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ECONOMIC CONSTANT OF INTRODUCING RESOURCE-SAVING TECHNOLOGIES AT A CONSTRUCTION COMPANY IN AN UNSTABLE MARKET ENVIRONMENT WITH LIMITED RESOURCES

ЕКОНОМІЧНА КОНСТАНТА ДОЦІЛЬНОСТІ ВПРОВАДЖЕННЯ РЕСУРСОЗБЕРІГАЮЧИХ ТЕХНОЛОГІЙ НА БУДІВЕЛЬНОМУ ПІДПРИЄМСТВІ В УМОВАХ ВПЛИВУ НЕСТАБІЛЬНОГО РИНКОВОГО СЕРЕДОВИЩА ТА ОБМЕЖЕНОСТІ РЕСУРСІВ

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Theoretical concepts and applied possibilities concerning the feasibility of introducing resource-saving technologies in a construction company under the influence of an unstable market environment and limited resources are determined. The article considers the dependence of construction production on many factors of the external and internal environment: natural and climatic, engineering and geological, economic, suppliers, sub-suppliers. This leads to the existence of a variety of projected cost and time indicators for a given construction project. This is due to the impossibility of obtaining accurate information on the conditions of project implementation. In the authors' opinion, the limited availability of raw materials and the threat of their depletion are the reason for the constant rational use of raw materials and the search for new energy sources. The authors argue that in an unstable market environment and with limited resources, introducing resource-saving technologies can have a significant economic impact. Economic benefits, reduction of negative impact on the environment, improvement of the company's image and status are the main advantages of introducing such technologies. It is necessary to compare the economic benefits of implementing resource-saving technologies with the costs of their installation and operation in order

to determine the economic feasibility constant. Economic benefits include increased productivity, reduced costs due to resource savings and improved product quality. Costs are related to the installation of new technology, replacement of equipment, staff training and other factors. Economic feasibility is an economic assessment that helps determine whether introducing resource-saving technologies is economically viable. It can help construction companies make decisions about investing in new technologies in the context of an unstable market environment and limited resources. The article gives examples of the use of cost-effective resource-saving technologies: the reconstruction of Maidan Nezalezhnosti (Independence Square) – the use of inventory shuttering in the complex use of softeners and chemical additives to concrete; the rationale for types of individual housing construction using recycled materials and the introduction of energy-saving technologies; the concept of “smart building”; the use of recycled materials such as bottles, paper, plastic and other materials in the construction of buildings. The article concludes that the use of resource-saving technologies can be an effective tool for ensuring the competitiveness and sustainable development of a construction company in an unstable market environment and with limited resources.

Keywords: economic constant, introduction of resource-saving technologies in a construction company, unstable market environment, limited resources, sustainable development, concept of “smart building”.

Визначено теоретичні концепти та прикладні можливості щодо доцільності впровадження ресурсозберігаючих технологій на будівельному підприємстві в умовах впливу нестабільного ринкового середовища та обмеженості ресурсів. Розглянуто, залежність будівельного виробництва від багатьох чинників зовнішнього і внутрішнього середовища, а саме: природно-кліматичних, інженерно-геологічних, економічних, постачальників, субпідрядників. Це призводить до існування різноманітності прогнозованих вартісних та тимчасових показників окремого будівельного проекту, оскільки неможливо отримати точну інформацію про умови реалізації проекту. Висловлюється думка, що обмеженість сировинних ресурсів та загроза їх вичерпання ставлять завдання постійного раціонального використання та пошуку нових джерел енергії. Авторський колектив стверджує, що впровадження ресурсозберігаючих технологій на будівельному підприємстві може мати значний економічний ефект в умовах нестійкого ринкового середовища та обмежених ресурсів. Основні переваги впровадження таких технологій включають: економічну вигоду, зниження негативного впливу на навколишнє середовище, підвищення іміджу та статусу підприємства. Для визначення економічної константи доцільності необхідно порівняти економічну вигоду від впровадження ресурсозберігаючих технологій з витратами на їх встановлення та експлуатацію. Економічна вигода включає збільшення продуктивності, зниження витрат на рахунок економії ресурсів та поліпшення якості продукції. Витрати пов'язані з встановленням нових технологій, заміною обладнання, навчанням персоналу та іншими факторами. Економічна константа доцільності є економічною оцінкою, яка допомагає визначити, чи є впровадження ресурсозберігаючих технологій економічним сенсом. У контексті нестабільного ринкового середовища та обмеженості ресурсів, може бути корисною для будівельних підприємств ухвалення рішень щодо інвестицій у нові технології. Наведено приклади використання економічно ефективних ресурсозберігаючих технологій: реконструкція Майдану Незалежності – застосування інвентарної опалубки у комплексному використанні пластифікаторів та хімічних добавок до бетону; обґрунтування типів будівництва індивідуального житла з використанням вторинної сировини та впровадженням енергозберігаючих технологій; концепція «інтелектуальної будівлі»; використання вторинної сировини, такої як пляшки, папір, пластик та інші матеріали, для будівництва споруд. У висновках зазначено, що в умовах нестабільного ринкового середовища та обмеженості ресурсів, використання ресурсозберігаючих технологій може стати ефективним інструментом для забезпечення конкурентоспроможності та стійкого розвитку будівельного підприємства.

