СЕМИНАР
INTEGRITY OF TRADITIONS AND INNOVATIONS AS THE BASIS FOR THE DEVELOPMENT OF MODERN ENGINEERING SCIENCE

METHODOLOGY OF IDENTIFYING CRITICAL OBJECTS OF INFRASTRUCTURE

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Annotation. This work is aimed at creating of methodology of identifying critical objects of infrastructure.

Various infrastructure - a guarantee a successful existence of any state. The main vulnerability of infrastructures - are critical elements within their structure. Failure of critical element leads to a significant drop in efficiency of functioning of infrastructure. Therefore, security of critical infrastructure elements is the basis for the security of infrastructure.

Infrastructure have been considered as non-deterministic complex systems that enter interaction with their environment and consist of a large number of objects and relations between them.

Methods of system analysis and system engineering were the main instruments of research infrastructures in this paper.

The developed methodology involves three major stages: decomposition, analysis and synthesis. All necessary information about the infrastructure will be obtained by performing these stages. Methodology allows us to study any infrastructure from side of its functions and from side of its structure.

The result of research of infrastructure by this method should be full infrastructure model that accurately represents structure and functioning of infrastructure. This model is sufficiently complete for using by specialists in the development of recommendations for improvements in the safety of critical objects of infrastructure.

The methodology is simple and not labor that allows verifying vulnerability of infrastructure in the shortest time.

Keywords: Infrastructure, object, relation, structure, methodology, security, environment, system analysis, system engineering, model.

Introduction

Currently, governments of many countries are paying special attention to the security of critical infrastructure. Disruption of the functioning of critical infrastructure can cause great harm to national security, the economy and the citizens of the state.

Infrastructure - a complex system of objects and relations between them, which provides performance of any human activity [1].

The list of critical infrastructures include:

- Power equipment and networks, for example, Electric Distribution Networks, gas pipelines, oil pipelines, fuel collectors, etc.;

- Communications and information technology, for example, telecommunications, radio and television broadcasters and networks, the Internet and other information networks, etc.;
- The financial system, for example, banking, the capital markets, the investment etc.;
- Health care, especially hospitals, blood supplies, laboratories, a sanitary and rescue services;
- Products, for example, food industry, agriculture, trade, a supply of food;
- Water, especially dams, hydro resources and water supply,
- Transport, especially aviation, highway, railway, combined communication nodes and transport management system;
- Production, storage and transportation of dangerous goods, especially chemical, biological, radiological, nuclear materials;
- Governance, especially the critical services and equipment, information networks, important economic objects, strategic objects and cultural monuments [2].

Each critical infrastructure is a complex system of various objects. Some of these objects have great importance for the functioning of critical infrastructure. These objects are called critical objects (CO). Disruption of the functioning of such objects can cause serious decline in efficiency of the functioning of critical infrastructure, until complete failure. Therefore the problem of identifying critical objects and ensuring their safety have particular importance.

In general, the security of critical infrastructure is the result of an analytical process, which comprises the following steps:

- Identification of CO of critical infrastructure at the national, regional and local level;
- Identification of relevant risks to CO;
- Vulnerability analysis of single CO of the critical infrastructure;
- Risk assessment of CO violation or destruction;
- Taking appropriate safety measures, i.e. creation of a protection system of critical infrastructure.

The goal of this work is the creation of methodology for identifying critical objects of infrastructure.

The main objectives of this work are:

- collection of information on the subject;
- selection tools of system analysis and system engineering required to implement a methodology;
- creation of a common concept of the methodology.

Methodology of identifying of critical objects of infrastructure

Any infrastructure that performs some activity can be represented as an organized system of smaller objects, interconnected and exercising some functional subtasks. However, some objects are more important for the functioning of the infrastructure, while others - are less important.

Objects that are most important for the functioning of infrastructure, called the critical objects. Failure of the critical object necessarily result in malfunction or total failure of infrastructure.

Therefore, the establishment of effective security system of infrastructure requires the identification of all critical objects, as well as the creation of a set of measures aimed at protecting such objects against threats arising in relation to them.

Identification of critical objects of infrastructure can be achieved by applying of methods of System Analysis and systems engineering [3].

Three main stages were identified in the methodology for the identification of critical objects in the framework of this paper:

- decomposition;
- analysis;
- synthesis.

Systems engineering terminology used in this paper, therefore, the term "system" will be used instead of the term "infrastructure".

Stage of decomposition

Overall representation of the system is produced on the decomposition stage. This stage includes:

1. Identifying and decomposition of the objective function of the system. Decomposition is realized by constructing tree of objectives and wood features.
2. Separation of system from environment (division into system / "no system").
3. Identification of factors influencing the system. These factors may include:

- Technogenic situation;
- Factor of natural disasters;
- Social situation;
- Political situation;
- The crime situation;
- Climate;
- Fauna & Flora.

and other factors

4. Description of the development trends of the system.
5. Functional and structural decomposition of system.

Functional decomposition. This type of decomposition is based on the analysis of system functions. However, the technology of functioning is not investigated. Base of decomposition into functional subsystems is common functions performed by the groups of system elements.

