ZRÍNYI MIKLÓS
NATIONAL DEFENSE UNIVERSITY
Doktoral Council

SÁNDOR UTASSY

Security Issues of Complex Electric Systems

author's review

Budapest
2009

ZRÍNYI MIKLÓS NEMZETVÉDELMI EGYETEM

SÁNDOR UTASSY

Security Issues of Complex Electric Systems

author's review

Scientific supervisor:

Prof. Dr. Gyula Zsigmond PhD, senior university professor

Budapest
2009

1. INTRUDUCTION, DESCRIPTION OF THE SCIENTIFIC PROBLEM

Complex electric systems are electric systems that consist of high-current, low-current, IT and other subsystems.

The safe functioning and operation of complex electric systems can be examined from several different perspectives. This thesis focuses on the integrated security (property security) systems of objects as complex electric systems.

Topicality of the research

Recent years have seen the security systems of complex electric systems in new investments, reconstructions, developments growing in significance; their importance seems to become even more crucial in the future with stricter requirements posed against them. Military objects also call for highly reliable, intelligent systems offering broad-scaling services, as well as enhancing the safety and cost-efficiency of operations and maintenance.

Nowadays, not only large objects consisting of several buildings, but also smaller objects raise the key issue of security, the cost-efficiency and operating safety of equipment, the quickness of troubleshooting activities, the digital logging of events, data, as well as their proper processing and evaluation.

These demands can be satisfied in the most adequate manner by integrating high- current, low- current, IT, communication subsystems into complex electric systems and the establishment of integrated building surveillance systems.

As security subsystems, integrated building surveillance systems – in fact complex electric systems – have particular significance in the case of military facilities, objects.

The scientific problem

In order to make the individual integrated security systems ratable, comparable, parameters pertaining to the rate of integratedness, the associated reliability, cost-efficiency and security are to be defined. For the time being, the necessary means of making such definitions are not available.

Indicators for the rate of integratedness of security subsystems or integrated property security systems as complex electric systems are not defined in the civil or military literature.

There is no calculation or estimation model, method for the establishment of the rate of integratedness.

There is no such an elaborated mathematical model for the estimation of the complexity of the individual security systems that would serve as the basis of the calculation of the rate of integratedness.

For the resolution of the above-described problems, there exists no fundamental, systematic, comprehensive description for the security components of complex electric systems, their subsystems in the civil or military literature.

In connection with the management of integration, there is no comprehensive description on the integration potentials, planning processes of security systems.

2. RESEARCH OBJECTIVES, HYPOTHESES

Research objectives

To resolve the scientific problem described in the introduction above, provide for the interrelated elaboration of the means required for such a solution, I have set forth the following research objectives:

1. Assessment of the security components and subsystems of complex electric systems, their systematic summary.
2. Description of the integration potentials, planning processes of security systems and classification of the integration types.
3. Elaboration of a mathematical model for the estimation of the complexity of security subsystems.
4. Performance of test calculations in order to establish the complexity of the security subsystems of military and civil objects.
5. Definition and elaboration of a mathematical model for the estimation of the rate of integratedness of security subsystems.

Hypotheses

The basis of the commencement, execution of any research work is the assumption that the particular scientific problem can be resolved by executing the given research tasks, accomplishing the research objectives set. This assumption has been proven by the verification of the following hypothesis:

1. The value of complexity can be quantified in the security subsystems of complex electric systems.

2. For the calculation of the complexity specific parameters can be established for integrated security subsystem architectures.

3. For integrated security systems, the rate of integratedness can be established, quantified.

4. In the case of security systems of military and civil objects, the complexity of any given system can be reduced by the integration of subsystems.

3. RESEARCH METHODS

The basis of the elaboration of the topic is the research, analysis and comparison of the available printed and electronic literature.

In the given context, materials used have included Hungarian and primarily international, printed and electronic (Internet-based) literature, case studies published by designers, manufacturers, installers, operators, security service companies and competent authorities, assessments, as well as the proceedings of professional and scientific conferences.

Another important point has been the examination, testing and analysis of the existing integrated systems.

The systematic knowledge, partial results explored in the course of the research work have been exposed at conferences, professional journals and course of military technical higher education, MSc courses of security education.

The hypotheses have been verified by applying the models elaborated with respect to the analysis of known mathematical models in existing systems.

It has been essential to conduct continuous professional consultations with the domestic and international scholars of the given professional field, as well as my consultant teacher, Prof. Dr. Gyula Zsigmond.

4. BRIEF DESCRIPTION OF THE THESIS IN THE ORDER OF CHAPTERS

The thesis has been structured in the light of the objectives of the research topic, the rationale of the elaboration of the topic.
It consists of an introduction, four main additional chapters and a summary giving a systematic description of the results of the thesis. The thesis also has a list of literature and references.

The **introduction** offers a historic overview on the process of integration of the building IT, security subsystems of complex electric systems to demonstrate the importance and topicality of the thesis.

This part describes the scientific problem, as well as the conditions that are essential in finding a proper solution.

The research objectives, hypotheses and the applied research methods are also specified, and finally the structure of the thesis is shown.

The **second chapter** describes the structure and components of complex property security, and a systematic summary is provided on the security components, subsystems of complex electric systems.

