

Theoretical Sources for a Theory of Safety and Security

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Abstract—Safety and security are top priorities in our society and addressing problems in these areas is crucial. Several different kinds of safety or security exist today, such as international security, cyber security, physical security, fire safety, and so on. The scientific community is starting to address the creation of a theory of safety and security. The theory of safety and security will be followed by a series of default theories. This paper discusses the concepts and theoretical sources we can draw from for the theory of safety and security, as well as subsequent knowledge.

Keywords—theory of safety and security; risk theory; crisis theory; causality.

I. INTRODUCTION

Nowadays, a mostly pragmatic approach prevails in the safety and security research [1]. Currently, safety and security research is realized independently, with each sector addressing its own kind of safety or security. Each kind of safety or security mostly creates its own professional conceptual apparatus.

Many specialists think that it is not possible to connect problems of international security, fire safety, information security or work health safety in one unit because they do not have a collective content. There are obvious reasons for that. Until now, no comparison was done between the different kinds of safety and security; in addition, no generalization was attempted.

Specialists in each field work on and develop their own kind of safety or security measures independently. Each kind of safety or security is solving its own specific problems of that field, which are meant to prevent danger or negative consequences. Because of this reason, each kind of safety or security was created by taking into account measures that make a reference object safe or secure. The different kinds of safety and security were researched and evolved separately. Until now, there is no common theoretical basis for safety or security.

Many scientific disciplines like informatics or electronics have their own theory. There also should be the theory of safety and security. The theory of safety and security should evolve from each kind of safety or security. This theory should reflect the existing theoretical knowledge in the area of safety and security research and other disciplines which have relations to safety and security.

The theory of safety and security can draw mainly from the following sources:

- Copenhagen school of security studies,
- risk theory,
- crisis theory,
- causality.

The following section analyzes the above mentioned sources and their impact on the theory of safety and security. The last part of the article discusses the starting points which should be respected in the theory of safety and security.

II. COPENHAGEN SCHOOL OF SECURITY STUDIES

Theoretical security research exists for a long time. The main research was done in the field of international security and military. The specialists who researched this field had mostly political science education. They researched the security from the political science and governance point of view. The aim of their research was to solve mainly military problems between states. The Copenhagen School of Security Studies (CSSS) had a significant position in this field. During the 90s of 20th century, the CSSS focused on the research into other sectors of security. In their work [1], they emphasized security research not only in area of military security, but in human security, environment and other sectors. The specification of security sectors and securitization process are the main benefits of CSSS for security research. There are three main questions about security:

1. Whose security?
2. Security of which values?
3. Security against what?

Answers to these questions should help analyze the security reality. They define what the reference object is, what protects it, and what the threats are. Answers to these questions allow specifying the basic elements and interactions in the analyzed kind of security. The situational analysis is the result of this process. This analysis is the basis for solving security problems and choosing of the appropriate security methods, measures and resources.

The representatives of the CSSS emphasize that security is ensured primarily in the military area. They also recommended to make the research and to solve the security

problems in the political, social, economic and environmental sectors. Through this, they developed from the security discipline the transdisciplinary scientific field. The creation of the security sectors meant a top-down approach for solving the security problems in society.

The identification of the securitization process was the last contribution of the CSSS. The securitization is speech act. Its aim is to transform the political problem into security problem. The securitization actor identifies some political problem, and after that he emphasizes the needs of solution as the security problem. This problem gets into the security agenda and has high priority of solution.

The specifications of a formal frame for security and securitization process are basic benefits of the CSSS for the theory of safety and security. The main drawback of this school is a lack of a solution for a security situation.

III. THE RISK THEORY AS A BASE FOR THE THEORY OF SAFETY AND SECURITY

Risk theory is a widely used scientific discipline, based on the identification of a threat, the specification of risk and the specification of how to overcome the risk. The essence of risk lies in the objective existence of threats. The risk comes from consciously controlled acting, or chaotic and uncontrolled acting of each part of a complex. In the behavior of elements, moments may arise when the elements, whether intentionally or randomly, are getting into direct interaction (collision, impact).

Many interactions are negative, with devastating impact. This impact is proportional to the magnitude and direction of the action (measure), where the individual reference objects are involved in negative interactions. This negative interaction is named "security incident". The application of the risk theory evaluates which threats (or negative acts) affect the reference object, and which ones have more or less significant impact. The purpose of risk identification is to identify the worst possible impact of threats and prepare measures to counteract these threats. The proposed measures should prevent the effects of threats or prevent negative impacts on the reference object.

