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SUSTAINABLE FIRE PROTECTION

A Magyar Köztársaság Kormánya határozatba - 2053/2005 (IV.8) - foglalta a fenntartható fejlődési stratégia kidolgozásának tartalmi és szervezeti kereteit. A fenntartható biztonság és ezen belül többek között a fenntartható tűzvédelem kérdéseivel foglakozik a szerző.

A stratégiának ennek megfelelően a társadalom jólétét, a jelen és a jövő nemzedékek jólétének elérését, illetve folyamatos biztosítását kell szolgálnia. Ennek érdekében kell óvni, illetve fenntartható módon használni a természeti környezetünk erőforrásait, megőrizni a biológiai sokféleséget, és a kulturális sokszínűséget, működtetni a gazdaságot és részt venni a nemzetközi együttműködésben.

A stratégia egyik lényeges követelménye a lehető legteljesebb társadalmi, politikai és tudományos konszenzus. Ennek érdekében az előkészítésbe be kell vonni a társadalom széles körét, együttműködést kezdeményezve különösen a tudományos élet, a társadalmi szervezetek és a gazdaság képviselőivel.

A tanulmány ennek kíván eleget tenni.

A fenntarthatóságot, illetve annak belső filozófiai tartalmát első megfogalmazása óta szinte minden tudomány és szakma használja. Ismert például a fenntartható tervezés; globális és regionális folyamatok; közigazgatás; vidékfejlesztés és területfejlesztés; tanítás és tanulás; valamint szakpolitika.

Ebbe a sorba kívánjuk elhelyezni a fenntartható biztonságot, a fenntarthatóságot, mint tűzvédelmi problémakört.

Ezidáig azonban nem került látókörbe a fenntartható biztonság és ezen belül többek között a fenntartható tűzvédelem. A fenntartható tűz elleni védekezés fogalmát a tűzvédelem hármas feladatrendszerében, megelőzés, tűzoltás és tűzvizsgálat keretében vizsgáljuk.

Abstract

The basic ideas of the study, sustainability, sustainable fire protection should be interpreted by analyzing the risk of non-sustainability as an undesired event or state. For this purpose, it is expedient to use the method of logical risk analysis. However, from the nature of the task, this procedure by itself is not suitable for constructively considering the risk factors caused by interactions between system global components endangering sustainability. For this purpose, the theory of cellular automata seems suitable. We try to approach this problem by uniting these two paradigms.

Introduction

The Government of the Republic of Hungary stipulated the content and organizational frameworks of the elaboration of a sustainable development strategy in a Decree (No. 2053/2005 (IV.8). Accordingly, the strategy should serve the well-being of the society, attaining the well-being of the present and future generations, and its continuous sustainment. In order to do so, the resources of the natural environment should be preserved and used in a sustainable way, its biological and cultural diversity should be sustained, the economy should be operated and we should participate in international cooperation.

One of the essential requirements of the strategy is the possibly most comprehensive social, political and scientific consensus. In order to do so the wide range of society should be involved in the preparation, initiating cooperation especially with the representatives of the scientific life, social organizations and the economy.

This study is intending to meet the above requirements.

Sustainability and its internal philosophical content, ever since their first definition, have been used by almost all sciences and professions. Amongst others, the following branches are known: sustainable planning; global and regional processes; public administration; rural and regional development; teaching and learning, and specialized policy.
We are intending to place sustainable safety and security, sustainability as a fire protection problem.

So far, however, sustainable safety and security, within them, i. a. sustainable fire protection, has not come to the fore. The notion of sustainable fire protection is examined in the triple scope of its tasks: prevention, fire extinguishing and fire investigation.

The study of sustainability, first of all, requires the clarification and definition of the notion itself. The following three notions justify the latter as well:

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (UN, Our Common Future Report, 1987).

To grow means "to increase naturally in size by the addition of material through assimilation or accretion”. To develop means "to expand or realize the potentialities of; to bring gradually to a fuller, greater, or better state”. When something grows, it gets bigger. When something develops, it gets different. The earth’s ecosystem develops (evolves), but does not grow (Herman Daly).