Structural decomposition. The result of this type of decomposition is a hierarchical model of a system structure, which can be displayed as a graph. This model shows the subsystem, communication between them and their properties [4].

Stage of analysis

Stage of analysis produces a detailed representation about system. This stage includes:

1. Functional-structural analysis of the system. It allows to formulate the requirements for the system. It includes a refinement of the structure, laws of functioning of elements, algorithms of functioning and mutual influence of subsystems, analysis of the integrity of the system.
2. Morphological analysis - analysis of the relationships of components and relationships between system and environment [5].

Stage of synthesis

Synthesis stage is the last stage in the methodology of the identification of critical objects. Engineer has full detailed representation of the investigated infrastructure at this stage and he can identify critical objects using their knowledge about the system. He can use the theory of reliability of complex technical systems for this.

Identified critical object will be characterized by three attributes:

- Critical capabilities are capabilities of object, which makes it crucial in the context of a specific scenario, situation or problem.
- Critical needs are conditions, resources, methods, or mode of acting that allow the object to achieve the critical capabilities.
- Critical vulnerability is the most vulnerable need or component, disablement of that does not allow objects to achieve the critical capabilities or complete the task [6].

Engineer can make any complex of measures for improve the safety of critical objects after their full description. It can significantly improve the security of the infrastructure.

General view of methodology of the identification of critical objects is shown in figure 1.

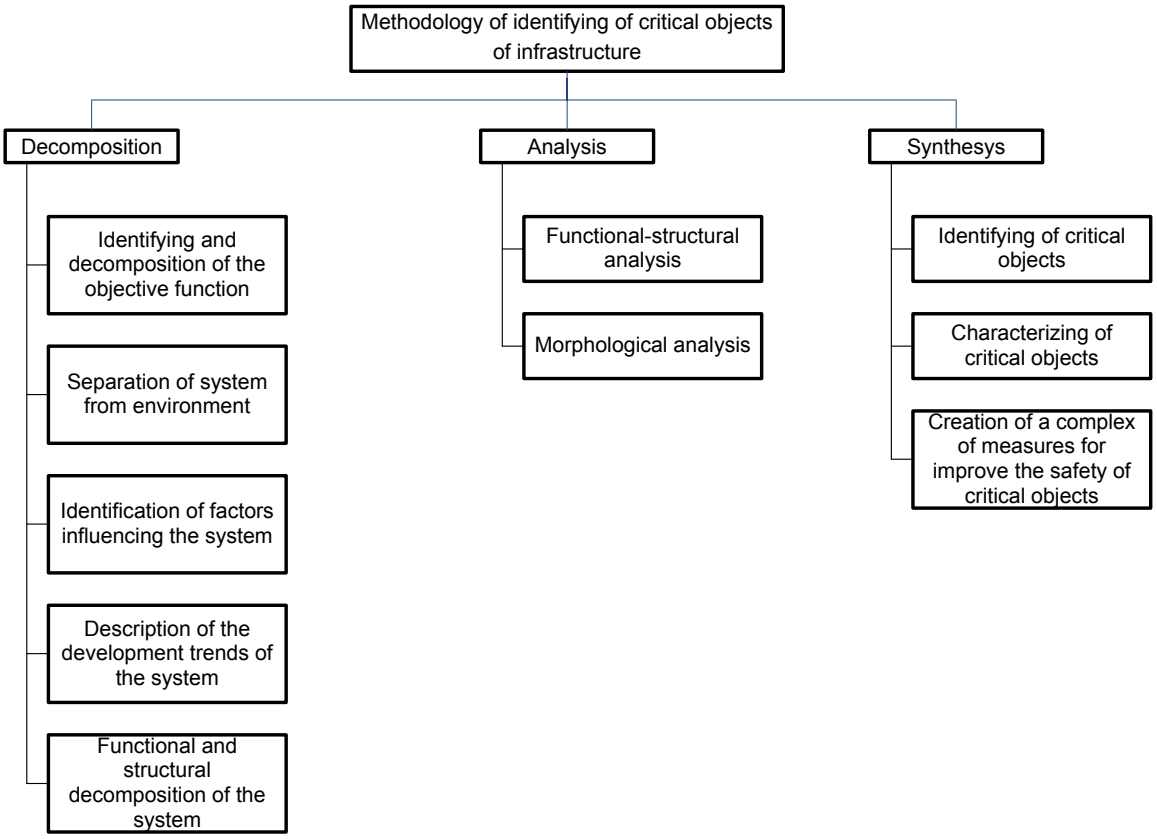

Figure 1. General view of methodology of identifying critical objects of infrastructure.

Conclusion

Critical infrastructure - infrastructure, disruption, failure or destruction of which could have a major impact on public health, social and political affairs, the environment, security and socio-economic wellbeing.

Any infrastructure is a complex system of different objects and relationships between them.

Objects, safety and stable functioning of which is crucial for the functioning of infrastructure, called the

critical objects. Security of critical objects is a priority in ensuring security of infrastructure. The main problem is to identify the critical objects.

This work aims to create a methodology for the identifying of critical objects using methods of systems engineering and systematic approach to the study of the infrastructure. Development of a methodology to identifying critical objects continues at present.

This paper contains a description of obtained results.

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