Artificial Information Security System Generation to Prevent Security Risks

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ABSTRACT: *Information systems are frequently at risk and vulnerable to numerous attacks; hence, the functioning and effectiveness of the information systems need to be assessed. Artificial and intelligent information systems are susceptible; hence, the process of controlling responsible critical issues can be addressed by creating modelling and predicting future work. When this control system is designed, the information, organization and functioning can be well addressed. Using functional homeostasis, an erratic strategic system is designed in this work.*

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1. Introduction

At the present stage of the development of society in today's techno-sphere, large ergatic systems acquire global distribution and dominating role. They are characterized by a wide range of self-organizing capabilities, behavioral freedom, a great deal of internal information and memory. Tendencies towards increasing scale and complexity of the technical systems grow. For example, development and creation of such systems as large-scale transport, energy, aviation, and others are associated with consuming huge amount of resources having been exploited for the lifetime of a whole generation and even further. Essential properties of such complex systems are conflict liability and low predictability of consequences, which is often unrecognizable and yields risky conditions and crises. These can evolve into a possible and constantly developing conflict occasionally related to catastrophic consequences.

The ergatic systems (ES) are a set of a large number of hierarchically dependent complex subsystems comprising teams of people and technical means of a certain degree of organization and autonomy. Particularly, the ES are brought together in accordance with the current hierarchy of objectives through the means of organization, while, commonly, the ES are combined through energy tangible assets and formation relationships in order to provide purposeful functioning of the system as a whole [1, 2]. The means of organization include control nodes the decision-making process takes place in and actuators turning information about decisions taken into actions which in turn are aimed at achieving the control objectives.

Generally speaking, in these systems, both control nodes and actuators can be complex man-machine complexes. For the purpose of quantitative analysis of large systems, it is necessary to formalize and evaluate all components included in the definition of large systems, i.e. degree of organization, hierarchy of objectives, information, autonomy, relationsships between man and machine within the control nodes [3, 4]. The ergatic system, in accordance with the objectives of functioning, must provide for the fulfillment of matter-energy processes. However, its integral functioning, development, and existence are determined by the processes of transmission, processing and transformation of information.

The process of informatisation is accompanied by a widespread dissemination of information-seekers, advisers, designers and other systems that have already entered into different areas of human activity. The constantly increasing need of processing the growing amount of information automatically, the development of computing techniques, and the activating role of the man as an element of complex ergatic systems, make it necessary to investigate further so as to increase their effectiveness. The purpose of this article is to propose a conceptual-evaluation apparatus that forms the principles of building functional-sustainable ergatic systems.

2. Risky Information Systems and a Problem for Functional Sustainability

As a result of extensive society informatization, the risky control functions are placed under the surveillance of automated systems. This process gives rise to the problem of providing the functional sustainability of complex ergatic systems using hybrid human-machine technologies for information processing. [5]. It is of immediate relevance, therefore, that the problem of automated information systems providing proper functioning of the control systems should be characterized by: presence of risk in solving functional tasks, territorial and information distribution, concentrating of restricted access information, use of biological and electronic technologies for processing information, semantic accessibility for information impact, time constraints of the control cycle, and others. These properties determine the complexity of technological processes for information processing and the potential danger of violating their functional sustainability.

Therefore, automated information systems can be considered to be a component of risky control systems. This in turn lets the systems be individualized as a class of risky information systems demanding strict requirements to be met in terms of the functional sustainability. These requirements are due to dangerous consequences that may arise after functional failures. Again, the risky information systems are allowed to be defined as a class of ergatic systems implementing information processes in risky control systems. The risk itself boils down to potential danger of impairing the systems' functional sustainability for full or partial system failure yields significant economic, political, military, ecological, moral and other losses.

Functional sustainability can be defined as a property of the risky information systems, expressing their ability to implement certain information functions (processes of information processing) under conditions of external and internal destabilizing factors. The criticality in this case is characterized by the high level of information risks depending on the amount of damage the information system destabilization might lead to [6].

