

Urban Safety as Spatial Quality in Smart Cities

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Abstract. Urban safety representing one of the most important aspect of spatial quality for human life in urban areas. The concept of smart city has to reflect the fact, that in today's society, where most people live in cities, a man is exposed to different kinds of danger every day. Integration of urban safety into the complex smart urban development strategies is recent challenge not only for a spatial planners. Urban safety assessment methodology, presenting in this article, has a potential to be a base for smart system of urban safety monitoring in urban areas reflecting of local specifics in different categories of settlements.

Keywords: Urban safety · Smart city · Spatial quality · Risks · Perception of safety

1 Introduction

The “smart city” concept is mostly interpreted as the concept of use of information and communication technologies (ICT) to improve quality and performance of urban services, to reduce costs and resource consumption, in some cases to improve the framework for active participation of the citizens. This concerns mostly the implementation of new ICT based technologies in transport, energy sector, water and waste management, communication of the citizens, government services. But the spatial planners following their co-responsibility for sustainable urban life – including every day processes and urban flows as well as short term and long term development processes understand the “smart” dimension of the cities much broader. The growing complexity and dynamics of the development in urban systems with its social, functional and physical subsystems in the combination with growing dynamics of unpredictable external changes (natural disasters, economic shocks, social changes...) brings more and more uncertainty in the decision making and development processes. The crucial quality of the cities nowadays seems to be resilience of urban socio-ecosystems (including natural ecosystems, communities, economic sector, services ...), closely connected with their ability to respond to challenges properly, in real time and with low transactional costs. To follow this dictate needs the use of advanced technologies, but this would be not enough. Even their efficient use needs the changes in societal processes, not speaking about the other dimensions of efficient responds. So the smart urban concepts developed by the spatial planners are going behind simple implementation of the information, communication and other technologies into the urban life

and development, behind the technology innovations, towards social and institutional innovations. One of important aspects of urban resilience, where the smart innovations seem to be crucial is urban safety.

2 Urban Safety as Spatial Quality

Urban safety as urban spatial quality - addresses physical as well as social environment. Safety belongs to fundamental psychological needs and its absence in the cities is destructive. Since the very beginning of human existence, people had to face tasks to ensure safety for themselves and their beloved ones, it was the motivation for first human settlement development. Nothing has changed on importance of safety in human life during the history. This need persists, although the structure of safety needs and the contexts of this spatial quality have changed with societal development. Basic needs associated with protection against imminent threats resulting from the nature impacts and thus ensuring basic conditions for survival developed via property protection, to the need to ensure the long-term safety sustainable development [1].

The concept of smart city has to reflect the fact, that in today's society, where most people live in cities, a man is exposed to different kinds of danger every day. Concentration of urban population, human activities, unpredictability of human behavior as well as external shocks brought new conflict risks of various functions implemented in the cities. The conflicts results not only from different requirements and interests in the field of land use, but they are linked to the very background of decision making – different value systems of different stakeholders acting on different positions following in many cases contra dictionary goals. This multiplies the problems increasing anonymity, impeded orientation, dynamics and complexity of interdependencies in the functioning and development of the urban settlements, menace of spreading epidemics, fire hazards, as well as social conflicts, etc. The issues of safety and security have thus not retreated on the contrary; they have become particularly important part of life quality, in many aspects directly connected with urban resilience, less and less manageable using standard concepts, approaches and tools [2].

The new impulse for urban safety issues have been not only the terrorist attacks in the USA on 11 September, 2001, but climate change with numerous unexpected natural catastrophes, globalizing war with the extremism, growing technologic dependence of humans and especially of the cities in the combination with growing sensibility on individual failures. Not only political scientists agree on the fact that after them (and the subsequent attacks on the civilian population in the European cities just confirmed this fact), the world has changed even more and the safety issue in the so called western culture becomes even more acute. However, new dimensions related to urban safety also relate to approaching natural resources limits - materials, energy, land and water, with a threat related of inefficient exploitation, unscrupulous interferences in natural environment, global climate change, and food shortages. Large cities and communities, as complex systems, are particularly sensitive and with their quantitative growth and increase in the complexity their vulnerability increases. In these contexts the society has gradually been adjusting its perception of safety and safety moves even higher in real values ranking.