Sustainability represents an idealized societal state where people live dignified, comfortable lives, satisfying their needs in environmentally sound and socially just ways so as to not compromise the ability of other human beings from doing the same now and into the distant future. It is, in effect, an attempt to merge development and nature conservation efforts in a mutually beneficial way for the common good of the planet’s present and future generations alike (Declaration of the World’s Academies of Sciences, Tokyo, 2000).

Therefore the interpretation of sustainability, from the aspect of security, requires the analysis of at least two notions. These are the notions of sustainable development and sustainable economic development. Sustainable economic development means the presence of economic development with continuous phase. The essential difference is that the satisfaction of demands and the development of social welfare stand in the center of sustainable development, besides the protection of natural resources. On the contrary, sustainable economic development includes the well-known possibility that the economy will boom in a spectacular way, the social gap will become wider, the strata lagging behind will have less and less chances, the natural environment will deteriorate, moreover, in many cases it will die.

Recently, the dispute besides the above-mentioned was between the notions of development and growth. One of the easing solutions was the name of the science of sustainability. Its content message towards the poor was that everyone should be given as much share of the goods as much is required for ensuring basic human demands. As far as the rich are concerned, they are suggested to change their way of life and consumer habits, and to live more modestly and economically.

Founding thoughts

In the work titled “The Limits to Growth”, published and become famous on the initiative of the Club of Rome, we have to drop sustainable *development* from the two basic meanings of the word in favor of sustainable *function* (mode of operation, mode of existence, quality of life). Implicitly, we think of the sustainability of artificial (built, human, civilization) environment, as opposed to the logically possible *untouched natural* environment, due to the simple fact that the latter does not exist at all nowadays. In the field of fire protection, the situation is peculiar: the artificial solution of the environmental sustainability of the sustainable function solves the majority of the problem of natural environment in one.

Therefore, according to our perception, under *sustainability* we understand *the functional sustainability of the artificial environment*. Accordingly, we use the terminus technicus *sustainability* for the latter.

We start off from the following: to study the sustainability of the protection against fire in this sense means to examine its *necessary* and *sufficient* conditions. It is, of course, not enough only to examine sustainability itself. Social expectations demand feasible, practically implementable methods (procedures, techniques, laws, strategies) to *sustain* global security functions. How can one grasp, in a technical way, the sustainment of the functioning of a system (involving the entire human society and all its significant relations)? According to our perception, it can be done, in any case, with suitable *institutes* and *measures*. However, the notions of institutes and measures, on the one hand, are by far less exact to handle them with strict theoretical (mainly mathematical, logical, IT) tools. Common language is also unsuitable to do it, but neither are the slightly more exact state administration or legal languages suitable. The answer to this question, i. e. the general question of sustaining the functioning of a system, can only be satisfactory if it includes the information on the *operation* of the institute and on the *method of* issuing measures. Concerning the latter, we can hardly say more than that our institutes’ system in question (about whose *functional sustainment* we talk), in any case, *must work well,* and in a way that the suitable measures should serve the prevention of undesired events affecting the system. When can we say that a system *works well*? According to our knowledge not when it is faultless (although, naturally and logically the sufficient condition of good operation is the faultless operation). Since such systems do not exist (according to some opinions they cannot even exist), the only possibility that remains for the content answer of the question is that such institutes should be established and such measures should be taken, which continuously *manage* the system’s *disfunction*. The *management of the disfunction* will mean the *prevention of* and/or the *response to*, in one word: the *management* of the *undesired* events of the system, in our case of fire. The notion of *prevention* and *response*, in one word: *management*, can be *explicated*[1], i. e. can be produced as a part of a formal and an exact theory[2]. In one sentence: according to our perception, the sustainment of the functions of a system – of the protection against fire -, means the continuous management of the undesired events of a system.

