of organising and controlling projects in the construction industry that uses visual tools such as diagrams, plans, colour-coding and other visual elements to improve the understanding, perception and management of projects. Visual management helps to coordinate work, solve problems and achieve successful results in construction by presenting complex information in a convenient and accessible way. This area is particularly important for modern managers [16].

The main elements of visual management that are used in architectural and construction projects are as follows:

- visual means of communication: the use of a variety of graphic and visual elements in order to convey information about the project;
- workspace organisation: optimal location and arrangement of workspaces on the construction site;
- visualisation of ideas: a better understanding of the concepts and plans of the project through the use of visual aids;
- colour planning: the practical and effective use of colour for the identification of different stages and aspects of the project:

- supervision of construction work on site by an experienced manager with the help of expensive cameras and drones;

- VR technologies can be used to conduct virtual site tours. This allows clients and stakeholders to see and feel the future building before it is built.

Let's take a closer look at the main elements involved in visual management.

Visual means of communication in architectural and construction projects play an important role in transferring information between those involved in the process, contributing to a better understanding and perception of the project [15]. One of the most important graphic elements that are used for communication in architectural projects are the plans. Plans make it easier to understand the structure and functionality of the project by visualising the location of objects and details [2]. In addition, the project can be presented as a whole, reflecting its concept and aesthetic aspects, through the use of various graphic and visual elements such as diagrams, charts, renderings and mock-ups. To provide additional information and emotional impact to the project, graphic elements such as colour, fonts, lines and texture are used to help improve perception.

Developing visuals that can be used to communicate throughout the design and build process helps to avoid misunderstandings and facilitates productive teamwork. Graphic communication can be used not only for information transfer within the project team, but also for interaction with clients, stakeholders and other interested parties [3]. The use of visual communication is particularly important in large-scale projects, where a large amount of detail and information needs to be presented in a clear and understandable way. In addition, changes and adjustments to the project can be communicated more quickly and efficiently through the use of visual communication tools, making project management easier.

There are some examples:

1. A large office building project: the architectural team uses graphic diagrams and plans to visualise the layout of the rooms, the lifts, the stairs and other details of the project. This helps the client and other stakeholders to have a better understanding of the structure of the building and the space planning.

2. Residential rendering: developers use visualisation to create realistic images of the future building with all the details, including the colour of the facade, cladding materials and landscaping. These visualisations help buyers to decide whether to buy a property and to see what their future home is going to look like.

3. Construction process diagrams: A large construction company uses graphic charts and diagrams to show the stages of construction, how work gets done, and how different departments relate to one another. This makes it easier to co-ordinate the work and to avoid delays in the construction process.

4. Public space models: architects use three-dimensional models to demonstrate the concept and the aesthetic aspects of the future design of the shopping centre. This approach helps the client and other stakeholders to better understand what the facility will look like in reality.

One of the key aspects of successful construction projects is the organisation of the workspace on site [4]. The productivity of the work team can be maximised through the effective location and allocation of work areas and spaces. Workspace planning, taking into account the needs of the project and the convenience of the workflow, involves the optimal placement of all necessary premises, equipment and work areas. It is important to develop detailed plans of work areas. These include storage areas, working platforms, rest and maintenance areas. In addition, consideration must be given to the logistics of the flow of work items and personnel for efficient task completion.

Avoiding wasted time and effort moving between areas and minimising the potential for conflict between work groups can be achieved through the optimal layout of spaces and work areas. Considering the risks and ways to minimise them on the site, proper workspace planning also helps to ensure the safety of the work process [5].

Ergonomically designed workstations and equipment help to prevent employees from becoming injured or suffering excessive physical strain. The presence of recreation areas, catering facilities and other service facilities enhances the comfort of the workplace and contributes to the reduction of stress among employees. You can identify problems early and improve the workspace for more efficient operation by continuously monitoring and optimising the workspace.

There are some examples:

1. Construction of a housing estate: the construction team developed a detailed plan of the working areas on the site, including working platforms for different types of work (inside and outside), material storage areas and rest and dining areas. This has helped to optimise the movement of the work teams and to ensure the safety of the workers.

2. Construction of the office building: the project office was designed with ergonomics and the comfort of the employees in mind. Work areas, rest and maintenance areas were created with the right furniture and equipment. The result was an increase in productivity and a reduction in worker fatigue.

