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ФІЛОСОФІЯ НАУКИ ТА ТЕХНІКИ

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ANTHROPOLOGICAL ASPECTS OF HIGH-TECH FACILITIES OPERATION SUPPORT

Purpose. The article, based on the analysis of actual materials, highlights the importance of taking into account the influence of the human factor in occurrence of emergency situations in terms of transport infrastructure. **Methodology**. The research is based on the interdisciplinary system analysis. It was comprehended how the service technicians of high-tech systems can create latent unsafe conditions that combined with other hazardous activities can cause an emergency and injury. The authors attempt to dramatize the issue in order to find a solution – on the one hand, man is the most crucial part of a complex technological system, on the other hand – he is the most unreliable part of the system, especially in terms of the extreme power of modern vehicles and their speeds. The above situation demonstrates the need for a new level of anthropic comprehension of the high-tech systems in the schematic set "human-system-environment". **Originality.** The paper analysed the problems and conditions of human factors that allow detecting the causes of technicians' errors. The authors highlighted proposals for psychocorrective work among the personnel of the facilities. The problem of further development of continuous improvement of the equipment maintenance systems, based on integrated approach taking into account the human factor, is also not overlooked. **Conclusion.** In the course of understanding the human factor and its influence on the processes, the most urgent tasks are as follows: implementation of new system software, automation of vehicles and development of high production culture based on moral qualities of experts.

Keywords: anthropological dimensions; anthropological factor; technical systems; motivation; incentives

Introduction

Community development is constantly accompanied by natural and man-made disasters, carrying out a large number of problems whose solution requires the creation of anthropogenic system as a response. For that matter in transport domain the man-made disasters are particularly dangerous, as they may result in tens of hundreds of casualties, so the safety of people is strategically important.

During the operation of high-tech transportation systems there are often failures of individual elements caused by both external circumstances influence and erroneous actions of personnel because of poor quality of transport service, as a result there is the reduced life of individual system elements and electric stock unsystematic movement. Therefore, further analysis is required for other causes of industrial injuries, which is very relevant today, despite the fact that the number of casualties on European continent is being markedly reduced in the area of transport infrastructure over the last period. Statistical data on the service sector of complex technological systems indicate that the main causes of accidents are mostly human factor as an inadequate response to emergencies by staff with low skills (60-70%), causes of technological origin (20-30%) and unfavourable external

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factors, etc. The above statistics show that the critical condition of trouble-free operation of dangerous infrastructure sections is the provision of highly qualified and reliable personnel, whose quality is influenced by a set of emotional, volitional, motivational, intellectual and other personal qualities that ensure error-free, adequate perception of the situation that may arise in different modes of work [4, 5, 7]. Considering also the economic situation of Ukraine, it is necessary to increase the efficiency of already installed equipment, apply new methods of diagnosing its technical condition, transfer to resource and energy saving technologies in view of improving the quality of the human factor.

The following scholars developed the theoretical principles and methods of planning the repair of complex technological systems: E.Y. Barzilovych, R. Barlow, F. Beihelt, N.M. Smirnov and others. However, the human factor and its quality characteristics in terms of system organization and maintenance efficiency were not given due consideration in the studies.

Many works devoted to the study of the human factor and its impact on processes analyse the possible potential sources of human error that precede the accident (E.G. Petrosov, A.N. Anokhin, A.N. Saraiv). It must be noted that the human factor is a very diversified and complex phenomenon, as it depends on many components, including the emotional and psychological indicators and the social conditions. Despite the psychological science and experimental data to date there is no accurate assessment of the reliability of a human as the ideal operator in the high-tech system "man-machine". When designing the technology systems and their management and maintenance, one takes into account the human reaction rate, the time on the situation reflection, on the decision making and on giving a command. Thus, in the conditions of continuous complication of processes, increase in capacity, handled by a person, there is growing psycho-emotional stress and the fatigue comes in shorter time as inability to respond quickly to external threats. Therefore, one of the priorities of psychologists and ergonomists is to develop optimal work conditions for the operator. This analysis leads to a paradoxical conclusion: on the one hand, a man can be the most crucial part of a technological system, and on the other hand, he is the most unreliable part of the system in terms of the extreme power of modern vehicles and their speeds. This situation demonstrates the need for a new level of anthropic comprehension of the high-tech systems.