The aim of risk is to express how probable and how large the negative impact will be on the reference object. The risk can be determined quantitatively as well as qualitatively. Its size has more variables. There is currently no definition of risk that is clearly defined and accepted. Usually, the risk is characterized by the size of the negative impact or the harm and by the probability of threat exposure. Some authors have added the vulnerability of the reference object into the risk definition [5]. The question of vulnerability is purposeful. The vulnerability emphasizes the threats to which the reference object is prone. This parameter is involved in specification of probability of exposition. If it is not prone to threat exposition, the exposure probability, and also vulnerability, will be lower.

The method of risk management is used in many fields. These include project management, investment, economics, and so on. It is also always part of the management. The goal of the risk management is not to find a way to efficiently

fulfill the objective function of the reference object. Its aim is to determine the negative impact, which can affect the reference object, how the reference will be affected, how it acts or how to minimize the impacts.

Risk management has an important position in the field of safety and security. It is focusing on minimization of damage or impact. The risk theory could be used as methodology for specification of possible negative impacts, which could harm the reference object. Due to this fact, risk management is used in many fields, in which significant theoretical development and practical applications were developed. Methods of risk analysis have been elaborated. Nowadays, we have many methods of risk analysis. These methods allow quantifying the level of risk. Depending on the approach and nature of the application, different risk analysis methods could cause different results, which were obtained during the analysis of one specific security problem.

Risk management prefers the repressive manner for ensuring the safety or security. It defines for what risk and how the reference object should be prepared. The disadvantage of the risk management is that it does not find out the causes of threats. Threats are taken as a fact and it only focuses on what they can cause. Unacceptable risk is solved by appropriate measures. The solution comes as acceptance of risk, risk retention, risk transfer and risk avoidance.

Despite this disadvantage, risk theory creates the basis of the theory of safety and security. The main contribution is its well developed methods of risk analysis. The risk theory is well applied in kinds of safety or security that protect the conditions of reference object (physical security, information security, administrative security and so on). Risk theory is less suitable for the kinds of safety or security that govern the reference object (international security, homeland security and so on). In these cases, it is about creating the secure of safe environment as the result of synthesis.

IV. THE CRISIS THEORY AND ITS RELATION TO THE THEORY OF SAFETY AND SECURITY

A crisis is an important phenomenon, which has negative influence on human society. The negative effect is a common sign of security breach and crisis. For the safety and security research, it is important to determine what is the reason and nature of safety and security problems. Moreover, we need to examine what is the relation between the theory of safety and security and the crisis theory.

Crisis theory is a scientific discipline focused on the theoretic aspects of crisis research, mainly on nature and causes of crisis. The basics of crisis prevention and its handling are based on the crisis theory.

The crisis theory has systems and a dynamic character. The crisis theory is independent from a concrete reference object; it also researches the basic aspects of the creation and development of crisis. The crisis theory is the basis for successful management of a crisis. Nowadays, the crisis is understood as:

- time when contradictions culminate,
- or as a complicated situation.

These terms are similar. They are appropriate for designation of a time period when existential complications arise. The crisis is considered as a state or period when danger is coming out and simultaneously the aim function of the reference object is threatened. The crisis arises when there is a significant change in conditions for the reference object. Changing conditions occurs due to the chaotic or uncoordinated behavior of each part of the system. During this time period, the configuration of conditions and environment are changing. It could be caused by a lack of inputs, a fault in the power supply or production elements, or escalation of electric voltage, and so on. Each change requires an adequate system reaction to provide adaptation. If the changes are expected, the system can be prepared for them and after that; it also can have a suitable reaction. The situation is different when a rapid change has a higher than expected value. During this situation, the system can have an inappropriate reaction and, following that complications or crisis may arise. Basically, the crisis is created due to:

- unexpected and large negative situation,
- unmanaged control.

A. *Unexpected and Large Negative Situation*

An unexpected situation is a situation which cannot be predicted. The complications are created by a negative event of large scale (for example, natural disasters, the sharp fall in the price of the shares on the stock exchange, large-scale attack of an unknown computer virus, and so on). The system is not prepared for these changes, because they are not frequent and the prevention is economically unbearable. The system should be prepared for these negative situations. Managing the crisis is based on minimization of the influence of the negative situation and also on system recovery. Crisis management is a special kind of management created for managing and overcoming the crisis. The activation of new forces and equipment is a basic crisis measure.