But changes in the system of values in the society also act from the opposite side, as there is change in the perception of a man as a basic reference frame unit for safety assessment in the space. While an “average man” (the so called “Modulor”) served as a model for environment creation and assessment of its safety within architecture and urbanism in the past [3], today the most “vulnerable” person is considered as the benchmark group and every environment should be addressed to suit it, including claims for safety - thereby ensuring usability for everyone. Furthermore, subjective requirements of each individual conditioned not only by his physical and mental attributes but also by his social and cultural dimensions are taken into account in a much greater extent.

Safety is a broad area that is difficult to be defined precisely by some borders [4] – there are exactly as many kinds of safety as there are various hazards and threats to a man, even if we restrict the area of dangers only to threats of a man and leaving aside, for example, some ecosystem risks. It is therefore important that the safety issue is to be systematically addressed.

3 Safety Smart Concept

Urban safety is not strictly a new issue, but so far it has been quite little conceptually addressed and there is no single universally applicable and generally acceptable definition, yet. An exact definition, moreover, may vary depending on the country in which the term is used. The expression is composed of two relatively easily understandable words (urban + safety), combination of which, however, leads to formation of a new term whose meaning acquires a wholly new dimension. The general definition of safety or security (see [5, 6]) is no longer sufficient when we discuss the so called urban (city) safety. For this purpose, it is clear that we have to add the “dimension of the city” to the safety/security definition.

Smart concept of urban safety includes a wide range of aspects and activities primarily linked to publicly accessible areas, from crime (prevention) through physical environment safety, accessibility (barrier-free solutions and principles of design for all - “universal design”) to institutional and organizational aspects. We define the urban safety (always, unless explicitly stated otherwise) as safety of any kind with respect to a man in any area within the city (urbanised area), where the public has more or less free access without restrictions (i.e. in public spaces, with emphasis on outdoor space), or any kind of man-related safety tied to phenomena and activities in these public areas.

The safety need, as well as the need for psychological well-being, have been essential for man’s life quality. This confirms the position of safety in human needs following the American psychologist Abraham Maslow’s hierarchy. Safety is placed here in the second position of importance, immediately after satisfaction of the primary biological-physiological needs. Abraham Maslow lined up the human needs in order of importance, thus creating a pyramid whose base consists of physiological needs (breathing, food, sleep, excretion, thermal comfort), other levels are organized in the order of importance (the lower the level, the more important) and it is the safety, emotional needs, the need for recognition, cognitive needs, needs of aesthetics and needs of fulfillment. According to Maslow’s theory the needs of a lower level have to be

(at least partially) satisfied if needs of a higher (less important) level shall begin to be fulfilled. From this is clear how much safety is important for humans and that it is not only the actual physical safety of human existence, but also a very safe feeling (perception of safety as the quality of the environment), which plays an important role for people's mental well-being and behavior. A man who feels insecure behaves instinctively, irrationally, and such behavior of a larger group of people (sometimes even the behavior of an individual) leads to chaos, resulting often in fatal consequences.

Coordination, harmonization, distribution of human activities in space and time and effort for their conflict-free rational cooperation is one of the objectives of the spatial planning discipline. It is therefore clear that safety must begin to be seen as one of the key components of both life quality and space quality for life and as such, it should be a dominant focus of the spatial planning - in collaboration with other disciplines, particularly architecture and urbanism, which are (from the perspective of urban safety) some kind of extended hands of spatial planning.

We assume that people perceive safety rather as part of the system quality of their environment, not as clearly defined quality of their lives (as evidenced by the fact that the concept of "urban safety" has no unambiguous definition). Safety is generally considered to be an integral part of the environment quality that either "is" or "is not" and not the quality based on individual needs, perception and human activity in space. The safety has been much discussed about on general level, however detailed knowledge and seize are lacking. There are principles for the level of safety to be increased or decreased, but there are not explicit rules (instructions) how to do this within the means of expression of architecture and urbanism. The existing knowledge is partial [7]. Generally, the safety issues are underestimated, the emphasis in examining it in the past was rather put on its economic dimension (e.g. risk-analysis in the insurance sector), followed by other aspects equally important for life quality. Currently the spatial planning with its integrative approach to shaping the space quality and the organization of human activities across the system levels and environment components should be the integrant platform for urban safety issues, both in relation to internal synergy of its aspects, as well as in relation to its systemic relations with other aspects of life quality and space for it.

3.1 Safety Classification

In the complex and coherent concept of smart city the interface between particular modules is of special important. This interface should create a platform for continual flow of information in not aggregated form relevant for the other modules. Speaking about urban safety, this continual exchange between the modules in smart city concept is precondition for efficient proper respond to the changes in the system and external shocks, as well as to safeguard low transactional costs. Important part in this context represents safety classification. Elaborating the classification is an important part of the assessment methodology. It is necessary to be aware that the difference in the priorities between particular security needs in various types of cities and its evolution over time has to be taken into account. Detailed study and benchmarking of these needs across

the whole dimensional, functional and spacio-structural scale of the cities is the object of recent research the results of which will further develop the methodology introduced in this paper.

