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INFOCOMMUNICATION BASED DEVELOPMENT OPPORTUNITIES IN THE SYSTEM OF COMPLEX FIRE PROTECTION

Abstract: The digital ecosystem of the European Union is connecting millions of users and tens of millions of ICT devices by the use of growing capacity networks. The EU's aim is to expand the digital infrastructure, and to establish e-government, and digital government within the Member States. As a result of the 21st century information revolution the available information and communication services significantly serve our comfort, health and safety. Systems enabling the virtual mapping and detection of real, existing spaces are able to increase fire safety and the safety of firemen intervention in the service of complex fire protection.

Key words: complex fire protection, innovative engineering techniques, fire safety net, dynamic use, information

МОГУЋНОСТИ РАЗВОЈА ЗАСНОВАНЕ НА ИНФОРМАЦИЈАМА И КОМУНИКАЦИЈИ У СИСТЕМУ КОМПЛЕКСНЕ ЗАШТИТЕ ОД ПОЖАРА

Резиме: Дигитални екосистем Европске уније повезује милионе корисника и десетине милиона ICT уређаја преко све разгранатије мреже растућег капацитета. Циљ ЕУ је да се прошири дигитална инфраструктура, и да се успостави е-влада, и дигиталне владе у државама чланицама. Као резултат информационе револуције 21. века, доступне информационе и комуникационе услуге значајно доприносе нашој удобности, безбедности и здрављу. Системи који омогућавају виртуелно мапирање и откривање реалног, постојећег простора у стању су да повећају заштиту од пожара и сигурност ватрогасаца при интервенцији, све у служби комплексне заштите од пожара.

Кључне речи: комплексна заштита од пожара, иновативне инжењерске технике, мрежа заштите од пожара, динамична употреба, информације

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1. INTRODUCTION

Today, by measuring exterior and interior temperature, our buildings automatically air-condition (heat, cool, overshadow) themselves, our fridge notifies about the quantities of food used or when it expires, the home alarm system sends a live video feed to our smart phone about the situation at home, and anyone almost anywhere in the world can contact anyone, spanning space and time. Nowadays security systems can perform a wide variety of commands: the alarm panel floods the interior with colored smoke to hinder the burglar's actions; the GPS system in the car sends a report to the smartphone on the whereabouts of the stolen car; the fire alarm system controls the fire doors to prevent the spread of fire.

A smartwatch is able to predict if our blood pressure or pulse gets critical due to which a heart attack may become manageable in time. Due to real space analyzing and detecting systems and the high development level of robotics vehicles are able to attend traffic automatically. Self-driving cars, subway trains, buses serve the convenience of humanity. Robots perform precision assembly work, and are capable of self-development of artificial intelligence as well. Without being exhaustive, this brief summary already illustrates the abundance of technical devices and systems which are available to serve our comfort, safety and health.

For the man of the 21st century health, safety and sustainability have emerged as key demands in this stage of development of civilization. In order to maintain and continually develop our European way of life and standard of living, a multi-faceted implementation of security is a must. Fire protection occupies a prominent place in the major part of the different types of protection devices (protection of life, security, etc.). Practically, it is involved in one of the broadest spectrum of general security; therefore its widespread use is not negligible.

2. THE DIGITAL AGENDA

The EU2020 Strategy gives priority to the wide range development of ICT services, which extends beyond infrastructure development, and includes usage incentives, instrument supply, education, etc. Among the objectives of the ICT cornerstone of the EU2020 strategy, the Digital Agenda, regarding e-administration in particular, are aims, such as that at least 50 % of the EU population should engage in e-administration, and that e-government and a broad range of e-services should rise over the borders and that the specific service should be available anywhere in the EU. [1] In case of the realization of the objectives of the EU a huge database of virtual network is created, which will greatly facilitate and accelerate e-government services, administration, including procedures concerning fire protection.