All of the above confirms the relevance of the research necessary to ensure the quality of equipment operation taking into account the risks due to the human factor.

Purpose of the research

To identify the ways of the human factor influence on ensuring the efficient operation of transportation infrastructure equipment.

Principal material of the research

Problems of human factors and technological sphere can be seen as rather complex phenomenon, as the processes of their interaction are associated with the man, his mind, emotions, physical state that defies technical algorithms and mathematical modelling. We have to worry about the fact that such issues should be on the agenda and considered by experts as extremely important because the errors made during maintenance of equipment can bring economic losses, and in many cases lead to loss of life. In the long run during the last decades, the research institutions and professional associations have conducted a considerable number of studies on human behaviour in extreme conditions. Equipment service errors are mainly caused by both latent aspects of the specification and situational factors resulting in misinterpretation of compromise between job assignments and safety objectives.

The compromise between effective production and safety is a complex and delicate balance where it is necessary to search for a reasonable approach, as the anthropic principle cannot be veiled, since any senses of true human existence are lost, as they are replaced by purely technical solutions. Technocratic approach clearly shows that attention to the anthropic principle reduces the efficiency of work, performance of enterprise and industry, leading to significant spending on safety, environment, social insurance funds and others. Search of compromise between technological efficiency and social factor in terms of achieving the "ideal" safety is historically changeable, permeates all stages of development of transport infrastructure. But sometimes a man

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disrupts the compromise balance toward technical priorities over the social ones, which leads to negative consequences.

Since taking reasonable compromises eliminates the number of non-standard situations in the transportation industry, leads to positive results in the system "man-technique". It seems that to understand the role of man, we must focus on the equipment operation in normal conditions and not on technical incidents.

First of all, let us note that the processes of repair and maintenance of equipment are considered to be the most difficult in terms of their organization as a whole and the presence of elements of uncertainty, compared to the process of infrastructure management. This view is due to design features, an incredible number of both equipment and process systems where the human factor plays a particularly important role. In fact, at many domestic enterprises the maintenance system often resembles a "black box" that consumes endless resources and takes much time. Professionals responsible for the maintenance and repair (usually technicians and engineers) are well versed in the technical matters of repair, but virtually have no systematic ides about its organization as a whole. It can be difficult for them to divide the areas of organizational system solutions from the purely technical sphere of human priorities. Hence the risk of inefficient use of assets, downtime when the equipment cannot be used as intended; the issues relating to the technical, economic and organizational ways of system quality increasing are addressed in scientific studies [3, p.10]. However, the problem of human factor influence on efficiency and quality of the organization and maintenance of technical systems requires further research.

The human factor is usually considered, first of all, as a fairly stable factor, which marks the mental capacities of man as a potential carrier of problems that appear when managing modern technology. It is necessary to think about what is in the human factor that affects the accident. For this matter there is the literature [5, 6, 8, 9], which emphasizes the following factors.

One important factor is human physiological indicators that reflect the cardiovascular system, locomotor system, etc.; poor health or disease with high probability can significantly reduce the personal safety of a person and safety of the people around him. Psychological features of the person are reflected in the types of temperament as the dynamics of human mental activity that cannot be ignored when assigning especially important work. With this in mind you can ask: can a person with a strong choleric temperament type, characterised by the haste in decision-making, for example, work as a traffic controller? Of course not. Attention is also paid to such peculiarities of human cognitive mental processes as the inability to focus the attention and quickly switch it from one object to another, or when the type of activity and thinking ability fall short of analysis, synthesis, concretization and generalization. The features of emotional and motivational processes of people with manifestation of the apparent passivity are analysed in detail; such features are typical for melancholic temperament – constant dissatisfaction, presence of stress, fear, anxiety, unformed motivation of activities, volitional qualities such as perseverance, self-confidence, discipline, responsibility.