The very concept of safety is related to several domains related to life within the city organism and safety can be further particularized and subdivided by different criteria.

Safety can be classified according to:

- **origin** (e.g. safety situations caused by intentional activity - terrorist act, assault... or safety situations of random origin – e.g. car accident, heavy snow disasters, etc.);
- **spatial dimension** (e.g. safety situation related to a particular area – nightclub, busy crossroad... or without any commitment to a particular area - theft, car crash resulting from driver’s carelessness, etc.);
- **time dimension** (e.g. safety situation pertaining to a specific time period - morning traffic jam, night, winter... or without any regard to the time aspect - an accident injury, a random car accident, etc.) [1]

The time dimension of safety can be further sub-divided into:

- **everyday safety** – (daily) safety situations with the potential hazard of a permanent nature – e.g. areas with higher concentrations of people - bus and train stations, subways, city center, areas in the city attractive for tourists...
- **spasmodic safety**:
 - *episodic* - disposable (safety situation happening once, e.g. scaffolds collapse in a construction site during a building reconstruction...)
 - *periodic* (impact situation, but recurring with some frequency, e.g. school year ends, periods of social benefits payment, public holidays, weekends,...) [1].

All categories and classifications of safety and security should also be considered from two perspectives:

- volumes and space without human factor (e.g. building structures safety, historic buildings, medieval walls, natural terrain modifications)
- “Man” in the environment - adding a human element to the environment (socialization, crime, community, human behavior in different situations), threats or rather improving man’s safety by another man [1].

Safety can be further divided according to the perception of the receiver into the following categories:

- **objective safety** = safety whose quality is evaluated (evaluable) on the basis of certain objective data (e.g. casualty statistics, number of criminal acts in an area, etc.);
- **subjective safety** = perceptible, it is individual and unique for every person (Fig. 1) [2].

3.2 Options to Measure the Safety Quality

As the universal way of assessing the state of safety in a city currently does not exist, the aim of this publication is to present the proposal of methodology of how the urban

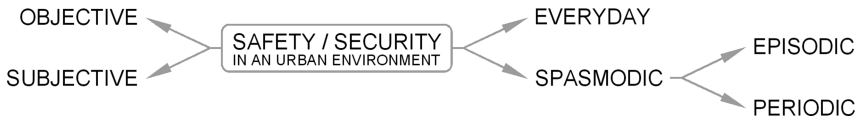


Fig. 1. Procedure basic division of urban safety [1]

safety can be comprehensively and particularly objectively investigated. In such analyses of urban areas four basic elements should be considered:

- volume-spatial composition, especially public spaces (i.e. street spaces, passages, buildings, parks, greenery areas, sports facilities...);
- the human element - people (taking into account differences in age, sex, social status and their communities...);
- technical elements (transport systems, lighting systems, access control elements, elements of spatial orientation...);
- organizational and institutional elements (neighborhoods, safety and emergency services, civic initiatives, unions and associations, etc.) [8].

But how is it possible to cover such a complex problem as the urban safety within space and time? The first step definitely is a detailed drafting of all elements and factors associated with the safety phenomenon. The second step is to describe all the possible safety/security risks that possibly threaten a man in the urban environment. The third step will then consist of searching mutual synergies (interactions) among the environment characteristics and potential risks. If we are able to achieve that no safety phenomenon and, at the same time, no safety risk will be forgotten, this method should exhaustively and comprehensively cover the issues of urban safety - for contemporary needs. In this way we obtain an objective method that is concurrently also sufficiently an open system that can be entered and flexibly modified if needed any time. The versatility of the whole system is essential as the perception of (urban) safety is constantly changing, the majoritarian behaviour of people is also altering, and new threats and risks appear.