The ultimate aim of the expressed aspirations of the EU, that is the creation of the Digital States, is realized with the common engagement of national governments, institutional and market participants. In this cluster fire protection occupies a significant area within the subset of safety, which within the service state is already partly integrated into the e-public administration, but still far from being fulfilled in such a way that it would have significantly moved the level of fire safety in the direction of complex fire protection realization. [2]

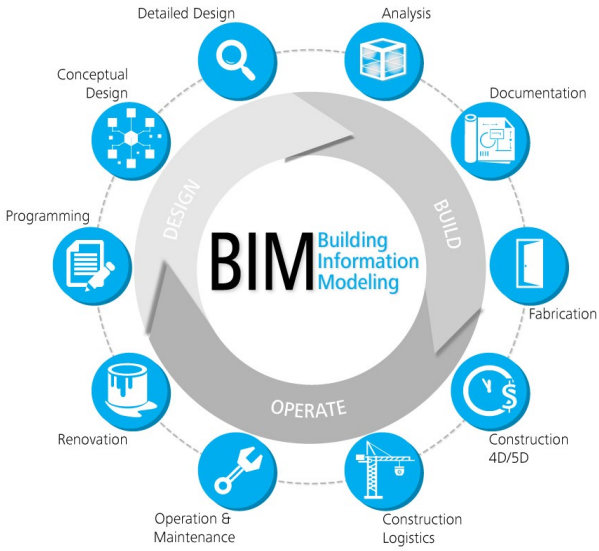

Figure 1. Lifecycle BIM. Source: IBM [3]

Thanks to the infrastructure of the digital state, a virtual system provided by the Internet, a fire protection net can be designed to cover complex fire protection. The actual presence of this system is tangible at the beginning of a building's complete life cycle. In practice, the designing of buildings and the processing of plans are now done with digital systems, computer software. These architectural and other additional software tools are capable of creating three-dimensional (3D) virtual spaces in a way so that the 3D elements intelligently convey information about the building. "The BIM, Building Information Modeling process actually represents an approach that manages the whole construction process as a unit, from the designing of the building to the end of implementation works (or even longer, to operation). The BIM displays and simulates projects, streamlines documentation and drawing, manages the data and facilitate cooperation between parties involved in the projects with an effective set of complimentary solutions. It provides several advantages for the project designers, construction professionals and owners throughout the entire project" [2].

The individual building elements and structures carry information that assist the design process and have the ability to convey the carried information. Constructed spaces are three-dimensional, as well as an actual fire phenomenon, therefore 3D planning and designing can and should operate on the basis of compatible principles. Thinking in 2D has to be forgotten both by the designers and the authorities as well, for reality is three-dimensional. This planning and controlling in the actual space is greatly promoted by the software that is already available. They are able to record 3D sections, showing fire staging within the full depth of the building, which is never a horizontal and / or a vertical line only, but a continuous system of relations of planes coming through in 3D, that defines and separates spaces. The analysis of the spreading of fire by engineering approach should

already be done in the design phase, and can be easily done using the above tools and methods. With the proper adaptation of the architectural model software simulating heat and smoke extraction or evacuation will be, and in a part are already able to map a phenomenon very similar to the reality by the using the conveyed information, therefore broadening planning and the engineers' way of thinking.

3. INNOVATIVE METHODS OF ENGINEERING

It is now clear that procedures known as engineering methods provide only partial results in a sub-system in which they came under particular test, but do not provide a complete solution in themselves for a given specific problem, and therefore greatly contribute to the implementation of a false sense of security. A real fire test conducted in a specific manner (e.g. fire propagation testing of façade insulation) manages the specific spatial design problems, but for every single building in different mounting positions and three-dimensional design the same system can only approximately be evaluated in the same way. [4] Using the results of a real fire test, in case of an appropriate selection of a model fire, and BIM (building information modeling) based information of spatial planning, with the currently available and rapidly developing simulation software the ability to plan the solution for above problem is there.