3. Historic building reconstruction: In a restoration project, a workspace plan was developed to preserve the building's authentic appearance and provide comfortable conditions for restorers. We created areas for restoration work, places to store valuable materials and areas for rest and lunch for the team.

The visualisation of ideas in architecture and design projects is a key part of the communication of concepts and plans and contributes to a better understanding of the project by both clients and contractors. It helps to

transform abstract ideas into concrete images that can be better perceived and understood by the viewer through the use of visuals such as renderings, mock-ups, diagrams and illustrations [6].

Visualising ideas allows not only to show how a future project looks, but also to communicate its functional aspects and emotional impact. Graphic elements such as colour, shape, texture and composition are used to create aesthetically pleasing visualisations that grab attention. Idea visualisation is widely used in marketing and advertising to present projects and attract new customers in today's environment. The visualisation of ideas helps the customer to better imagine a future project and to make the right decision on how to implement it. By providing a concrete and easy-to-understand representation of ideas, the use of visual communication tools can help resolve disagreements and misunderstandings between project participants [10].

Visualising ideas also allows faster and more efficient development and adaptation of project concepts in the early stages, reducing the time and cost of making changes at later stages. Using visuals makes it possible to take a creative approach to designing and presenting unique and attractive ideas [13].

Colour planning is an important design tool that allows you to visually identify and highlight different stages and aspects of the project using different colours. The use of colour in planning allows you to create a system of markings that makes it easier to perceive and understand information and to navigate through plans and diagrams [7]. Each colour can be designed to indicate a specific type of information, for example, red can indicate hazardous areas, blue can indicate water bodies and green can indicate parking areas.

A ring colour system can be used to identify different categories of objects or project elements, allowing you to quickly distinguish between different groups of objects or elements. Colour planning can also be used as a troubleshooting tool to quickly identify and correct design flaws or errors. Project management and time planning can be facilitated by using different colours to indicate different timeframes, priorities or statuses of tasks [8].

Colour planning also helps to increase creativity and work efficiency. It stimulates the development of new ideas and approaches to solving problems. The use of colour psychology in design can have an impact on people's mood and emotional state, contributing to an increase in productivity and workflow comfort. You can create a harmonious and balanced system of notation that will help you achieve the most accurate and clear results by analysing and choosing the right colours for planning.

There are some examples:

1. Architectural design of a residential building: the architect used 3D rendering to create a visualisation of the building from different angles, including the exterior and interior. This helped to demonstrate functionality and design solutions, as well as helping the client to better imagine how the house would look in reality.

2. Café interior project: the designer created a collage of illustrations, textures and colour schemes to show the client the café interior concept. The result was a visualisation of the atmosphere and style of the place, as well as the placement of furniture, bar and lighting.

3. Landscape design of a park: the landscape architect used colour planning to show different elements in the park like pathways, pavilions, trees and flowerbeds. This has helped to make the project easier to understand and to show the harmonious combination of the different elements in the park.

An important aspect of the modern construction industry is the use of cameras and drones to monitor the work being carried out on the site by an expert supervisor. The progress of work can be monitored more accurately and efficiently, possible defects can be identified and timely measures can be taken to rectify them by using advanced technologies and high-quality equipment. An experienced manager with a high level of professionalism and mastery of technology becomes a key member of the site team, contributing to the successful completion of the project.

High-quality cameras and drones provide high image quality and the ability to remotely monitor various aspects of the construction work, allowing the experienced manager to obtain objective information about the current state of the site and to respond in a timely manner to any problems or discrepancies. This approach helps to ensure the high quality and timely completion of construction projects. This is critical to the successful completion of the work [1].

An experienced manager with access to advanced technologies and equipment can respond quickly to any problems or inconsistencies during construction, allowing for continuous production control and timely adjustments to the work strategy. Using cameras and drones also allows an experienced manager to monitor various work processes, identify task efficiency and ensure optimal resource allocation.

The use of cameras and drones to monitor construction sites increases site safety as the experienced manager can observe and analyse work processes from a safe distance. The use of this technology also enables the timely detection of potential hazards and prevents their spread, thus avoiding the risk of problems and accidents.

Using cameras and drones to monitor construction is important not only for ensuring project quality and efficiency, but also for reducing costs and increasing productivity during construction [9]. With this technology, an experienced manager can manage resources efficiently. He can detect deviations from the plan in good time and ensure that time and money are used optimally.