The **third chapter** offers a comprehensive description on the integration potentials of security systems, as well as the planning process of integrated security systems.

The **fourth chapter** analyzes descriptive models of system complexity as required for the estimation of the rate of integratedness of complex electric systems, with the selection of the usable methods, parameters. For the modeling of the complexity of the most frequently used security systems (intrusion detection systems and entrance systems), the parameters to be applied in practices are defined.

The **fifth chapter** provides the definition, calculation model for the rate of integratedness of integrated security systems, and then via the example of an intrusion detection and entrance system of a military surveillance object the process of the establishment of complexity indicators and the rate of integratedness is demonstrated.

At the end of the individual chapters, the partial conclusions of the research work described in the given chapter are also provided.

The **summary** exposes the main ideas arising from the partial conclusions of the main chapters, as well as the research results as a synthesis of these conclusions. The summary also designates those fields of studies that – in my opinion – call for additional research work or further elaboration.

The **list of publications** enumerates my publications in connection with the given topic while the **literature and references** details the referenced literature.

5. SUMMARY CONCLUSIONS

The research work has focused on issues associated with the integration of the components of security systems as complex electric systems.

This research that can be regarded to close an existing gap in international literature, and aiming to define and quantify the rate of integration of integrated systems has accomplished its objectives by defining the rate of integration of integrated systems, elaborating calculation models for complexity and the rate of integratedness.

Our activities for the assessment and systematic description of the scope of the given topic – that has been essential for the accomplishment of the ultimate objectives, as well – have also contributed to the establishment of scientific grounds in certain fields of MSc courses of security education.

6. NEW SCIENTIFIC RESULTS

1. By providing a scientific exploration and description of the given topic, proper grounds have been provided for the high-standard elaboration of certain topics of the professional subjects I also teach in MSc courses of security forming important elements of military technical higher education.

2. The descriptive models of system complexity for the estimation of the rate of integratedness of complex electric systems have been analyzed, and the methods, parameters needed for the estimation of the complexity of security systems have been defined.

3. It has been ascertained that some models used for the establishment of complexity may as well be applied to the establishment of the rate of integratedness under certain conditions, and thus for the most frequently used security systems (intrusion detection systems and entrance systems) the practical parameters of modeling complexity have been defined.

4. The definition of the rate of integratedness of integrated security systems has been framed, the mathematical model for the quantification of the rate of integratedness has been formulated, and via the example of an intrusion detection and entrance system of a military surveillance object the process of the establishment of the complexity indicators and the rate of integratedness has been demonstrated.

Verification of the hypothesis

1. Chapter 4 analyzes the descriptive models of system complexity for the estimation of the rate of integratedness of complex electric systems, defines the methods, parameters needed for the estimation of the complexity of security subsystems.
   It is to verify Hypothesis 1 stating that “the value of complexity can be quantified in the security subsystems of complex electric systems”.

2. Chapter 5 demonstrates the process of the establishment of complexity indicators via the example of an intrusion detection and entrance system of a military surveillance object.
   It is to verify Hypothesis 2 stating that “for the calculation of the complexity specific parameters can be established for integrated security subsystem architectures”.

3. Chapter 5 provides the definition of the rate of integratedness of integrated security systems, as well as the mathematical model for the quantification of the rate of integratedness, and then via the example of an intrusion detection and entrance system of a military surveillance object it has demonstrated the process of the establishment of the complexity indicators and the rate of integratedness.
   It is to verify Hypothesis 3 stating that “for integrated security systems, the rate of integratedness can be established and quantified”.

4. Chapter 5 shows that the aggregated complexity indicators of the non-integrated intrusion detection system and entrance system of the military surveillance object are larger than the complexity indicator of the integrated intrusion detection system and entrance system of the same object.
   It is to verify Hypothesis 4 stating that "in the case of security systems of military and civil objects, the complexity of any given system can be reduced by the integration of subsystems".

7. RECOMMENDATIONS, UTILIZATION OF THE RESEARCH RESULTS

The novelty and complexity of the given research topic have allowed only the creation of proper grounds for further studies. The obtained results give way to the continuation of associated research in different directions:

1. From among the security subsystems of complex electric systems, the models framed for the establishment of complexity and the rate of integrated should be tested for additional subsystems.

2. In system models reflecting major deviations in terms of system architecture (for instance, video surveillance systems), the application potentials of other parameters should be examined, and the mathematical models are to be modified as required.

3. Apart from security subsystems, the mathematical models should be applied to other systems, such as automated building management systems (heating, cooling, ventilation, lighting control, etc.) or high-current automation systems, as well, and these mathematical models are to be modified as required.

4. For subsystems featuring high rates of integratedness in themselves (for instance, IP-based network subsystems), with respect to the given process parameters new mathematical models should be framed.

5. Additional research topics may emerge from the mathematical modeling of the complexity of systems, their rates of integrated and reliability, planning, investment and operating cost implications.

6. One of the most important directions may by the research of the application potentials of complexity calculation and the calculation of the rate of integratedness in military applications.

7. The chapters describing the structure, components of complex property security, their systematic summary, as well as the integration potentials of the security subsystems of complex electric systems, the planning process of integrated security systems may serve as a scientific basis for the elaboration of educational materials in important fields of military technical higher education, MSc courses on security engineering.