Ключові слова: економічна константа, впровадження ресурсозберігаючих технологій на будівельному підприємстві, нестабільне ринкове середовище, обмеженість ресурсів, сталий розвиток, концепція «інтелектуальної будівлі».

Problem statement. The modern construction industry is facing a number of challenges. First and foremost, among these is the need to conserve the amount of land available in Ukraine. Given the growing population and the need to develop infrastructure, there is not enough land to build on, especially in large cities. The second problem is the reconstruction of the historic centres of the cities. On the one hand, the historical heritage and architecture must be preserved. On the other hand, new buildings and modern communications must be provided. The third problem has to do with the use of areas with difficult conditions in terms of engineering

and geology. These are areas that are unsuitable for surface development. There is a risk that granite sinkholes, settlement sinkholes and other features will be exacerbated. The fourth issue relates to saving energy when operating buildings and structures. It is necessary to use energy-efficient technologies and materials in view of rising energy prices and the need to conserve natural resources. Last but not least, the natural environment needs to be preserved. The negative impact of the construction industry on the environment and natural resources can be reduced by using resource-saving technologies in construction. Sustainable development and

the preservation of our natural environment for future generations are of paramount importance. On the other hand, it should be noted that the construction industry in Ukraine is facing a number of challenges, including the impact of an unstable market environment and limited resources. Regarding the volatile market environment, Ukraine is experiencing a challenging economic and political environment, which creates instability in the market. This may lead to changes in the operating environment, including changing legislative, taxing and regulatory policies. Such changes can have an impact on the company's profitability and strategy. Another challenge is resource constraints; the construction industry is a major user of financial, material and human resources. Limited access to these resources can make projects difficult to complete and affect quality and productivity. Moreover, the cost of materials and labour is subject to market fluctuations. Undoubtedly, despite the challenges, construction is likely to remain an important sector of the Ukrainian economy with potential to develop and invest.

Analysis of recent research and publications. In the works of Ukrainian scientists various aspects of this problem have been studied and presented, e.g: O. O. Sosnovska, L. V. Dedenko [1]; V. I. Piliavskiy [2]; E. M. Akhromkin [3]; I. O. Tarasenko [4]; V. V. Hubina [5]; E. S. Kovalenko [6]; N. I. Ilchuk, O. Z. Shafranska [7]; B. Andrushkiv, I. Stoyko, B. Fedyshyn [8]; S. Stavskaya, O. Zozuliev [9]; D. Tarasenko [10]; M. Malyovanyi [11]; N. Dankevych [12].

The purpose of the study is to define theoretical concepts and applied possibilities regarding the feasibility of introducing resource-conserving technologies in a construction company under the influence of unstable market environment and limited resources.

Presentation of the main research material. An important place in today's business environment is occupied by the optimal concept that allows for the correct and economically sound formation of a strategy for the sustainable functioning of a company. This concept is adapted to a certain degree of instability and uncertainty. The environment of a company is a set of business entities, their interconnections, infrastructure links and operating conditions. The study of this environment is related to the fact that economic entities do not operate in isolation when carrying out their activities. They interact with each other and with other economic entities, i.e. they carry out their activities in the external environment.