3. Aspects of the System-information Analysis of the Functional Sustainability of Risky Information Systems

Providing for functional sustainability of the information systems used in risky applications is a complex problem requiring working out systematically a solution of interrelated tasks related to development of theoretical positions, methods for automatic modeling, and analysis of complex systems. All this makes it possible to take the systems apart, to build reliable models of the information architecture and the information processing, to define requirements for the functional sustainability to meet, and to evaluate its implementation. Methods for system-information analysis of the functional sustainability include the following three steps:

1. An initial step appears to be study of information structure of the system under consideration. As a result of this step, main levels of the control hierarchy and related information streams are distinguished.

2. The next task of the analysis is essentially a matter of determining functioning purposes and building a relevant hierarchy. The quality of functioning depends on the fulfillment of certain set of criteria. The assigned objectives are actually images of parameters and criteria in the system state space, in which the system functioning is being monitored and the control commands are being applied.

3. Main goal of the analysis is development of a summarized criterion that make it possible to assess the system functional sustainability.

At the presented material, the degree of uncertainty (entropy) of the system's functioning in terms of defined purposes is proposed to be used as a generalized criterion. In this way it is possible to report all system states related to purposes, and also to determine the probabilities of occurrence of different situations [7, 8]. In this sense, formation of the control structure ensuring functional sustainability will be reduced to distribution of information resources in risky information subsystems between the possible situations within the big system, i.e. between a finite number of possible situations, determined by significant changes in its properties or changes in the environment. In doing so, the search for a solution boils down to how optimally one can allocate the information resource between the baseline situations determining the main modes of functioning and the risky situations. The latter, in case of improper control and adverse conditions, may evolve so as to yield loss of functional sustainability, i.e. termination of the system existence as a whole.

Risky information systems are self-organized ergatic systems, characterized by the presence of technological areas with automatic, automated, and intellectual control. The last circumstance considerably complicates the analysis in the problem area, for the properties of functional sustainability are ambiguous in relation to information systems with different levels of complexity of the structural organization.

One of the most promising approaches used during building management strategy in risky ergatic systems is based on the principle of functional homeostasis, according to which: "Any system which is under the impact of other systems has the property of preserving, within certain limits, a set of sustainable functional behaviors in solving its own private or common tasks." [9, 10]. Researches in this area show that homeostasis is an integral concept describing the structural organization of systems. This organization is characterized by a high degree of internal freedom which permit the system's resources to be used rationally so as to achieve purposes in terms of the external uncertainty. This complex structural organization of homeostatic systems covers the following aspects:

- Purposes of control;
- A process of purposeful functioning;
- The system as a loop of a homeostatic control.