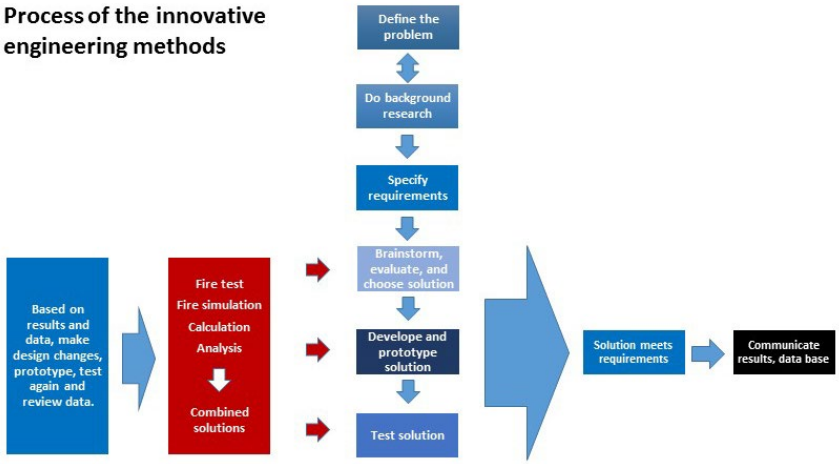

Figure 2. Process of the innovative engineering methods. Source: author

This, of course, means unique a solution in each individual design, requires the proper application of several engineering methods and takes final shape in an evaluation and survey summation with which meeting fire protection requirements can be verified. Conscious and innovative use of engineering methods requires team of professionals on almost the same level of knowledge both from the participants of professional and the civil sector. This can be achieved by a very thorough and targeted professional training.

The innovative engineering approach is therefore a correlation system, a new kind of approach which provides a unique solution to the individual fire protection problems in a way that it mixes the necessary engineering methods to the extent required, analyzes the effect they have on each other, compares it with the measured experimental results, summarizes and evaluates it in a critical point in the building, in a critical time, or interval.

By using innovative engineering methods it is possible to determine critical areas and potentially inflammable periods, thereby creating an appropriate security. This security serves the special on-site security of fire safety interventions as well. [5] With the determination of critical sites a new use, proven by engineering methods, can be planned for the potentially risky time intervals. Instead of the legislation based static (depending solely on legislative changes) usage rules, dynamic usage regulations with a new approach can be created.

According to futurology, in the not so distant future of around 2020-2030, smartphones will be replaces by so called super phones, which will be able to replace almost all human senses by their sensors. They will scan the space around us in real 3D, identify the source of the sounds and their distance, and even measure our blood pressure, the physical parameters of the surrounding environment, air quality, temperature, etc. [6].

Behind the smart sensors there will be intelligent computer systems, powerful data analysis servers with artificial intelligence and the ability to learn. With our smart gadgets we will be able to keep in touch in a more natural way compared to today's digital displays, within the confines of extended and virtual reality (VR and AR), and they will understand our video and sound commands perfectly as well [7].

4. FIRE SAFETY NET

A fire protection based on innovative engineering approach can be created with a fire safety net, from the initial design phase through a fire intervention to the total demolition of the building, and starting from there again.

The fire protection net, similarly to a matrix, contains all information about the current fire situation, which can be reached in a cloud-based shared system for the people connecting to the network. The information is always on a shared storage, which changes can be monitored clearly and continuously in every moment by all participants. Practically, it is under constant control, up to date and easily accessible from the cyberspace.

So the information is placed on the net in a clearly identifiable manner (e.g.: the temperature of a fire compartment, which gets a clear identifier, e.g. Fire Section 1, of specific building, which is located under a particular and individual plot number). Designers create this information, turn it into virtual reality with a BIM-based process, and if required they feed it into various simulation software in order to analyze it. Here they expand the respective fire section data with more information, which can be compared with the data of real fire tests, results of fire investigation procedures, and calculations, which can be obtained from the joint EU database.

Figure 3. Fire Protection Net. Source:author

All-access, cloud based dynamic files and e-logs, which are already accessible from smart devices, make it possible to carry over and record design changes in a dynamic way which becomes known for all participants immediately. After the creation a completed state is displayed in the storage space, which can result in a dynamic use by the actively used passive fire protection systems that can be followed-up later during a control or an intervention of firefighters. With the knowledge of critical places and times and we can perform active fire prevention locally with the use of passive systems.