In this study, we try to approach the problem of the sustainable protection against fire based on disaster theory. However, here, in order to avoid false associations, we immediately have to keep aloof from the name introduced by R. Thom, which has been monopolized by a considerably wide range of people to study the singularity of certain differential equations describing natural phenomena. At the same time, we would not like to fall into the inauspicious trap of the extra-disciplinary connotations of disaster management.

It seems expedient to return to the original colloquial meaning of *disaster theory*, according to which: disaster theory "is a theory which does not explain the changes occurred to natural development, but to an unexpected and radical "coup de théâtre" (translated version, comment by the translator).[3]

According to a definition, to a degree more precise – and better meeting our requirements – "disaster theory as a special branch of the dynamic system theory studies and classifies the phenomena, in whose behavior the slight change of circumstances incurs surprisingly great changes"[4]. This is well known by fire fighters.

The above induces a conclusion that the theoretical foundation of functional sustainability, which is actually the goal of this study, means the development of a theory, which does not *originate* from a process (should it be natural or artificial), but defines the *regulations* and *actions*, which have to be kept and implemented under given circumstances in order to reach a certain goal. Accordingly, we are not trying to establish a *descriptive* but *normative theory*.[5]

The two adjectives are not entirely independent from each other. When we speak of defined *goal* and *given circumstance*, it is inevitable that we have to give their *description*. While the most important components of the descriptive theory are *statements* (declarations, judgments, ascertainments), the normative theory's components are *instructions* (orders). Naturally, the more developed descriptive theories never end by the mere (laxative) listing of facts (fact statements), but they strive to be deduced from one another. Its outcome is that on the one hand deduction rules have to be accepted, on the other hand, it has to be agreed which statements are accepted to be true without proving them. These usually called axioms, postulates or hypotheses, mainly according to the taste and preferences of the paradigmatic representatives of the theory.

With respect to the normative theory, the accepted rules cannot always be used independently from each other, because it can happen that they contradict each other. This can have later significant practical consequences.

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[1] Information on explication as a risk analysis procedure can be found in [Bukovics-Molnár].
[2] In respect of the definition of a formal system and theory we recommend [Curry]'s and [Pawlak]'s work.
[3] Dictionary of foreign words, (edited by Ferenc Bakos) Akadémiai Kiadó, 1978, Budapest
[4] http://www.exploratorium.edu/complexity/lexicon/catastrophe.html,
[5] The notion of normative theory is in close relation to the logic of norms and is not to be confused with similarly sounding words, used in legal materials. With respect to the logic of norms we recommend [Ruzsa]'s book.

In the normative sense, (to some extent analogously to the applicability limits of the descriptive theory) it can happen that not all notions or ascertainments of the theory can be applied to reality. This is to be understood that (at least temporarily) we do not know how to keep the rules in the theory (of course, after the interpretation of the necessary notions) or implement the actions in the theory. These are the *uninterpreted* components (of the normative theory). We will speak about such in later on, now, just for the sake of illustration, we only mention one single example. It is a typical normative component ("social expectation") that society should do something in order to terminate the *causes* of the breakout of fire. Due to the theoretical and problematic feature of the notion of causality[6], the application of this normative is many times foredoomed to failure, and not always this road proves to be the most successful. (Compare with: the legendary improvement of public security in New York)

Similarly, for the sake of sustainability, (some political factors declare that) it is a social expectation to terminate the *causes* of the deterioration of the environment. However, the notion of the *causes of the deterioration of the environment* is quite uninterpreted.

Based on the rethinking of the above we came to the following recognition:

(1) The weakest points of keeping and implementing every safety regulating rule and action are to be found, theoretically in the absence *scientifically well-founded state*, practically in the *unorganized state*[7].

In the quite frequent appearance of the unorganized state the change of the structure of the system causes disfunction[8].