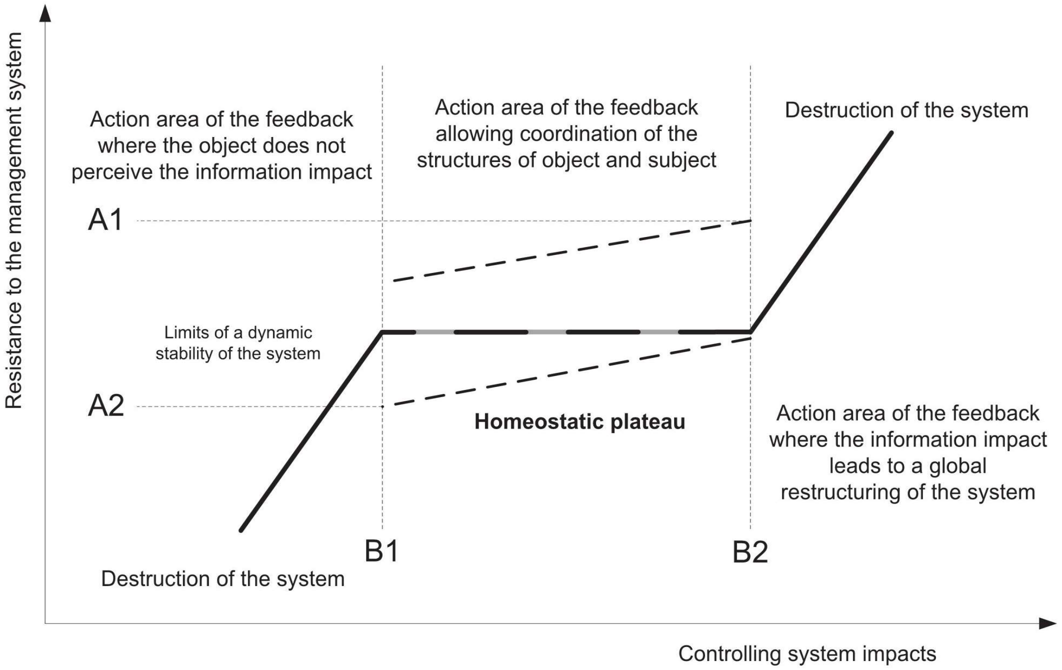

Figure 1. Homeostatic plateau

The essence and purpose of homeostasis is to provide constancy of the internal parameters of each system, the preservation of its integrity, and ability to survive in a dynamically changing environment. Then, functional sustainability of the system class under consideration can be defined as a dynamical equilibrium within the tolerances of the homeostatic plateau (Figure 1). The inconsistency between the subject and the object of the control effect getting the system out of the borders of this area, yields functional instability and information destruction of the system. This in turn produces an inability to adapt or modify the target function of the system as a result of global structural reorganizations.

Homeostatics is formed on the verge of various sciences and disciplines such as informatics, system analysis, biology, medicine, psychology, philosophy, artificial intelligence, economics, ecology and etc. The essence of homeostatics is studying the mechanisms of hierarchical control of complex systems providing constant vital functions, parameters, and modes of the development. It should emphasized that homeostasis is interpreted differently in cybernetics and homeostatics. In traditional cybernetics, in terms of purposes, homeostasis is seen as some stable control of the object state. It is provided by the fact that any difference between the controlled target state and the control goal is made up for by a negative feedback. In homeostatics, the homeostasis is seen as a dynamical constancy of the parameters, functions, and modes of development of the controlled object in the course of the purposeful or the unintended existence. This dynamical constancy is maintained at the expense of managing the internal contradictions existing or incorporated in the object. Maintaining homeostasis is performed in the hierarchical control structure consisting of three control loops, as the purposes in two of them is contradictory which is why they are targeted by the third control loop. A homeostatic system is a system that consists of a controllable and controlling part, as the latter appears to be a homeostasis. The homeostasis is a structure of control of material objects containing straight, inverse, and cross links. These provide for, in the course of their work, homeostasis maintenance, i.e. the dynamical constancy of vital functions and system parameters.

Essential properties of large ergatic systems are conflictuality and low predictability of consequences caused by different contradictions during the control processes in the individual subsystems. These are commonly not taken into account yielding critical situations that can evolve as a possible and constantly evolving point of a conflict, occasionally related to fatal consequences. In this respect, with the creation of new technologies in modern conditions and the improvement of responsible technological processes, reliability issues in technics, its safety, and questions about discipline, order, and organization acquire paramount importance [11, 12]. There is a sustainable trend in increasing number of accidents, incidents, and catastrophes worldwide. This is due to a number of reasons: while the technique evolves, the danger obviously grows faster than the human ability to resist; the accident toll increases; not only do people tend to get used to the danger but also to break the rules. In most cases, dangerous situations occur in case of close interaction between the technique and the operators.

4. Conclusion

Based on the ideas of homeostatic control, a large number of behavioral models can be formulated which are able to control internal contradictions. This yields a high level of sustainability and adaptability to influence of various adverse factors. The basic idea is how much the active contradictions make use of the system’s resources (energy **”E**, substance **”V**, information **”I**), moving in this way towards dangerous situations. It is also important to estimate how far these resources can be released in order to preserve purposefully systems sustainability and maintain homeostasis. In this way a contradiction is “set” inside the system in advance which is an additional possibility for carrying out system control in case of emergency and other severe situations.

An essential feature of ergatic systems is the strong relationship between the general functioning of the system and the behavior of its subsystems and elements. The integrity and dynamical sustainability of such systems are to a large extent guaranteed by full or partial compensation of opposed trends based on the principle of homeostasis. Starting from the idea of a single scientifically methodological apparatus based on the principles of functional sustainability, objective assessments of the information systems used in risky applications can be made.

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