There are other factors, such *as* ergonomic one, determining the labour compliance with physiological and mental capabilities of man: remoteness and isolation of the workplace, strict time limits for work, too high work intensity, monotone rhythms, adverse environmental conditions (noise, vibration, etc.). There are also other influencing factors such as social stressors: impossibility of self-realization, worker's uncertain role in production, cluelessness about remit, a large number of tasks, assignments. These factors also include the degree of readiness of a man for extreme situations where inadequate actions increase significantly. A person loses the ability to think soberly, falls into a panic and makes mistakes.

In summary, it is concluded that the man is the main cause of accidents, hence the question arises: is it possible to avoid the negative effects of human factors and avoid economic losses, save the life of hundreds of people? This problem could be solved by complete automation of production processes and improvement of transport technologies, i.e. removal of man from his workplace. But then there will be another danger – the social one. This is unemployment that will cover lots of qualified professionals, which greatly complicates social tension.

It should be noted that the way-out of this situation is the organization of the psychological service in the infrastructure field with a view not

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only to diagnose any defects a person, but also to conduct the trainings and psychocorrective work.

A range of major errors of technicians when servicing the technological equipment is very wide. Analysis of the causes of accidents, cases of occupational injuries usually indicate a human factor component, due to stress, fatigue, lack of knowledge, uncertainty in their actions, negligence, lack of training, lack of communication, etc. [1, 3]. Such cases can occur at almost every level of activities, ranging from manufacturing the equipment to daily maintenance thereof, as well as during overhauls.

The author cannot ignore study of the current problems arising in everyday working conditions of the equipment maintenance technicians who face with the situations unconventional for them; one of them is the emergence of new technologies. To stay competitive, transport companies begin to operate the new equipment with automated computer control systems. Accordingly, the staff is not always ready to adapt to new conditions, that results in staff frustration. Another reason for the accident may be aging of technology park, absence of prompt communication between headquarters and industrial facility, as some technical errors of the staff can be undetected for a long time, which becomes the source of a traffic accident.

For us it is important to pay attention to the work of vehicle technicians and their work at night, which leads to daily arrhythmias, and in this regard to the occurrence of significant errors in the staff work. The opinion polls show that 20% of technicians working at night feel sleepy during the night shift and often fall asleep, that leads to decrease in labour activity and reliability, resulting in circumstances related to maintenance quality [2].

In the author's view, an important factor in the changing nature of equipment technicians' work is accelerating the process of automation and computerization of workplaces. An increasing number of decisions are made using modern computer technology and control systems that are now used in almost all areas of information management, including work scheduling, reporting, tool monitoring, inventory costs, etc. These programs are designed to detect errors in maintenance and aim at making the system more resistant to such situations. The created maintenance management system enables to detect timely and accurately a departure from the operating instructions. But above all it should be noted that the root cause of many errors lie in the lack of training and lack of knowledge that do not meet the requirements for a competent specialist. Maintenance works require combination of deep knowledge, ability to intelligently process the data and hone the skills needed to perform the professional duties in accordance with established procedures.

But there is another side of the problem that is related to the concept of special maintenance safety culture, which should be realised through moral and material incentives of the employees for fairly identified deficiencies, especially those which constitute a threat to the movement safety.

Motivation and incentive of technical service staff should be made by forming an appropriate system that, inter alia, provides for incentive of each employee. It is necessary to thoroughly consider the question of increasing the responsibility of personnel providing conscientious performance of its functions.

Originality

Further development is gained by the method of continuous improvement of maintenance through an integrated approach that allows improving the efficiency and quality of the system not only due to major interrelated areas: technical, economic, institutional, but also taking into account the risk of possible failures and accidents, caused by human factor.

Conclusions

The study comprehended the latent unsafe conditions of transport infrastructure that may not manifest themselves for a long time, and then combined with other factors, can cause traffic accidents and occupational injuries. Particular attention is paid to the basic concepts of human factors, which include organizational, administrative, cultural, psychological factors, etc., which are fully applied to the technical staff. Special attention to the human factor influence on the processes enables implementation of high production culture and moral qualities of the experts.

