ENSURING THE SAFETY OF CONSTRUCTION FACILITIES: ECONOMIC, ENVIRONMENTAL AND MANAGERIAL COMPONENTS

INTRODUCTION

The construction industry is an industry that is characterized by a high level of risk in the field of ensuring the safety of participants in the construction process. Responding to the need to improve health and safety indicators, construction organizations are currently developing and implementing a number of safety programs. These programs are aimed at improving the level of safety of construction work through an integrated set of rules and measures and are a systematic combination of actions, procedures and auxiliary tools designed to ensure and maintain a safe and healthy workplace (OGUNDE, DAFE, AKINOLA, OGUNDIPE, OLOKE, ALEMOLA, AKUETE, OLANIRAN, 2017).

All employees of construction companies, including the architect, engineer, contractors, subcontractors, suppliers and other participants in the construction process, are responsible for ensuring that each project is completed without injuries or registered accidents. The use of the above programs allows one to reduce the accident rate on the construction site and create safe working conditions. Moreover, the use of safety programs, as well as the development of a safety culture, can make the most effective feedback between the management and employees of construction companies.

Despite the proven advantages, the implementation of safety programs in the construction sector is still very limited. There are no safety programs or they are not fully implemented due to the lack of well-coordinated management in the construction industry and insufficient attention to the issues of organizing construction safety on the part of the management.

The purpose of the work is to consider the features of ensuring the safety of the implementation of construction projects, as well as to investigate the economic and managerial aspect of this process.

MATERIALS AND METHODS

In the process of writing the work, an array of literature was analyzed within the framework of the research topic, as well as analytical and comparative methods were applied.

RESULTS

All construction projects have certain common characteristics, however, in the construction industry, the success of a project is usually measured by its timely completion, regardless of whether the project is completed within budget, if the project meets the quality criteria, that the work is done safely and finally satisfies the customer. Therefore, safety is considered as a criterion of success in construction projects. However, the industry suffers from poor project
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Performance, partly because project work involves a complex combination of different participants, stakeholders and sub-processes. This also affects the project lifecycle.

Each project goes through different stages. Usually, a project begins with a defining stage, at which the project goals are set. Then the project is planned to be completed as the time frame, resource allocation, risk acceptance levels, staffing table, and so on are determined at the planning stage. Then the project will move to the implementation stage, where the actual construction will take place. This is the phase in which accidents usually occur. Finally, the project ends by providing the result to the client.

In the context of project management in the construction industry, structural and cultural systems of project planning at the organizational level at the early stages of the construction process will affect the organization of the workplace, in this case, the construction site. More specifically, structural and cultural regulation and practice will influence which subjects are included in the project team at what stage, which factors are mainly emphasized, which problems are considered as risks in the project, and so on.

These local factors in the workplace then act as hidden conditions that can affect the next stage of the project and can lead to an undesirable incident or accident.

The high level of safety indicators in the construction industry provides many advantages associated with the effective implementation of an investment construction project (ICP) as a whole. Reducing the level of accidents and diseases in the workplace reduces the cost of eliminating the consequences of accidents, reduces the number of absenteeism and staff turnover, increases labor productivity and improves the moral climate in the construction team. It is believed that the goals of implementing safety programs in construction projects are to avoid unnecessary and dangerous actions, to report risks and dangers, and to ensure that all accidents are documented and handled appropriately. Also, construction organizations that have implemented security programs improve the quality of their work, increase their reputation, improve interaction between personnel and increase their profits.

There are many studies on the obstacles to the implementation of security programs. During a financial crisis, a lack of resources is a serious obstacle that can negatively affect security programs. To implement the safety program, management is responsible for providing the necessary resources, including qualified personnel, time, finances, information, safe working methods, equipment, tools and mechanisms (TUNJI-OLAVENI, OMUH, AMUSAN, AFOLABI, OJELABI, OGUNDIPE, 2017).

A tight schedule for the implementation of ICP is another common obstacle to the implementation of security programs. Working on a tight schedule adds more pressure and stress, which often leads to health and safety problems and reduces productivity.

