

Risk perception during construction works execution

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Abstract

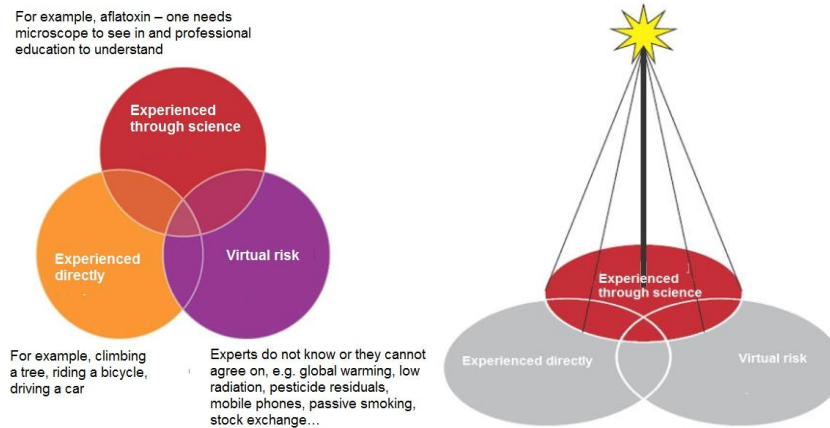
Risk is a universal concept, presenting deviation from the proclaimed (or in other way defined) goal. Risk communication is very important in ensuring safe workplaces. Speaking about risk, we can't not to talk about 'stakeholders' also, because perception or feeling of risk is, in some cases, completely different by people in different positions or functions. The paper aims to present research (with appropriate questionnaire for opinion eliciting) what people on the construction sites feel about risk of injury or health endangering, without prejudice to what is prescribed by law and regulations, but simply what they really feel like a risk. The paper will explore important characteristics of the construction works for the occurrence of injuries and damage to health, risk as a feeling and empirical system of risk from experience, develop and conduct a survey with elementary questions and implement a comparison with a documented risk assessment for the selected site. Finally, the paper will present the results of comparing risk as feelings and risk from documented assessment, conclusions and recommendations, with the aim of improving occupational health and safety during construction works.

Keywords: risk, perception, construction works execution, occupational health and safety

Introduction

The world is suffocating in risk assessment. Almost everyone has “duty for concern” to formally identify all possible risks for itself, or which it may impose on others, and to show that all reasonable steps are taken to “control” risks. It is not clear whether those who express this duty value the size and weight of tasks which they set. The problem becomes even more difficult when one moves on to the challenge of quantifying the risk in the fields with serious consequences, construction sites, for example. Risk is the word which refers to future. It does not have an objective existence. Future exists only in imagination.

Risk is the word which means various things to various people. It is the word which causes the feeling of urgency because it aims at the possibilities of detrimental, sometimes catastrophic outcomes. The bigger part of equal urgencies, i.e. urgent equalities, results from the lack of agreement about the meaning of the word. People use the same word to address to different terms. There are numerous ways in which the problems of risk and its management can be categorized. Picture 1 gives the typology which proved to be useful in eliminating certain useless arguments (Adams, 2014).



Picture 1: Typology of risk a) Schematic view b) Isometric, adapted from (Adams, 2014)

Some risks are naked-eye visible. We manage them by reasoning. *Direct perceptive risks* deal with the usage of *reasoning* – the combination of instinct, intuition and experience. No one performs the formal, probabilistic risk assessment before crossing the street. Crossing the street in the presence of traffic implies the prediction based on reasoning. One must review vehicles speed, gaps in traffic, walking speed as we always do almost automatically. Here we talk about a familiar parameter, e.g. a familiar unknown, e.g. the uncertainty about the cancellation level or potential seriousness. It is clear that there is a risk, but is it not certain how big it is.

Others are noticeable only to those ones who are armed with microscopes, telescopes, polls, scanners and other measuring devices as well as the data they produce. Most bibliography about risk management belongs to the category *risk perceived through science*. There are not here only biologists in laboratory coats peeping through a microscope, but also physicists, chemists, engineers, doctors, statisticians, epidemiologists and numerous other categories who helped us to see the risks which are not naked-eye visible. They collectively significantly improved our ability to manage risk – as one can see in the huge increase of average life, which coincides with the rise of science and technology. This is the field of quantitative risk assessment. Uncertainty comes in this domain with numbers in the form of probability. This type of risk is aleatoric risk. We know the risk and we know that we know it. Where there is coincidence, it is understood and characterized completely.