There are some examples:

1. Control of a construction project on a university campus: an experienced manager used a drone to monitor the construction site from the air to track the progress of the work, to assess the progress of the construction

and to identify possible problems, such as deficiencies in the work performance or schedule violations. In this way, he was able to intervene quickly and resolve any problems that arose during construction.

2. Supervision of a large infrastructure construction project: the experienced manager used cameras installed on special manoeuvrable working platforms to monitor the work processes online during the construction of a road. This enabled him to manage the production process effectively, to monitor the quality of the work and to respond to any potential problems in a timely manner.

3. Control over the construction of a residential complex: all project participants had access to up-to-date information about the construction process by uploading video images from cameras on the construction site to the cloud. This helped to improve communication and coordination between contractors and the client, helping to ensure that the project got done in an efficient manner.

VR technologies, which can be used to create virtual tours of future buildings, offer unlimited potential for builders and developers. This is an innovative way of allowing potential clients and stakeholders to get a full picture of what the project will look like before it is built [11].

VR technologies allow you to see the building from the inside and outside, see its features and functionality, and feel the atmosphere of the future building. Such a virtual tour allows clients to have a better understanding of what the finished object will look like, and to correct potential defects or changes before the start of construction [14].

The provision of virtual tours through the use of VR technologies not only improves communication between developers and clients, but also increases the latter's level of satisfaction [12]. The ability to see and feel the future building first hand provides a special emotional connection. This influences the decision to cooperate and the choice of partners in the construction process. For the sale of real estate on plans or during construction, virtual tours using VR technologies can be a useful tool. Virtual reality allows buyers to see every detail of their future property, feel their ambience and see realistic representations.

For developers and architects, virtual tours are becoming an important tool for project planning. Increased interactivity and the ability to add a variety of details and elements make it possible to create more detailed and realistic virtual tours, making them even more attractive to customers. Developers can effectively demonstrate the benefits of their projects and attract new clients by impressing them with virtual tours, using VR technologies. Developers can increase the competitiveness of their projects by creating a unique and innovative image in the property market.

Virtual tours using VR technologies can become a necessary tool for international projects, as they allow you to show the facility from any angle, regardless of where the client or investor lives. Using VR technologies to conduct virtual tours in construction saves time and money, as clients can make decisions about working together without having to visit a site. Virtual tours also improve collaboration and team efficiency by improving communication between different project stakeholders.

There are some examples:

1. A developer created a virtual tour of its future housing development using VR technologies. Potential buyers were able to see the apartments from the inside, to examine the atmosphere and design of each room, and to feel the spaciousness and attractiveness of the building. As a result, customers had a better understanding of what they were buying and could make a more informed purchase decision.

2. To present their projects to investors and clients, the architecture firm used VR technologies. They created virtual tours of projects that had already been completed, allowing people to see the details of the buildings and to understand the spatial layout and architectural features. This helped to ensure a higher level of engagement and interest from potential clients.

3. A real estate development company used VR virtual tours to showcase the unique features of their innovative residential development project. The company was able to attract the attention of high-end buyers and investors by showcasing the features and aesthetics of the building through a virtual tour. In this way, they were able to increase the interest in the project and make it more popular in the market.

Overall, for architectural and construction projects, visual management is an integral part of the modern quality assurance system. It is an essential tool for companies seeking to achieve a high level of competence and competitiveness in the market, thanks to its potential to increase efficiency, improve communication and enhance the quality of the final product. Further integration of the latest technologies continues to broaden the horizons of visual management, making it a key element in successfully managing modern construction projects.

Recommendations for the implementation of the elements of the visual management in the activities of the architectural and construction companies:

1. Creation of platforms for visual communication: use innovative technologies such as virtual reality (VR) and augmented reality (AR) to create visual representations of the project for all involved. This will help improve understanding and facilitate effective communication between all those involved.

2. Implementation of visual planning and mapping: use Gantt charts, Pert charts and other visual project management tools to plan and monitor project progress.

3. Usage of visual management elements to ensure accessibility and interaction: provide electronic and paper-based project information and visualisations that can be easily shared and updated by all project stakeholders.

4. Holding visual planning meetings on a regular basis: organise meetings with project stakeholders to jointly analyse and discuss project visualisations and plans to help resolve issues and ensure a common understanding of objectives.

5. Investment in visual management training and development: to ensure that visual management elements are successfully integrated into your architecture and construction projects, provide staff with appropriate training and education on the use of visual methods in project management.