B. *Unmanaged Control*

The nature of the crisis arising is based on the unmanaged control. The crisis usually includes periods (stages) of latent symptoms, acute, chronic and resolved/unresolved crisis. In the stage of latent symptoms, the accumulation of unresolved problems happens. If the managing system is not catching up or is not solving the crisis symptoms, the crisis comes out. In the acute stage, problems culminate. The unsolved problems accumulate, too. The control system should start solving these problems slowly. A breakpoint of the situation is then reached. This breakpoint is based on the capacity of the system, especially on the control system. The crisis is eliminated if the system is capable of activating and ensuring plenty of resources for appropriate measures. The crisis management has been activated, too. The crisis management has to act fast and has to be effective enough to solve the crisis without harming the

elements of the complex. In crisis, we usually do not have enough relevant information. So, crisis solving must be done during an unclear situation. Knowledge and experience, obtained from previous crisis, plays a key role in managing complicated situations. Decisions usually have irreversible implications. The systems have to be prepared for crisis and also have to make the plans for eliminating the crisis situation. At the same time, they should solve the crisis immediately in the stage of latent symptoms. This ensures avoidance of crises.

C. *Relations between Crisis and Safety and Security*

The crisis theory and the theory of safety and security represent the common form of scientific knowledge, which gives the systematic view about laws and main substantial relations, reasons and conclusions of special types of negative effect affecting reference objects. These negative effects are crisis and security incidents. Both of them have negative effects for the reference object. The reason why negative effects happen is different in each case. The key reason of crisis is the unmanaged control and the key reason of security incident is the objective existence of danger and intentional, unintentional or accidental emergence of safety and security incidents. The common signs of crisis and safety and security incidents include:

- a negative effect for the reference object,
- arising due to changes in the reference object and its inputs,
- the fact that overcoming of complications requires a specific type of management,
- the fact that the size of the impact can be minimized by prevention and repression,
- the usage of the risk theory as the basic theory for its managing and overcoming.

The different signs are:

- difference in the nature of arising,
- security incidents happens suddenly, but a crisis usually comes gradually.

Disclosure of security breaches lies in the objective existence of threats and intentional, negligence or accidental exposure. The security incident emerges due to the chaotic evolution. It can be a cause of negative interaction and also as creation of damage. The crisis is based on an unmanaged control of changed conditions. Both theories have many common points, but their basics are different. Crisis can cause security incidents and also security incidents can cause crisis. On one side, the economic crisis leads to increasing criminality and also, on the other side, a security incident such as an attack on oil pipeline can cause an energy crisis, for example. There are relations between them. In practice, the safety or security is ensured continuously. On the other hand, the crisis is solved only at the time it arises.

Also, there are applied relations between superiority and subordination. The security manager provides measures in

each kind of safety or security. The physical security, personal security or information security are basic kinds of safety or security in a manufacturing company, for example. If the crisis begins, the crisis manager takes care of management. His task is to lead the organization out of the crisis. The crisis manager must understand the fulfillment of objective function of the organization. By his actions, he tries to make the organization become fully operational. The security manager helps the crisis manager especially with prevention of crisis by minimizing security incidents in the field of property, staff or information. During the crisis, the crisis manager is superior to security manager.

V. CAUSALITY AND ITS RELATION TO THE THEORY OF SAFETY AND SECURITY

The causality is a scientific discipline which researches relations between cause and effect. The term causality has evolved from the Latin word „causa“. The cause is relation, where cause and effect are mutually connected. The law of causality determines that anything that happens has at least one cause, and also any cause has future consequences. The same causes create the same effects. It is structured by a causal relationship (causal nexus). Causality is an expression of the relationship between two events, where one of them raises and the second is called the "cause". Basically the reason is the term, which causes effect.

Causality is key for the theory of safety and security. It allows establishing a logic chain of causes of security or safety violation. From this point of view of safety or security, there is inadequate position of causality. A role of causality is neglected. It is important to focus on this problem.

VI. BACKGROUND FOR THE THEORY OF SAFETY AND SECURITY

The theory of safety and security should specify the basic concepts and knowledge in the field of safety and security in the most general context. The Czech concept of the theory of safety and security will be different from the English concept. The security identifies security incidents caused intentionally. The safety identifies safety incidents caused by negligence or accidentally.