Thanks to the implementation of sensors in measured spaces, in case of a possible fire and aided by the fire safety net a digital firefighter is able to prepare in advance with the help of a smart device in a real-time, long distance detection during a rush to the fire, and can carry out the safest and most effective intervention by using a decision-making assisting system. Thus, the most advanced intervention could become a reality. The fire chief would already have such information upon arriving to the scene of the fire which has been practically obtained by distant detection that today, in such depth, a very thoroughly carried out on-site investigation cannot get either. For this reason, and due to the decision making support systems, prepared plans would be available, with which combined, or the most suitable selected, the speed of intervention would significantly increase, i.e. effective firefighting can begin at an earlier stage of fire development, when the full burning of the given space is still not fully developed, thereby significantly reducing the risk of injury in case of the occupants, and also fire damage. The safety of the intervening firefighter staff would increase significantly, and it would optimize the use of the extinguishing substance. Overall, the efficiency of the fire service intervention would be significantly increased, and safety along with economic efficiency would also increase in direct proportion.

Besides the use of smart devices, the intervening firefighter's personal protective devices also could be equipped with sensors that would continuously examine the life functions and the state of the immediate environment of the firefighter. Thus, personal security would significantly increase too with the help of the in-built systems of buildings.

The building and the personal protective equipment could synchronize automatically on the principle of compatibility, thus can develop a mutual symbiosis between the fire scene and the intervening firefighters that could offer comprehensive security for the firefighting staff. In addition, the system could capture a significant amount of information, which could be used during the fire investigation. The obtainable information from the intervening firefighter staff during the fire investigation procedures that can be obtained today by hearing, would appear in a whole new quality, with exact figures.

The fire safety net would increase the quality and effectiveness of the controls as well. On the one hand the control of the system would be done digitally, whether we talk about a construction e-log, the checking the operability of an active fire protection equipment. This is certainly not a substitute for live on-site inspections, but makes it possible to prepare for them, makes the existence of continuity traceable, and extends the possibility of inspections, that is, overall, significantly increases the efficiency of control. This is true for both the operators and the specialists of the authority area. In the case of complex fire protection, the process closes a full circle, full interaction is formed, practically complex fire protection takes place. Information of the passive fire-proof substructure, which was actively used as an example, is determined at the planning stage, it is evaluated, and then it is permitted as part of a system based on the resulting data. The information is further used at construction, and through product manufacturing, where they can provide feedback to the designers. The professional field is also informed about everything, can also can control and investigate, during which it can also give feedback to the manufacturer, or the designer. During use, the specialists of the operator personnel also apply the information and take the necessary action, carry out maintenance, controls and provide feedback to the authorities and special authorities, manufacturers and designers as well.

Finally, the same information can be applied by the fire-fighting and fire testing professionals as well during a fire and thereafter [8, 9]. Their experiences can be shared for the same technical solution for all the previous fields of expertise and professionals with the help of the fire protection net. Virtually an entire interaction is formed, which is capable of developing fire protection dynamically, the significant and efficient improvement of fire safety throughout the complete lifecycle of a building. The information and data collected in an exact way would be recorded in a vast amount in a common EU database, by which exact empirical informational capital could grow huge, helping the unified development of fire protection.

5. CONCLUSION

Complex fire protection, the high level of heterogeneity in the case of participants, and the dynamic change of building-man-fire parameters in time results in white spots of a critical risk in the complete life cycle of a building, which significantly reduce the fire safety of the building. It can be stated that with the innovative and combined use of engineering methods, in addition to the solution of specific fire safety issues, on the basis of the engineering results and experience of fire investigation critical periods and places can be determined, to which usage can be planned in an exact way. This method is an innovative engineering approach, a diversified, modern, computer assisted analytical and evaluation method. has helped a wide range of analytical, modern, computer, assessment methods. Using BIM-based design and advanced cloud-based ICT systems our passive fire protection instruments can be turned into active ones.

Basically by the operation of passive fire protection systems in an active way a new type of dynamic operating system of rules develops, which continuously provides security throughout the full life cycle of a building. Participants of the complex fire protection can operate in the virtual system of the digital state in the same space and time, therefore a homogeneous, new, engineering approach fire safety net can serve the security from the first step of design through the planning of firemen intervention and organizing of inspections, to the building's final destruction. For an innovative implementation a fire protection that is able to catch up with today's accelerated world pace it is necessary to broaden and accelerate the paradigm shift which has already begun, and a conscious, engineering-oriented transformation of the training of fire protection is necessary.

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