Therefore, the unstable external environment can be represented as a set of three levels of its qualitative characteristics: (1) dynamism, determined by comparing the speed and frequency of changes in the external environment with the reaction of the company to these changes; (2) complexity, characterised by the number of current events influencing the company in comparison with past events; (3) uncertainty, characterised by the habit of events in comparison with events in the past and the predictability of the future based on past experience and knowledge [1, p. 355].

In particular, the dependence of construction production on many factors of the external and internal environment, i.e. natural and climatic, engineering and geological, economic, suppliers, subcontractors, etc., determines the existence of a certain variety of projected cost and time indicators of a particular construction project, since it is impossible to receive accurate information about the conditions of the project [12, p. 69].

Therefore, it should be noted that today the level of external environment of business entities in Ukraine and the level of instability of the economic system is critically high compared to other countries.

The problem of replacing non-renewable resources and the use of unconventional energy through the development of scientific and technological progress is becoming increasingly important for the Ukrainian economy as a whole. One way out of this situation is the use of nuclear energy. However, nuclear energy is controversial because it poses a threat to the environment. Moreover, nuclear fuel and uranium reserves are limited. Therefore, the use of alternative energy sources such as solar, wind and tidal power is a necessary part of the solution to the energy problem. Thus, the limitation of raw materials and their imminent disappearance dictate the constant need to use them rationally and to search for new sources of energy [2, p. 197].

In the face of an unstable market environment and limited resources, the introduction of resource-saving technologies in a construction company can have a significant economic impact. The main advantages of introducing such technologies are:

1. **Cost-efficiency:** resource-saving technologies usually reduce the cost of energy, water, raw materials and other resources, helping a company to reduce production costs and increase profit [3].

2. Reduced environmental impact: resource-saving technologies contribute to the reduction of emissions and environmental impact. This can help a company to comply with environmental regulations and standards, which in turn can open up new markets and make it more competitive [4, p. 108].

3. Image and status enhancement: the adoption of resource-saving technologies can enhance a company's image and reputation if the company fulfils its social and environmental responsibilities [5].

However, it is worth taking into account some factors that may have an impact on the feasibility of the implementation of resource-saving technologies in an unstable market and with limited resources [11]:

1. Implementation costs: investing in technologies that conserve resources can be costly, which can be difficult for a company to afford in times of financial instability.

2. Timing to implement: the introduction of new technologies usually requires time for preparation, training of staff and adaptation of production processes. A company's ability to do this may be limited by unstable market conditions.

3. Lack of demand: in some cases, resource-saving technologies may be new to the market. There may not be sufficient demand or competition to support their development and implementation.

4. Legal constraints: some resource efficiency technologies may be subject to changes in legislation or the need for special permits. This can be challenging where regulatory frameworks remain unstable or lacking in support.

In general, a detailed analysis and evaluation of all economic, social and environmental factors is required to determine the feasibility of implementing resource-saving technologies in a construction company in an unstable market environment and with limited resources. In order to make a decision that best suits its needs and capabilities, each company should prioritise and compare costs and potential benefits.

Economic feasibility is an economic assessment that helps determine whether implementing resource-saving technologies makes economic sense. It can be useful for construction companies to make decisions about investing in new technologies in the context of an unstable market environment and limited resources.

Particular attention should be paid to a construction company's lifecycle. The

"obsolescence" period for construction company business systems is 13 years. This should be taken into account when drawing up long-term development and construction project management programmes. In particular, in the periods that fall at the end of the "maturity" stage and later time horizons, the timing of incoming and outgoing cash flows associated with different projects should ensure a stable 40-50% level of financial autonomy [6, p. 29].

In addition, the economic benefits of implementing resource-saving technologies must be compared to the costs of installing and operating them in order to determine the economic feasibility constant. Economic benefits include increased productivity, reduced costs due to saved resources and improved product quality. Costs are associated with installing new technologies, replacing equipment, training staff and other factors.