But where science is unconvincing, we are taken back to reasoning. We are then in the domain of *virtual risk*. These risks are culturally constructed – when science is unconvincing, people are free to argue with and act upon beforehand set beliefs, convictions, prejudices and superstition. Such risks may but do not have to be real, but they have real consequences. In the presence of virtual risk, what we believe in depends on who we believe, and who we believe depends on who we trust. This type of risk is also named ontological risk. Unidentified holes and shortages in our understanding, unfamiliar unknowns. We do not know how many risks exist, but present types of risk can also be uncertain.

We are all “risk managers”. No matter, we buy a house, cross the street, ponder whether to vaccinate our child or not or perform construction work, our decisions will be under the

influence of our reasoning about what we could do. The world of risk managers is infinitely reflexive.

Work execution and injuries at work

From the standpoint of safety and health at work, construction work belongs to the group of highly risky activities because a big number of severe injuries with fatal result happen besides the application of protection measures. Injuries at work and health damage of workers in construction work happen primarily because of unsatisfactory relation of both employers and employees, risk underestimation, workers' inexperience, lack of time for prevention measures, lack of financial funds and the fatigue of workers (Sotic, 2013). Works in construction are especially risky not only in our country but also around the world. According to the data of European Commission for safety and health at work, each year in EU in construction activities almost 13 out of 100.000 workers are injured and in other activities 5 out of 100.000 workers on an average. The most often examples of the injury at work on construction sites happen are because of falls from the high spots, because of electrical current, accidents with vehicles, burying at digging as well as falling objects. Workers at construction sites are also exposed to other risks, asbestosis, diseases of the spine because of carrying the burden, in hand, hearing damage because of increased noise, skin diseases because of the usage of cement, lime, bitumen and the like.

A large number of accidents during the project execution (i.e., works) may be caused by the inadequate coordination, especially in cases when at one construction site a few employers perform work simultaneously or one after another. In this respect, it is necessary to constantly improve coordination between different parties who participate in the preparation and execution of the project as well as to have respected the minimum of requirements which should guarantee a better protection of health and safety at temporary or movable construction sites. Risk perception in the conditions of construction works execution and the existence of numerous participants in construction is, thus, a very challenging and completely unexplored field in our country.

Risk as a feeling

The works of Slović (2004) are characteristic about risk as a feeling and they are a predominant source for the whole chapter. According to Slović (2004), modern theories of cognitive psychology indicate that there are two fundamental ways in which human beings understand risk. "Analytical system" uses algorithms and normative rules, like calculating probability, formal logic and risk assessment. It is relatively slow and requires effort and conscious control, "Experiential system is intuitive, quick, mostly automatic and not so much accessible to conscious. Experiential system enabled people to survive during the long period of evolution and it is even today the most natural and the most often way of reacting to risk. It relies on pictures and hints, which are by experience connected with emotions and affects (feelings which are sometimes good and sometimes bad). This system represents the feeling which tells us whether it is safe to walk in a dark street or to drink the water which has a strange smell.

Advocates of formal risk analysis tend to observe affective behavior to risk as irrational one. Current knowledge denies this standpoint. Rational and experiential systems function parallel and act by relying one on another. Studies showed that analytical reaction does not have effect if it is not led by emotions and affects. Rational decision making requires the integration of both forms of opinion. Both systems have their advantages, deficiencies and limitations. Although they use sophisticated methods of risk assessment, most people rely on the intuitive risk assessment (Slovic, et al., 2004).

Importance of affect

The affect denotes a specific type of “goodness” or “viciousness” experienced as the condition of feelings (conscious or not) and distinguishing of positive or negative type of incentive. Affective reactions appear abruptly and automatically. The feelings which become prominent during assessment or the process of decision making depend on the features of an individual and the task as well on the interaction between them. Individuals differ on the basis of how affectively they react and by their tendency to react on the basis of experiential opinion (Slovic et al., 2004).

Tasks differ depending on how much information is estimable. These differences result in affective qualities of pictures which should stimulate and various ways in which they are “designated” or interpreted. All images in human intellect are designated or marked by different levels of affects. The reservoir of affects has in itself all positive and negative markers connected (consciously or unconsciously) with pictures. An affect may serve as a sign at many important decisions (also including the probability assessment).