Therefore, in order to improve the quality of project execution, increase management efficiency and ensure successful project completion, the introduction of visual management elements in modern architectural and construction projects is an important step. Solving problems of cooperation between all project participants, reducing risks and improving project quality can be achieved by implementing visual communication, visual planning and training staff in visual management. Careful planning of the integration process, active interaction between project participants, and continuous training and development in visual management are recommended for the successful implementation of visual management elements. Collaboration, understanding and project management in the construction industry can be improved by consistently following these recommendations.

CONCLUSIONS FROM THIS STUDY AND PROSPECTS FOR FURTHER RESEARCH IN THIS AREA

To summarise, visual management is a key organisational and application base for modern architectural and construction projects. It can increase the efficiency of construction project management, improve communication between stakeholders and ensure better outcomes through the use of various visual tools such as diagrams, plans, colour coding and innovative technologies. In particular, in order to facilitate better understanding and acceptance by both clients and contractors, visual management plays a key role in communicating ideas, concepts and project plans. The use of visualisation techniques, colour planning and workspace organisation can help optimise processes and identify and resolve problems at an early stage, improving the quality and efficiency of construction projects. The possibilities of visual management in architecture and construction are expanding with the use of modern technologies such as cameras, drones and VR. They allow for the remote monitoring of the progress of work, virtual tours of future facilities and effective interaction between all those involved in a project.

Creating effective visual communication platforms, holding regular visual planning sessions, and investing in staff training and development in the use of visual management methods are necessary for the successful implementation of visual management elements in the activities of architectural and construction firms.

In general, visual management contributes to the efficiency, quality and competitiveness of companies in the industry and is an integral part of modern management of architectural and construction projects. The role of this approach in ensuring the successful delivery of construction projects will only increase with the further introduction of innovative visualisation technologies and methods.

References

1. Holubiev, L. P., Riabokon, Ye. I. (2020). Zastosuvannia komp'iuternoho zoru v systemi kontroliu yakosti produktsii [Application of computer vision in the product quality control system]. Visnyk Khersonskoho natsionalnoho tekhnichnoho universytetu = Bulletin of the Kherson National Technical University, № 3, P. 75–79, DOI: https://doi.org/10.35546/kntu2078-4481.

2. Zhaldak, R. Yu. (2024). Informatsiino-analitychnyi bazys otsiniuvannia nadiinosti vykonavtsiv budivelnykh proiektiv [Information and analytical basis for assessing the reliability of construction project contractors]. Mistobuduvannia ta terytorialne planuvannia = Urban planning and territorial planning: scientific and technical collection, Kyiv: KNUBA, Vol. 85, P. 211–223, DOI: https://doi.org/10.32347/2076-815X.2024.85.211-223.

3. Kolisnychenko, T. V., Myronenko, V. V. (2014). Orhanizatsiini komunikatsii (reklama ta pablik ryleishnz) yak poliparadyhmalnyi fenomen: monohrafiia [Organizational communications (advertising and public relations) as a polyparadigmatic phenomenon: monograph]. Dnipropetrovsk: Oles Honchar Dnipropetrovsk National University. 160 p.

4. Danyliuk, T. I., Murafa, T. R. (2024). Proektuvannia orhanizatsiinykh zakhodiv z menedzhmentu yakosti na stadiiakh stvorennia obiekta budivnytstva [Designing organizational measures for quality management at the stages of creating a construction site]. Efektyvna ekonomika = Effective economy, № 8, DOI: http://doi.org/10.32702/2307-2105.2024.8.85.

5. Mudra, M. S. (2023). Onovlennia operatsiino-vyrobnychoi systemy ta orhanizatsiinoi struktury yak bazys innovatsiinoho rozvytku budivelnoho pidpryiemstva [Updating the operational and production system and organizational structure as a basis for innovative development of a construction enterprise]. Shliakhy pidvyshchennia efektyvnosti budivnytstva v umovakh formuvannia rynkovykh vidnosyn = Ways to increase the efficiency of construction in the conditions of the formation of market relations: collection of scientific works, Kyiv: KNUBA, Vol. 51, Part 1, P. 162–171.

6. Biliaieva, Ye. I. (2023). Vizualizatsiia arkhitekturnykh proektiv z vykorystanniam kompiuternoi hrafiky [Visualization of architectural projects using computer graphics]. Radioelektronika ta molod u KhKhI stolitti = Radioelectronics and youth in the 21st century: collection of materials of the 27th International Youth Forum, May 10–12, 2023, Kharkiv: KhNURE, Vol. 6, Part II. (Conf. "Information Intellectual Systems"), P. 232–233.