Another important reason for the high occupational morbidity and injuries in the construction industry in the countries is the low commitment to health and safety. The commitment to security depends on the level of security awareness, which, in turn, affects their priority. A low security priority leads to a poor security culture. There is a misconception that security is the responsibility of security personnel only. This perception implies that it acts as an exceptional one, and when it is implemented, there is no need to organize teamwork and cooperation between management and ordinary employees. In addition, limited awareness of security considerations at a higher management level affects the understanding and content of security and risk management strategies throughout the organization (WINDAPO, 2013).

According to the authors, the most common problems in the implementation of security are the lack of safety training and the lack of a security policy. However, safety training of personnel is essential to prevent and reduce accidents. The lack of appropriate training of workers in the field of occupational safety leads to an increase in the number of accidents and an increase in the level of injuries.
It should also be taken into account that ensuring the safety of construction machines is also very important in the construction process. A construction machine is a device and its function is to increase or replace the physical strength of a person when performing construction processes. This or that construction machine is used on construction sites, which, as a rule, are an environment consisting of many resources, such as personnel, equipment and materials, which are involved in dynamic work tasks. Due to the unstructured and almost random movement of many resources associated with various tasks in the workplace, the construction machine faces difficult and dangerous working conditions. To ensure the safety of the construction machine during operation, safety technologies are used, which include passive safety control technologies and active safety control technologies.

For example, there is a practice of using a 3D range visualization camera within the framework of active sensing technologies to collect range data, which are used to receive real-time feedback about the location of objects in the sensor’s field of view. Accordingly, the safety of construction can be improved through the use of new technologies, such as 3D-range imaging cameras. It also uses a 3D laser scanner, radio frequency remote sensing and operation technology to improve construction safety by warning or alerting pedestrians and equipment operators in active real time when the equipment is too close to unknown or other equipment. And this active real-time proximity and alert technology for daily construction work can solve the safety problem associated with various parts of construction equipment.

A magnetic field proximity detection and notification system has been developed to ensure a distance between complex equipment operating in too close proximity to each other, and this system can provide an additional level of protection for foot workers on construction sites. Modern technology is also used in the field of real-time data collection and visualization, which transmits data from real-time positioning sensors to a real-time data visualization platform. With this technology, you can get important information related to both safety and the operation of the machine on site.

The safe mode of the machine is automatically monitored and visualized in real time, which provides benefits such as increased awareness of the situation for workers, equipment operators or decision makers, anywhere in the construction project or remotely.

The US specialists used a computer vision solution to automatically evaluate the machine, including the position and orientation of not only the base of the machine (for example, tracks or wheels), but also each of its main articulated components (for example, a stick and a bucket), which can be an important component of technical innovations aimed at improving safety and productivity in many construction tasks. This method uses a network of cameras and markers to provide such an opportunity for complex machines. First, the flat marker is magnetically fixed to the final effector of interest. Another marker is fixed on the work site, the 3D position of which is set in the coordinate system of the project. Then a group of at least two cameras, respectively, observes and monitors the most effective work of the equipment. Information technologies are widely used in the active security system. However, this will lead to a functional failure of the active security management system due to the low reliability of the information system, so that the security management systems will not be able to continue to prevent the danger if they fail. In this regard, the human factor is quite important in ensuring the security system in construction. Especially important here is the competent organization of the management process, which should be aimed at forming a working and effective safety system or program when performing construction works (HAADIR, PANUWATWANICH, 2011).

Also important is the economic component, without which the organization of safe working conditions in construction is impossible. This should include the financing of personnel retraining programs, the purchase of innovative construction equipment, the level of work safety at which is quite high, as well as the purchase of information systems to ensure active
and passive safety, which will help reduce the number of accidents on the construction site and increase labor productivity.

**DISCUSSION**

We believe it necessary to consider in detail the main factors hindering the implementation of the labor safety program at construction enterprises within the framework of managerial and economic aspects.