Way of thinking

Experiential system made it possible for people to survive during the long period of evolution. Long before the existence of probability theory, risk assessment and decision analysis, there were intuition, instinct and feeling (in stomach) to tell us if it is safe to approach an animal or if drinking water is safe. As life was becoming more complex and men gained more control over their environment, there was made the analytical tool to “help” the rationality of our experiential thought. After that analytical thinking was proclaimed as meritorious and it was named the representation of rationality. It was thought that affects and emotions mixed up in the intellect. The comparison was given in the following table:

Table 1: Two ways of thinking: comparison of experiential and analytical system, according to (Slovic & al., 2004)

Experiential system	Analytical system
Holistic	Analytical
Affective: oriented to pleasure and pain	Logical: oriented to intellect (what is reasonable)
Connecting by hints	Logical connecting
Behavior mediated by “signals” from previous experience	Behavior mediated by conscious assessment of an event
Codes reality into concrete pictures, metaphors and narration	Codes reality into abstract symbols, words and numbers
Faster processing: oriented to current effect	Slower processing: oriented to delayed reaction
Self-evident important: „to experience means to believe	Requires justification through logic and proof

Assessment of risk and benefit

The earliest studies of risk perception also found out that, while risk and benefit tend to be in a positive mutual connection in reality, they are in a negative correlation on people’s consciousness. This result implies that people base their assessment of activities or technology not only on what they *think* about it, but also on what they *feel* about it. If their feelings towards activities are favourable, they will continue with it, assessing that the risk is small and benefits are big; if their feelings are not favourable, they tend to assess in a different way – that the risks are big and benefits are small. According to this model, affects have more priority and they govern the assessments of risk and benefit. This process, which is called “exploratory affect” assumes that if a general affective opinion states the perception of risk and benefit, giving information should change risk perception and vice versa.

Manner of assessment

Slovic claims that some individuals understand the reality through two interactive, parallel systems of assessment. *Rational* system is the intentional, analytical system which functions after the principle of established rules of logic and proof (e.g. theory of probability). *Experiential* system *codes* the reality into pictures, metaphors and narrations which the affective feelings became attached to. Hendrick (1989) found out in his research that warnings are more effective when they are represented in the form of picturesque scenarios and anecdotes burdened by affects instead of being represented in the sense of relative frequency of damage. The results of this research can rather significantly indicate in which direction one should perform the affective training for safe work, make instructions for safe work, inter alia.

Deficiencies of experiential system

If it were always possible to follow one's affective (experiential) instincts, there would be any need for the rational (analytical) system of thinking to develop and become so prominent in people's business. Experiential thinking deceives us in two important ways. One originates from the intentional manipulation with our affective reactions from those who want to control our behavior (advertising and marketing serve as an example of such manipulation). Another originates from the natural limitation of experiential system and existence of stimulators in our environment which are simply not submissive to a valid affective representation.

Assessments and decisions may be wrong, not only because their affective components are manipulative, but also because they are the subject of inherited prejudices of the experiential system. The inner factors include instinctive states like hunger, thirst, emotions and pain. They have a direct, hedonistic influence which has a strong effect on behavior. Unlike current experienced inner factor, which have a disproportionate influence on behavior, delayed inner factors tend to be ignored or not to have any weight in decision making.

Emotions, intellect and risk management

Understanding the complex mutual effect between emotions, affects and intellect which is connected with human brain and is essential for rational behavior, there is in front of us a challenge to think creatively, which means the control of risk. On one hand, how to use the intellect to restrain strong emotions which appear during some risky events? On the other hand, how to instill necessary "doses of emotions" in the circumstances in which the lack of experience can leave us too "coldly rational"? The risk analysis has benefits from the experiential thinking and it is easily verifiable.

The research of Rottenstreich and Hsee (2001) proves that the events connected with strong feelings can overwhelm us even if their probability is distant. Since risks are, like feelings, likely to complicate fatal consequences, we must invoke risk as the analysis which will give us the perspective about the probability of such consequences. For example, when our feeling of fear forces us to buy a pistol to protect ourselves from criminals, our analytical being should take care of the proofs which show that it is 22 times more probable that the pistol will be fired in the house and injure us, our friend or a family member instead of injuring the unknown, hostile aggressor. Some types of problems, like safety at construction site, can largely torment and put on test the possibilities of quantitative risk analysis, by the people who in a way participate in performing construction work.