In our opinion, the economic constant of expediency means that in the process of construction and reconstruction of buildings and structures it is advisable to use new technologies and materials. These reduce the cost of work, improve its quality and enable the construction of structures with complex architectural forms. In the specific case of the reconstruction of Maidan Nezalezhnosti (Independence Square), the use of inventory formwork was a complex application of plasticisers and chemical additives to concrete [7, p. 356]. As a result, the construction of monolithic reinforced concrete structures was more efficient in terms of material use and lower in terms of labour costs. There was also the introduction of a new technology for the dry laying of granite slabs, which was also a time and cost saver. In general, construction costs can be reduced and the quality of work improved by using new technologies and materials with appropriate additives and plasticisers. Such innovations also open up new possibilities for the design and aesthetics of buildings and structures, making it possible to create structures with more complex architectural forms.

Another example is justifying the construction of individual dwellings, including the use of recycled materials and the introduction of energy-saving technologies.

At present, the walls of houses are constructed using a variety of building materials. Red brick, silica brick, gypsum blocks and adobe (clay with straw) are the most common. Cement slag, gypsum and other mixtures are also used in some cases. The choice of material depends on the financial possibilities and costs, as well

as on the natural and climatic conditions and the time needed to build. Consideration is also given to the individual skills of the builder and the use of construction organisations. For a young family, the cost of building materials is the most important component of the overall economic concept of implementing an individual building plan.

The study shows that in the context of the resource crisis, house builders are using a variety of household and industrial waste for the construction of the walls of a building. We are of the opinion that the use of straw for the construction of house walls should be the subject of special attention for economic reasons. For example, straw is hardly used as a feed material by agricultural companies due to the low demand. Information on the use of straw bales as a building material has been published on the website "My straw house – Ternopil" [8].

The cost of traditional building materials can be significantly reduced through the use of straw bale huts or other straw-based construction technologies. It will also encourage the development of affordable custom housing for young families, improving their standard of living and reducing waiting lists for housing in local communities. In addition, this type of construction will save energy, materials and financial resources, as well as the resources used to produce these. For example, making bricks requires gas, coal, etc. to produce. Central heating systems will obviously reduce heating costs. Construction costs can also be reduced by using straw for roofing, eliminating the need for additional insulation.

This is a more modern example. In order to attract investment, the concept of the "smart building" should be used by domestic companies that use resource-saving technologies. Implementing the smart building concept means using modern technologies and solutions that optimise energy consumption, improve living comfort, ensure efficient use of resources and guarantee safety.

In order to justify the cost-efficiency, it is necessary to analyse the costs and the benefits of the application of the smart building concept. There should be an assessment of the extent to which resource savings (electricity, water, heat) will be a factor in the reduction of utility costs. The savings in building maintenance and management costs due to infrastructure automation and the use of intelligent systems should also be considered. The technological

feasibility and reliability of implementing resource-saving technologies and the smart building concept should be demonstrated to potential investors. It is also worth highlighting the competitive advantages that can be gained through the implementation of these technologies, such as a reduction in operating costs and environmental impact, and an increase in the attractiveness of the building to tenants and developers. In addition, it is important to carry out a feasibility study of the projects, which includes calculating the costs of implementing the technologies, the expected economic results, the risks and a financial recovery plan. Reliable data and calculations are the key to convincing investors of the feasibility and prospects of investment in the smart building concept. In particular, S. M. Stavska, O. V. Zozuliev consider the economic feasibility of the concept on the basis of (1) reducing operating costs (by reducing service staff). It takes 50 people to maintain a 200,000 m² public or administrative building equipped with traditional systems. The number of maintenance staff can be reduced by at least half by using "smart building" systems. (2) The time between major repairs can be extended. Whereas a conventional building needs to be renovated at least once every 30 years, the use of "smart infrastructure" allows you to avoid major repairs for at least 50 years. Furthermore, in an ordinary building, emergency repairs are likely to be required after an emergency (burst pipe, fire), which will involve significant expenditure and loss of thousands of dollars. In contrast, in an intelligent building, a system will be activated in time to shut off the water flow or activate fire protection systems, and the emergency will be immediately reported to the appropriate service dispatcher, while damage is minimised. Of course, it is difficult to have a precise estimate of the economic impact in this case, as it is dependent on each specific situation. (3) Electricity savings through the optimisation of energy consumption and the operation of sub-systems (heat transfer pumps, water, burglar alarms) [9, p. 120].