Among the first, we should mention the unfavorable working climate in the team. Such a climate can occur when there are insufficient resources, insufficient commitment to occupational safety, as well as in the case of propaganda of the idea that safety is the exclusive responsibility of safety personnel. These obstacles are interrelated and determine the success of the implementation of the security program.

There is an opinion that the lack of resources leads to a low commitment to labor protection on the part of management personnel. On the other hand, the lack of security obligations is demonstrated by the lack of resources for the implementation of security programs. The lack of commitment to occupational health and safety is also often expressed in the understanding that safety is the responsibility of personnel dealing with safety issues. The lack of well-structured cooperation between the working and engineering personnel of the project and the security personnel leads to ineffective security programs, ineffective risk management methods and ineffective security controls (REASON, 1990).

Leadership commitment is a success factor that is most often mentioned in security studies. Thus, increasing the commitment of management to occupational safety and health is the key to solving the problems associated with an unfavorable working climate.

Also, an important factor hindering the implementation of the labor safety program at construction enterprises is the poor awareness of personnel about the basic requirements for safe work on the construction site. The following disadvantages should be highlighted here: the lack of regular training in the basic rules and techniques of safety both at the workplace and at the relevant specialized courses, ignorance of the risks and problems associated with safety, and the lack of safety checks (OLIVEIRA, OLIVEIRA, ALMEIDA, 2010). The lack of properly organized training leads to limited knowledge about risks and security, which reflects the lack of awareness of management about security issues. All this leads to the inability of managers to assess, prevent and control the risks associated with a decrease in the level of safety at the construction site.

The third factor is the insufficiently high managerial level of the organization of work on labor protection at the construction site. For example, the company may have a lack of occupational safety standards, lack of safety rules and policies, etc. All these obstacles are associated with insufficient security management. Without security policies, rules and regulations, managers and stakeholders are not aware of their roles and responsibilities in implementing security programs. There is an opinion that the lack of rules, policies and security standards is a serious obstacle to the implementation of the security program.

Informing all stakeholders about safety standards and regulations is of paramount importance for creating and maintaining a safe working environment and developing a high safety culture. One of the manifestations of this factor may be the lack of regular security monitoring by employees who are assigned this mission and who have an important responsibility for managing the implementation of the security program and involving all interested parties in the process (OTHMAN, AZMAN, 2020).

Another factor is related to the shortage of competent workers in the construction industry, as well as the tight schedule of the project. All this allows us to talk about a fairly low security priority. It is known that construction projects, as a rule, have a short implementation time, and quite often, in an attempt to complete the implementation of the ICP as early as possible,
management may pay insufficient attention to safety issues on the ground. In this case, safety is put on a low priority level, which is further aggravated by the limited resources of the construction company and the weak commitment to safety in the organization (HINZE, CAMBATESE, 2003).

In modern conditions, it is impossible not to note another factor - financial, which arose due to the increase in the cost of building materials several times. In this regard, the cost of implementing construction projects has also increased, which caused a revision of the budget of projects already taken into operation. However, it must be said that construction tenders, auctions and tenders for which were held at their cost, calculated on the basis of prices that took place before the rise in price in the construction materials market, are currently becoming difficult to implement for the companies that won them. The reason here is that the revision of the tender conditions is not directly provided for, and the authorities do not always want to recognize the attribution of price increases to force majeure circumstances. For this reason, construction companies are forced to make significant cost reductions, among which the cost of safety equipment is not the last place. For this reason, in the future, the question of the necessary level of safety of construction works in such projects may become acute, since the need to implement them may cause a reduction in funding in the field of labor protection and, as a result, an increase in the level of injuries on construction sites (SILVA, AMARAL, 2019).