(2) In relation to scientific well-founded state, modern chaos theory and disaster theory, in very close relation to the latter, seem very enticing. Based on modern disaster theory as an alternative to avoiding causes, the methods for preventing and responding to consequences can be elaborated. This approach is regarded as one of the notions of *environmental adaptation*[9] and used in a reduced sense for *risk management*.

Therefore, we think that functional sustainability can be accomplished based on environmental adaptation. Our goals to establish a system whose designated functions remain despite the change of its structural components. Typically, self-organizing systems have such features (to a lesser or greater extent).

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[6] Compare: [Russell]

[7] In connection with this, the politician [Borel]'s book is interesting and remarkable. J. Borel, the current President of the European Parliament, who, during his functioning as a mathematician, gave voice to this approach quite distinctly.

[8] An example, closely related to our topic, for the appearance of disfunction caused by the change of the structure , is the dissolution of the skirmish-line. E. g., it can happen when thoroughly checking the area in an airport waiting hall suspicious for smugglers of narcotics in a skirmish-line that a smuggler draws the attention to himself with a smaller amount of drugs, and using the dissolution of the skirmish-line that tries to capture him, the accomplice runs away. In order to avoid such types of situations we expect the assistance from the theory of self-organizing systems.

[9] The issue of adaptation is in the closest relation with sustainability. In this context, we refer to the VAHAVA Project. (http://www.kvvm.hu/szakmai/klima/dokumentum/3projekt.htm)

(3) We regard the methods suitable for preventing the unorganized state and the ones suitable for restoring organized state of environmental adaptation as adequate tools. Such methods were produced by the theory of *self-organizing systems* in the past decades. There are such amongst them, which can maintain their disfunction despite the change of their structures.

(4) The artificial self-organizing systems are known as *cellular automata*, a network of automata[10] in the form of *self-reproducing automata*, as a follow-up to the epoch-making work of János Neumann (a former general of the US Army).

(5) Cellular automata, on the present level IT development, are quite widely used in practice[11].

According to this preparation, to study the problem of sustainable fire protection a normative system should be established, which

(1) Can be demonstrated (modeled, simulated, imitated) on a computer

(2) Its operation can be reproduced

(3) Its performance can be measured (numerically characterized)

(4) It provides exact definition for each component to be interpreted

(5) It should be applicable to and presentable for a specific fire or disaster situation, whose characteristic features have a computer access.

Anticipated the achievements attained by us so far, we provide information on our system in the Summary, which was abbreviated by the acronym SORS in order to avoid frequent repetitions from the expression "**S**elf **O**rganizing **R**aiding **S**ystem".
Due to wordage restrictions we can only give its short outline in our present study.

Basic ideas

The central notions of SORS (which are not defined with a strict theoretical apparatus, but only described colloquially (in a narrative intuitive way) are as follows:

(1) *Site* and *scene*. Site as the most basic notion of SORS is what sustainability can be referred to, to which the model of sustainability (normative and not descriptive) is intended to be used. Site is where events happen, where processes go on, from which some are to be sustained, some are to be changed (including the logically possible *termination*). We intend to elaborate and apply the paradigm of sustainability to sites, where the ongoing changes are typically chaotic, quasi deterministic and unique. In SORS, site is the interpretation of scene; i. e. scene is the abstraction of site. In other words, scene is the *explicatum* [12] of site. *Site* may be the entire surface of our Earth, or it can be a well-describable geographical unit: London, New Orleans, Madrid, a jungle, a flood- or earthquake-stricken settlement, a part of a forest becoming inflammable due to aridity, an area infected by viruses, an agricultural unit

[10] See: [Neumann]
[11] In this respect, we primarily refer to the monumental book by [Wolfram]. In modern warfare, *centric network warfare systems are gaining more and more ground*. These seem to show a certain kind of mental relativity with the cellular automaton paradigm approach. In this respect we refer to the studies by [Moffat], [Moffat–Witty] and [Szabó].
[12] L. [Bukovics-Molnár]

populated by a weed-killer resisting weed-relative of a transgenic weed-killer resisting rape, an area of an airport waiting hall suspicious for narcotics smugglers etc., etc. The success of application on all the above depends on how well the applier of SORS can correlate scene to site (more precisely: some given features of site in SORS to the features or requirements relating to scene.) Scene is what a cellular space (cellular automaton) represents in SORS theory.