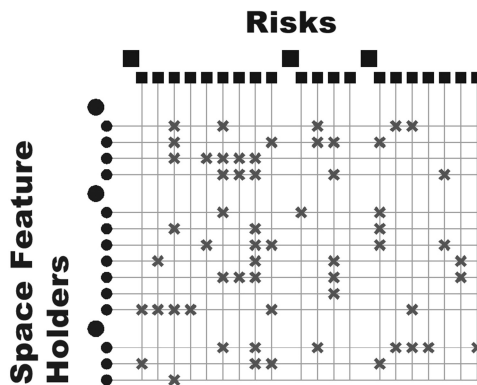
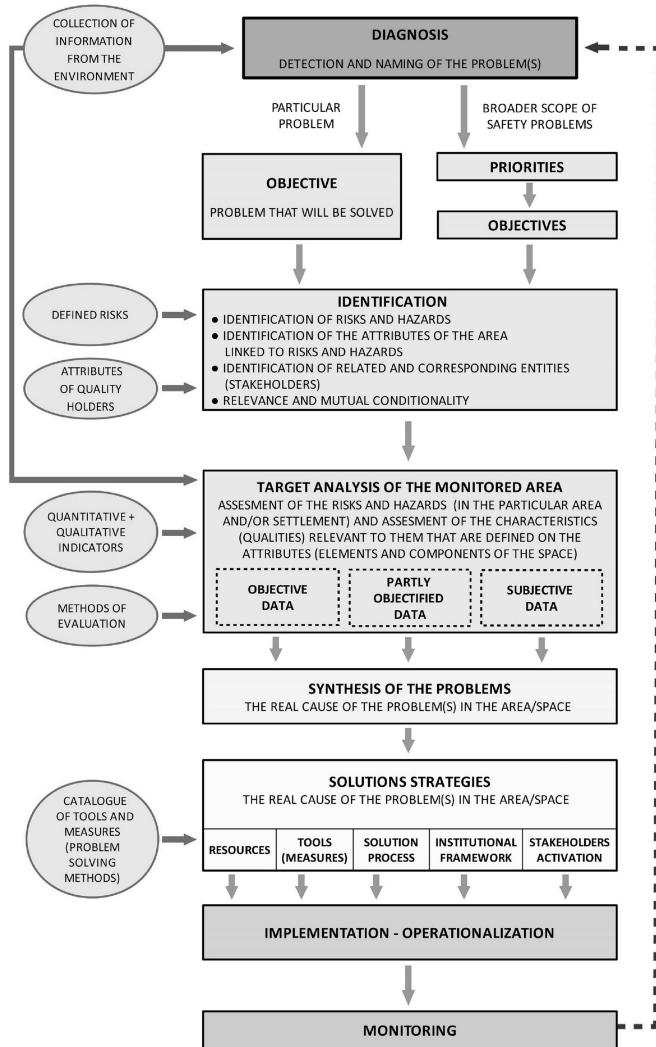


Fig. 2. Procedure simplified diagram of the methodology for assessing urban safety [1]

The proposed method of assessing urban safety (see Fig. 2) can be simply visualized as a large chart that has been created by the intersection of the vertical (y axis) and the horizontal (x axis) levels. The vertical part has been formed by the space feature holders that make up some quality of the environment. The horizontal part of the chart is a list of those risks we come into contact when dealing with urban safety.

It is obvious that we can find quite a number of space feature holders as well as potential safety/security threats in an area. They need to be logically sorted into major categories in the very first stage. For the field of risks they are the following four ones:



Diag. 1 Procedure for applying the method of assessing the quality of urban safety for solving identified safety threats [1]

- A Health risks (endangering human physical condition and/or life);
- B Socio-psycho-pathological risks;
- C Economic risks and losses on property;
- D Energy/resource safety.

The field of space feature holders consists of five main categories as follows:

- 01 Physical structure (volume and space);
- 02 Functional structure (space function and management, traffic safety);
- 03 Man and society (social environment) – a man as a passive or active participant of the environment;
- 04 Man as an object of reference (safety for whom);
- 05 Legislative and institutional environment [1].

Despite the fact that the urban safety approach must reflect the uniqueness of each area, there are some “crucial” points of procedure for solving identified safety threats in an area. The logic of the procedure is visualization in *Diag. 1*.

4 Conclusions

In recent research a unique methodology for the assessment of urban safety is currently being further developed in the whole complexity and tested in the model cities as a part of the complex concepts of smart urban development. As the recent experience has shown, the efficiency of urban safety concept depends on its embeddedness into complex strategies development and management using the system of interrelated smart tools. The issue of urban safety has to be integrated into the complex smart urban development strategies growing up on broader analytical work including urban safety assessment. Based on the developed methodology it is possible to launch smart system of urban safety monitoring based on permanent interactive assessment and evaluation of urban safety and incorporation of local specifics in different categories of settlements. This is the precondition for proper reaction and system flexibility in proposing and implementing appropriate measures for its improvements.

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