The identification of obstacles to occupational health and safety is extremely necessary in the construction industry, so that appropriate practical measures can be proposed and applied at both the governmental and internal levels to gradually eliminate obstacles and improve safety indicators. This process should begin with the creation of an appropriate management system at the national level to support the implementation of safety programs, so that safety can gradually become an integral part of the implementation of the construction project. The improvement of labor protection legislation and its proper implementation are the key points in this management system. This will force construction organizations to start taking safety issues into account in their activities. Through ongoing security commitments at the national and industry level, security awareness and leadership commitment can also be developed at the organizational level. Consistency in these concerted efforts to improve safety is critical to ensuring the progress and transformation of the construction industry.

CONCLUSION

Construction accidents are an urgent problem, despite the level of awareness about the promotion of labor protection methods for decades. Safety practices are based on the behavior of employees in relation to safety measures and behavior that determines the attitude of employees to perform their tasks at work in order to reduce or even eliminate accidental injuries.

Thus, the implementation of safety programs in the construction industry is a way to minimize security threats, reduce the number of injuries and deaths, eliminate the costs associated with low safety indicators, and protect the reputation of the construction organization. It can be concluded that ensuring safety in construction should be based both on competent management of the construction project implementation and on the corresponding economic component, since labor protection management will be effective only if its system is based on coordinated actions of specialists in this field and is supported by appropriate financial costs aimed at financing measures to reduce the impact of negative factors affecting the process of ensuring labor safety on the construction site.
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Ensuring the safety of construction facilities: economic, environmental and managerial components

Garantindo a segurança das instalações de construção: componentes económicos, ambientais e gerenciais

Garantir la seguridad de las instalaciones de construcción: componentes económicos, medioambientales y de gestión

Resumo
O artigo considera os rumos de garantir a segurança dos objetos de construção no contexto econômico, ecológico e gerencial. Os autores observaram que a falta de segurança durante as obras é um problema sério nesta indústria. A implantação do programa de segurança sempre foi uma das medidas mais bem sucedidas para reduzir o número de acidentes na construção civil. No entanto, deve-se ter em mente que a garantia da segurança na construção deve ser baseada tanto na gestão competente da implementação do projeto de construção quanto no componente econômico correspondente, uma vez que a gestão da proteção do trabalho só será eficaz se seu sistema se basear em ações coordenadas de especialistas nessa área e é apoiado por custos financeiros adequados destinados a medidas de financiamento para reduzir o impacto de fatores negativos que afetam o processo de garantia do trabalho — segurança no canteiro de obras.

Palavras-chave: Projetos de construção. Segurança ambiental. Aspecto econômico e gerencial da segurança.

Abstract
The article considers the directions of ensuring the safety of construction objects in the economic, ecological and managerial context. The authors noted that the lack of safety during construction work is a serious problem in this industry. The implementation of the safety program has always been one of the most successful measures to reduce the number of accidents in construction. However, it should be borne in mind that ensuring safety in construction should be based both on competent management of the construction project implementation and on the corresponding economic component, since labor protection management will be effective only if its system is based on coordinated actions of specialists in this field and is supported by appropriate financial costs aimed at financing measures to reduce the impact of negative factors affecting the process of ensuring labor safety on the construction site.

Keywords: Construction projects. Environmental safety. Economic and managerial aspect of safety.

Resumen
El artículo considera las direcciones para garantizar la seguridad de los objetos de construcción en el contexto económico, ecológico y de gestión. Los autores señalaron que la falta de seguridad durante los trabajos de construcción es un problema grave en esta industria. La implementación del programa de seguridad siempre ha sido una de las medidas más exitosas para reducir el número de accidentes en la construcción. Sin embargo, debe tenerse en cuenta que garantizar la seguridad en la construcción debe basarse tanto en una gestión competitente de la ejecución del proyecto de construcción como en el componente económico correspondiente, ya que la gestión de la protección laboral será efectiva solo si su sistema se basa en acciones coordinadas de especialistas en este campo y está respaldado por costos financieros adecuados destinados a financiar medidas para reducir el impacto de los factores negativos que afectan el proceso de garantizar la mano de obra — seguridad en el sitio de construcción.

Palabras-clave: Proyectos de construcción. Seguridad ambiental. Aspecto económico y de gestión de la seguridad.