The parts of scene are cells (as the elements of cellular space), in SORS, theory parts of site correlate them. Such parts can be demonstrated typically as a block of flats in a city, a pollution source with measurable emission, a piece of land with soil pollution, etc., etc.

(2) *Cellular space, transitional function*[13]: A scheduled system, connected according to a homogenous network of identical, finite, deterministic automata – cells – , in which every cell's next scheduled state only depends on the last scheduled state of its own and its neighbors. The kind of dependence is specified by the (local) transitional function.[14]

(3) *Cell state:* In the SORS model, it is a number between 0 and 15, indicating the cell's *threat degree* (of the part of site, forming the cell's interpretation).

(4) *Threat degree:* In the SORS model, the threat degree of a cell (a part of site correlated to the cell) is defined by the kind of interval of the management cost and time demand of the *cell's prime event* (specified by preliminary agreement).

(5) *Prime event:* A common undesired event is assigned to every cell, the management (prevention of or the response to) of which is the goal. This undesired event is called prime event and is correlated to and interpreted for every cell (more precisely: to every part of site correlated to every cell). To manage a prime event we use the methods of logical risk analysis[15].

(6) *Logical risk management*: It deals with the so-called non-probabilistic risk. The unique and unrepeatable events' – disasters are, naturally, like these – risk cannot be described by the method of probability calculus. Since we are intending to approach sustainability using disaster theory methods, we cannot avoid using logical risk analysis.

The expression "non-probabilistic risk" can hardly be found in the Hungarian specialized literature in its literal translation (at least according to the Internet). One of the possible synonyms could be "deterministic risk", "logical risk (?)". The intuitive content of its meaning could be perhaps defined that we can speak of non-probabilistic risk if uncertainty prevails in case of events, phenomena, happening, whose *probability cannot be interpreted*. "Cannot be interpreted" *does not mean* that, for us (due to the lack of our knowledge or information), *the probability in question is not known*, but it means that the assumption that the event *has* probability leads to a logical self-contradiction.

The fact that an event can be risky even if it does not have probability (i. e. the numerical probability cannot be interpreted), might seem surprising at first glance, but 9/11 2001 (the day of the New York terrorist attacks) made not only the basic issues of security and freedom necessary to be reviewed, but also the theoretical bases of risk analysis and disaster management, emphasizing the imperative necessity to use logical risk analysis.

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[13] L. [Fáy]

[14] This intuitive expression is a quote from [Fáy]'s study. The exact mathematical definition, by far exceeding the latter, can be found in [Riguet]'s study. In the present study, it will not be needed to such an extent, although it is indispensable in forming SORS and in its computerized implementation.

[15] The method of logical risk analysis is characterized by the fact that we omit all that refers to probability from the probabilistic risk analysis (in other words from the fault-tree method).

The presentation and the components of SORS can be found at www.katasztrofavedelem.hu.

Conclusion

For experts dealing with daily operational issues the ideas of this study may seem perhaps "useless, inapplicable, quasi-scientific" in the first glance. There is no doubt that the researcher is not only motivated by the direct benefit of the achievements of his research, he is driven by the desire to learn and discover news things.

A researcher dealing with "pure, basic" research frequently does not know what kind of effects his achievements may bring. However, we should not forget that without Fermat's theorem regarded then as "useless", today we could not purchase on the Internet and could not arrange our bank transactions through computers, and the IT security systems would not work either without Hardy's prime numbers. Furthermore, without the application of the absolutely "uninterpretable" $\sqrt{-1}$, nanotechnology, so popular nowadays, could not develop.

Therefore, we should not be surprised that even the idea "extinguishing fires with Boolean algebra" also appeared.

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