7. Anishchenko, V. M., Artiushyna, M. V., Herliand, T. M., Kulalaieva, N. V., Romanova, H. M., Shymanovskyi, M. M. et al. (2019). Teoriia i praktyka proektnoho navchannia u profesiino-tekhnichnykh navchalnykh zakladakh: monohrafiia [Theory and practice of project-based learning in vocational and technical educational institutions: monograph]. Edited by N. V. Kulalaeva. Zhytomyr: Polissia. 208 p.

8. Bereziuk, O., Tymchenko, M. (2024). Formuvannia tvorchykh zdibnostei maibutnikh dyzaineriv zasobamy khudozhno proektnoi diialnosti: monohrafiia [Formation of creative abilities of future designers by means of artistic project activities: monograph]. Zhytomyr: Publishing house of Ivan Franko ZhDU. 357 p.

9. Krainiuk, O. V., Buts, Yu. V., Barbashyn, V. V., Didenko, N. V. (2023). Analiz sfer zastosuvannia bezpilotnykh litalnykh aparativ dlia vyrishennia pytan bezpeky pratsi [Analysis of the areas of application of unmanned aerial vehicles to solve occupational safety issues]. Komunalne hospodarstvo mist = Municipal utilities, № 1 (175), P. 182–188, DOI: https://doi.org/10.33042/2522-1809-2023-1-175-182-188.

10. Chupryna, Kh. M., Derkach, A. Ye., Rovenskyi, A. Ye., Huliaiev, D. A. (2022). Vizualno-hrafichna defrahmentatsiia zhyttievoho ta operatsiino-vyrobnychoho tsykliv budivelnoho pidpryiemstva za standartyzovanymy stadiiamy [Visual and graphic defragmentation of the life and operational and production cycles of a construction enterprise according to standardized stages]. Shliakhy pidvyshchennia efektyvnosti budivnytstva v umovakh formuvannia rynkovykh vidnosyn = Ways to increase the efficiency of construction in the conditions of the formation of market relations, № 50 (1), P. 101–109, DOI: https://doi.org/10.32347/2707-501x.2022.50(1).101-109.

11. Potapiuk, L. M., Masovets, O. A. (2019). Virtualnyi tur yak efektyvnyi sposib prosuvannia pidpryiemstva [Virtual tour as an effective way to promote a company]. Inzhenerni ta osvitni tekhnolohii v elektrotekhnichnykh i kompiuternykh systemakh = Engineering and educational technologies in electrical and computer systems, Kremenchuk: KrNU, Vol. 7 (1), P. 40–47.

12. Zhurba, M. A. (2014). Virtualna realnist: riznovektorni poshuky [Virtual reality: multi-vector searches]. Hileia: naukovyi visnyk = Gilea: scientific bulletin, № 86, P. 171–175.

13. Chernyshev, D., Prykhodko, O., Zhaldak, R. (2021). Functional-technological subsystems of digital transformations of business processes and organizational structures of construction enterprises. Mistobuduvannia ta terytorialne planuvannia = Urban planning and territorial planning: scientific and technical collection, Kyiv: KNUBA, Vol. 78, P. 508–519, DOI: 10.32347/2076- 815x.2021.78.508-519.

14. Wayne, T. (2005). Virtual Reality and Artificial Environments. A Critical History of Computer Graphics and Animation, № 1, P. 9–15.

15. Yashchenko, O., Makatora, D., Kubanov, R. (2024). Impact of economic factors on design and construction processes in architecture and construction. Tavriiskyi naukovyi visnyk. Seriia: Ekonomika = Tavria Scientific Bulletin. Series: Economics, № 19, P. 139–150, DOI: https://doi.org/10.32782/2708-0366/2024.19.17, URL: http://tnv-econom.ksauniv.ks.ua/index.php/journal/article/view/484/452.

16. Makatora, D., Yashchenko, O., Kubanov, R. (2023). Features preparation of the project manager in the architecture and construction industry. Menedzhment = Management, № 2 (38), P. 133–150, DOI: https://doi.org/10.30857/2415-3206.2023.2.11, URL: https://menagement.knutd.edu.ua/wp-content/uploads/sites/10/2024/07/mng-2-38-2023-11.pdf.