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АНТРОПОЛОГІЧНІ АСПЕКТИ ЗАБЕЗПЕЧЕННЯ ФУНКЦІОНУВАННЯ ВИСОКОТЕХНОЛОГІЧНИХ ОБ'ЄКТІВ

Мета. Стаття, заснована на аналізі фактичного матеріалу, спрямована на висвітлення важливості врахування впливу людського фактора на виникнення аварійних ситуацій на прикладі транспортної інфраструктури. **Методологія.** Дослідження побудовано на міждисциплінарному системному аналізі. Осмислено, як фахівці з обслуговування високотехнологічних систем можуть створити приховані небезпечні умови, котрі, поєднавшись із іншими небезпечними діями, можуть бути причиною аварійної ситуації та виробничого травматизму. Автори статті роблять спробу загострити проблему, щоб знайти рішення: з одного боку, людина є найвідповідальнішою частиною складної технологічної системи, а з іншого – вона стає самою ненадійною ланкою системи, особливо при екстремальних потужностях сучасних транспортних засобів та їх швидкостях. Зазначена ситуація свідчить про необхідність нового рівня антропного осмислення високотехнологічних систем в схематичній сукупності "людина-система-середовище". **Наукова новизна.** Проаналізовані проблеми та умови діяльності людського чинника, що дозволяє виявити причини помилок технічного персоналу. Авторами виділені пропозиції щодо психокорекційної роботи серед персоналу підприємств. Не обійдена увагою й проблема подальшого розвитку безперервного удосконалення систем технічного обслуговування устаткування на основі комплексного підходу з урахуванням людського фактора. **Висновок.** По мірі розуміння людського фактора та його впливу на технологічні процеси найактуальнішими задачами стають: впровадження нових системних програм, автоматизація транспортних засобів та виховання високої виробничої культури на основі моральних якостей фахівців.

Ключові слова: антропологічні виміри; антропологічний чинник; технічні системи; мотивація; стимулювання

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АНТРОПОЛОГИЧЕСКИЕ АСПЕКТЫ ОБЕСПЕЧЕНИЯ ФУНКЦИОНИРОВАНИЯ ВЫСОКОТЕХНОЛОГИЧНЫХ ОБЪЕКТОВ

Цель. Статья, основанная на фактическом материале, направлена на освещение важности учета влияния человеческого фактора на возникновение аварийных ситуаций на примере транспортной инфраструктуры. **Методология.** Исследование построено на междисциплинарном системном анализе. Осмысленно, как специалисты по обслуживанию высокотехнологичных систем могут создать скрытые опасные условия, которые, соединившись с другими опасными действиями, могут быть причиной аварийной ситуации и производственного травматизма. Авторы статьи делают попытку обострить проблему, чтобы найти решение: с одной стороны, человек является самой ответственной частью сложной технологической системы, а с другой, – он становится самым ненадежным звеном системы, особенно при экстремальных мощностях современных транспортных средств и их скоростях. Указанная ситуация свидетельствует о необходимости нового уровня антропного осмысления высокотехнологичных систем в схематической совокупности "человек-система-среда". **Научная новизна.** Проанализированы проблемы и условия деятельности человеческого фактора, позволяющие выявить причины ошибок технического персонала. Авторами выделены предложения по психокоррекционной работе среди персонала предприятий. Не обойдена вниманием и проблема дальнейшего развития непрерывного совершенствования систем технического обслуживания оборудования на основе комплексного подхода с учетом человеческого фактора. **Вывод.** По мере понимания человеческого фактора и его влияния на технологические процессы актуальными задачами становятся: внедрение новых системных программ, автоматизация транспортных средств и воспитания высокой производственной культуры на основе нравственных качеств специалистов.

Ключевые слова: антропологические измерения; антропологический фактор; технические системы; мотивация; стимулирование

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