Automated process control systems can reduce energy consumption by up to 10-20%, increase productivity by 5-8%, significantly improve comfort and safety, and reduce environmental impact in business centres, office buildings, hotels and other buildings. As a result, the total cost of running a building is reduced by up to 30%. Repair costs are almost halved. Depending on the complexity of the automated solutions, one dispatcher per residential building

is enough to facilitate the technical operation of such buildings. Experts also note that it is more efficient and cost-effective to build smart buildings from the ground up than to upgrade existing buildings.

Thus, equipping a building with automated control systems for its technological processes has a significant economic impact. It depends not only on the equipment used, the algorithms and the optimisation of its operating modes, but also on who is operating the building and what the objectives of the investor are.

The economic performance of a building can be affected by the correct implementation of automated process control systems in the building. Some of the most important economic benefits of automation are:

1. Improved energy efficiency. By ensuring optimum operation of heating, ventilation, air conditioning and lighting systems, automated systems can optimise a building's energy consumption. This can lead to significant reduced energy costs and lower running costs.

2. Increased comfort and efficiency. Automated systems allow you to independently control the operating modes of comfort systems (heating, cooling, lighting). This creates optimal conditions for employees and building occupants. The result can be an increase in occupant comfort and productivity.

3. Reduced maintenance costs. Automated systems monitor equipment condition and detect potential failures or malfunctions. This makes it possible to maintain and repair equipment in a timely manner, to predict the cost of replacing parts and to prevent accidents. Reduced maintenance costs can result in significant savings for building owners.

4. Optimised operating modes. Automated systems can be configured to operate in optimal modes to ensure efficient use of resources such as water, energy and other materials. This can result in cost savings and improved building economics.

However, the success of building process automation depends on many factors, including the quality of the equipment, the correct programming of the algorithms, the skills of the staff and the quality of the building management. It is also important to consider the needs and objectives of the investor, as the economic impact can vary depending on priorities and requirements. In general, an important factor in attracting investment in resource-saving technologies and stimulating the development of this sector of the national construction industry is

to justify the cost-effectiveness of the intelligent building concept.

There is a very important example. One way to recycle waste is to use recycled materials such as bottles, paper, plastic and other materials in building construction. This approach is environmentally sustainable and helps reduce the amount of waste sent to landfill. The facade of a historical museum in Ningbo, China, is an example of the successful use of recycled materials in construction. It has been built with rubbish from 30 villages in the area of the museum's construction. Waste was transformed into an aesthetically pleasing building using the traditional Chinese technique of "wapan" [10]. There are several advantages to this approach. Firstly, it reduces the need to use virgin materials, which helps to conserve natural resources. Secondly, using recycled materials helps reduce the amount of waste sent to landfill and reduces greenhouse gases from decomposing organic waste. Projects of this kind contribute to the conservation of natural resources and to the development of an environmentally sustainable construction industry. Businesses will be better able to adapt to volatile market conditions and limited resources by addressing all these key aspects of sustainable development. Businesses can maintain their competitive advantage, reduce risk and ensure sustainability by addressing all aspects.

Conclusions. The performance of the entire Ukrainian economic system and the activities of its entities are unpredictable and incalculable in a volatile global economy. The current market environment creates conditions of high uncertainty in forecasting possible demand, production costs, profitability and business results due to intensified competition, unpredictable external environment, increased information, strengthening of integration processes and expansion of global market borders. The use of new approaches to development is always associated with successful business operation in an uncertain environment.

For construction companies, unstable market conditions and limited resources create a difficult economic environment. Under such conditions, the introduction of resource-saving technologies can be advisable for many reasons. Firstly, especially when energy and material prices fluctuate, reducing resource consumption can lead to lower costs for the company. Secondly, resource-saving technologies can help to reduce a construction company's environmental impact. This can be important for compliance with

environmental standards and for maintaining the company's reputation with consumers and other stakeholders. Thus, in an unstable market environment and with limited resources, using resource-saving technologies can be an effective tool to ensure the competitiveness and sustainable development of a

construction company. To conclude, volatile markets and limited resources continue to challenge construction companies. However, these challenges can be overcome and businesses can operate and develop successfully with proper planning and strategic decision-making.

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