The Czech language, contrary to the English language, uses the terms “safety and security” as one term "bezpecnost". The Czech language does not distinguish between intentional and accidental incidents. Therefore, the Czech concept of the theory of safety and security will be in certain aspects different from the English concept of the theory of safety and security.

The theory of safety and security should follow up to the crisis theory, the risk theory, the causality and the CSSS. Based on the analysis of the above mentioned theories, the theory of safety and security exploits the following findings and conclusions:

A. The Copenhagen School of Security Studies

The CSSS’ benefit is a conceptual security framework which gives the answers to basic questions: "Whose security?“, „Security of which values?“, „Security against

what? " The response is the notion of a" reference object ", which refers to an object whose security is assessed. Another benefit is the list of threats affecting the reference object.

A sector approach to decomposition of the security environment is another benefit. Sectors refer to areas where security issues should be identified and addressed. If there is an accumulation and a repetition of security problems, a new kind of security is created for its solution.

The last benefit is specifications of the securitization process. This concept shows how the problem becomes a security issue. The problem then comes to the security agenda. Security issues are those that have to reference the object’s existential influence and impact.

B. Risk Theory

The risk theory offers to the theory of safety and security a basic methodological approach to the identification and assessment of safety and security problems by identifying threats, risk analysis and the choice of method of risk management. Risk theory gives to theory of safety and security the basic terms. Basic terms are a threat, risk, damage and impact.

C. Crisis Theory

The crisis theory is closely linked to the theory of safety and security by managing the breach consequences. Most security breaches get a reference object into a crisis and it is important to overcome it.

D. Causality

The causality deals with the causes of safety and security breaches. The theory of safety and security can utilize the types of causes of safety and security breaches. It is the intent, negligence and chance.

The above described theories offer to the theory of safety and security new knowledge and themes. The newly created theory of safety and security can draw from this knowledge. The theory of safety and security can be created in several ways. Based on the conclusions, the theory of safety and security will be established by generalization and induction.

Such a theory should be created in the form of postulates creating a systematic, generalized picture of the essential patterns and contexts of safety and security, its breaching and ensuring.

TABLE 1. USABLE KNOWLEDGE FROM THE ANALYSED SOURCES

Source	Usable Knowledge
Copenhagen school of security studies	<ul style="list-style-type: none"> • answers for situation analyses, • sector approach, • securitization.
risk theory	<ul style="list-style-type: none"> • basic methodological approach: • threat – risk – measure.
crisis theory	<ul style="list-style-type: none"> • solution of safety or security event.
causality	<ul style="list-style-type: none"> • causes of safety or security event.

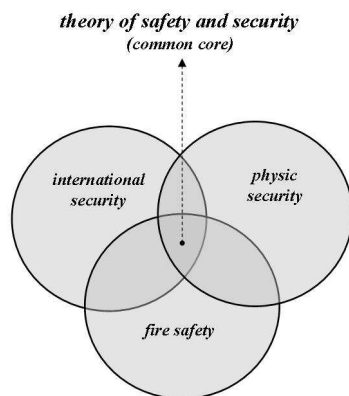


Figure 1. Induction of the kinds of safety or security

Then, the theory of safety and security could clarify the issue of safety and security in the whole range of the most general aspects. Fig. 1 depicts the generalization and induction of the selected kinds of safety or security as a way for creating the theory of safety and security.

VII. CONCLUSION

Nowadays, there is an effort to create the theory of safety and security. The newly created theory of safety and security would provide a common framework for all kinds of safety and security. The problem of safety and security has been addressed for a long time, and a theory of safety and security should utilize already established theories and theoretical discipline. Based on long-term research, we identified fundamental theories which should establish a background for the theory of safety and security. These theories can be used as source for creating the theory of safety and security. The theories discussed include the Copenhagen school of security studies, risk theory, crisis theory and causality. The newly created theory of safety and security is based on a generalization of the findings from the already established kinds of safety and security. This theory will be realized in the form of postulates. It can be assumed that the Czech version of the theory will be different from the English version. Czech language and other Central European languages do not distinguish between intentional and unintentional threats, like English language does. The substance of the theory of safety and security, however, remains the same. It will focus on clarification of the issue of safety and security in the most general aspects.

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