Conducted research

There was conducted a preliminary indicative research on a construction site of a building on the territory of Belgrade city. The research aim was double: to have the insight in whether there is a difference between the experience of risk by workers and managers, as well to prepare the comparative review of personal experiences of risk with the risk assessed by professionals from the field of safety and health at work. The subject of work research is to establish the experience

of risk of workers and managers on the mentioned construction site. The research was conducted on the basis of the questionnaire as the instrument of research, which consists of 20 questions relating the personal experience of risk. The respondents expressed their attitudes by filling in, choosing offered replies, ranking of offered answers. The questionnaire was structured in two parts:

- First part: on whose basis one gets general, demographic data important for the research like sex, age, work experience, work position and the like.
- Second part: elements of measuring the perception and experience of risk.

There conducted filling in of the questionnaire was anonymous. The research about the risk perception was done on the sample of 43 workers (34 are direct executors and 9 managers). The basic research was conducted in June 2014 at writing a specialist paper by Mitrović (2014), and it was supplemented during July.

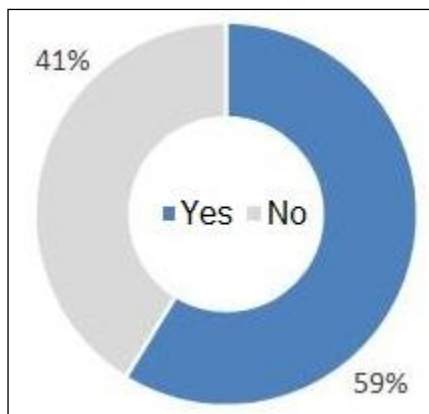
Results

If we tried apply the risk classification mentioned by Adams (2014) on the subject of conducted indicative research, the risk expressed by workers on the construction site (both managers and executors) could be classified in the risk experienced in a direct way, and the risk calculated (i.e. assessed) by individual methodologies, within the risk assessment, could be classified in the risk experienced through science. There follow parallel characteristic reviews of results of giving opinion to some questions that asked by two groups of workers, managers and direct executors of construction work.

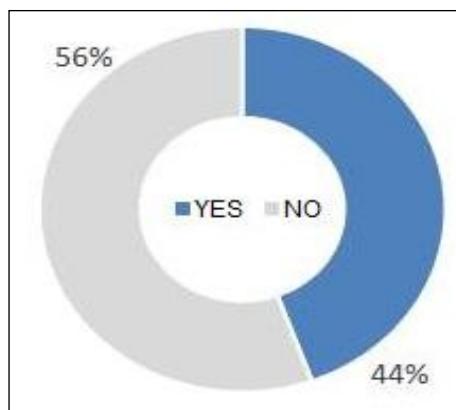
MANAGERS

DIRECT EXECUTORS

3. Do you agree that it is normal that injuries happen at construction sites?

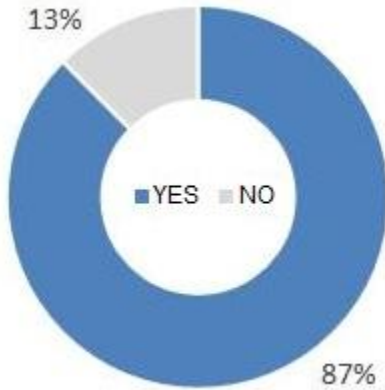


In understanding construction site as the place where injuries normally happen, managers' opinions are almost equally divided, which represents a big field where to improve the attitude.

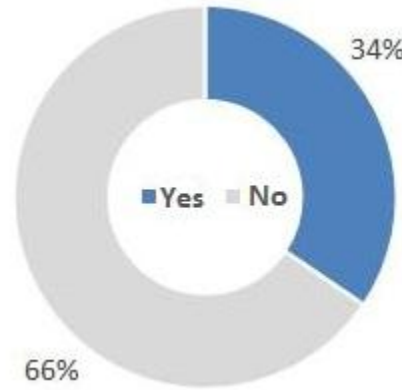


In understanding construction site as the place where injuries normally happen, almost 60% of direct executors agree with it.

4. Are you afraid in some situations? Explain.

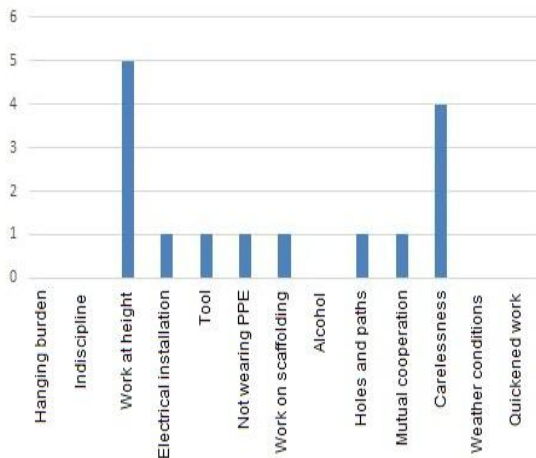


A large majority of managers feel fear at work construction site. In the explanation, the respondents agreed it happens at working on scaffoldings.

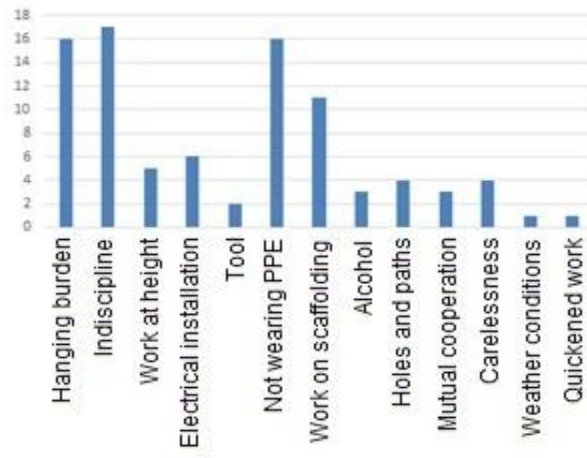


Most managers do not feel fear at work in construction site (60%), while at remaining respondents fear is present in some specific situations.

7. What do you feel to represent the risk from injury at construction sites? (name by priorities from the largest to smaller)

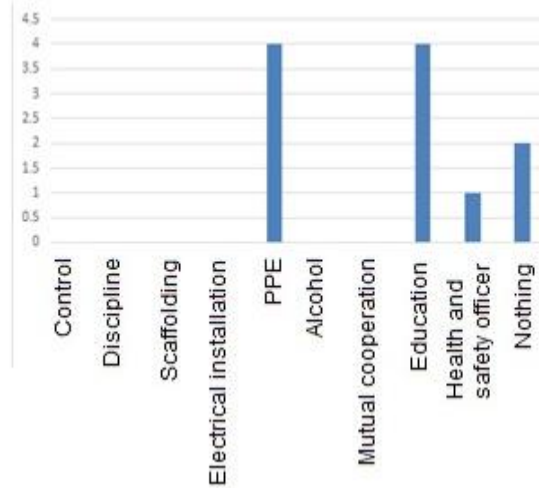
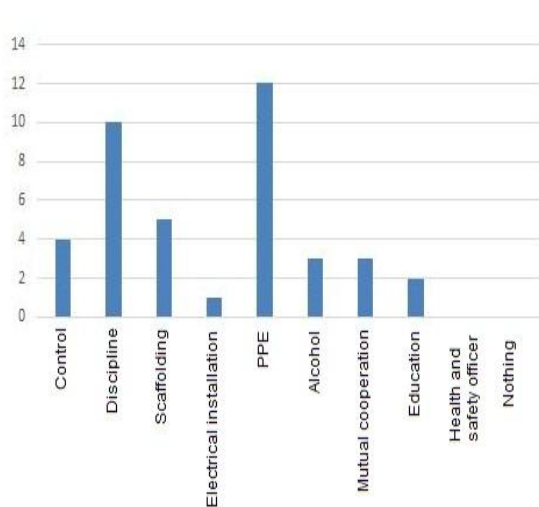


As the largest risk from injuries, managers feel work on height and inattention, and they also mentioned: electrical installation, work with tool, work on scaffolding, holes and moving paths, mutual cooperation and carelessness. Carelessness in risk assessment were not recognized as risk.



Half of respondents agree that they are discipline and usage of PPM, for other respondents they are control of personal protection, more careful work on scaffoldings, better mutual cooperation and prevention of alcohol usage. Indiscipline and not using means and equipment for personal protection in risk assessment were not recognized as risk.

8. What should, in your opinion, be done so that people would be less injured?



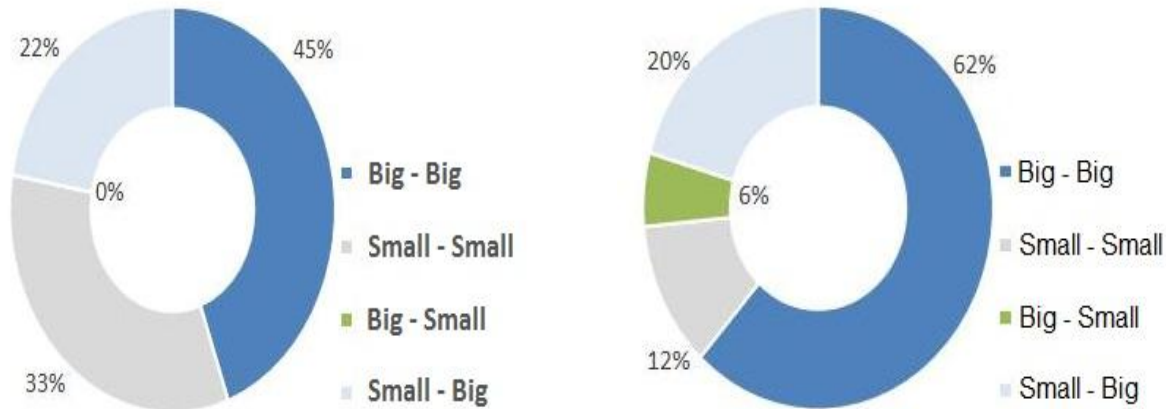
Main elements for managers with the aim to decrease injuries are education and using means and equipment for personal protection. According to some managers, nothing should be done. There was also mentioned the engagement of Persons for health and safety at work.

As the largest risk from injuries, managers feel indiscipline, not wearing means and equipment for personal protection and hanging burden, risks of medium level are work on scaffolding, work at height and electrical installations.

The question of problem experience was checked by comparison of replies given to question 9 and 13, in which the same level of risk is mentioned, but the context is changed.

9. On the edge of the concreted slab on the facility of nursery and kindergarten there was not installed the protection railing. Which risk level from falling do you feel if you approach the edge?

13. The same, for the case of the factory which produces explosive materials.



One-fifth of managers did not have the same experience or risk at changing context.

At majority of direct executors (74%) there was the same risk experience regardless context, while one-fourth felt the context to change risk experience.

Conclusion

Risk management is not “a space shuttle” – it is more complicated. The very defining of risk concept in professional practice causes many public, often severe and very opposed arguments. At the beginning of this paper, there was suggested one vision of risk. Certain researchers prefer quantitative risk assessment. Risk, however, is not only a number. The obvious proof for that is the existence of a few interested parties at performing some work and different vision of a problem. Risk perception is a complex concept, and it can generally be structured through experiential and analytical system. This paper showed the conducted preliminary indicative research of risk perception by two groups of workers who performed the work relating construction work, i.e. managers and direct executors expressed their opinions. Besides that, such risk was compared with the documented risk assessment done by a professional person. The results in some elements were expected and in others they were not, but they, in any case, offer a more realistic picture of the state of consciousness, i.e. the risk perception on construction sites. which gives good bases for the improvement of total state of safety and health at work.

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Biographies

Mr. Aleksandar Šotić holds Master of Science degree from University of Belgrade, Faculty for Civil Engineering, where he was working as Research Assistant and where he is finishing PhD study concerning systemic risk analysis methods. He teaches Risk Analysis & Management on Construction Sites and OH&S Audit on Higher Engineering School of Applied Sciences ‘Technicum Taurunum’, Belgrade, Serbia. He was involved in numerous risk assessment studies, OH&S Plans and has been working as a licensed CDM co-ordinator. He was engaged in numerous OH&S training courses and he is author of OH&S visualization identity ‘Safety Temple’. Member of Association of Civil Engineers, Serbia and Engineer Chamber, Serbia, InfraAsset association. Area of interests (at the moment): risk analysis & management, system engineering, human behavior modeling, risk perception, etc.

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