

Dorota Jopek  orcid.org/0000-0003-1504-771X
jopekd@uek.krakow.pl

Department of Regional Economy, Cracow University of Economics

INTELLIGENT URBAN SPACE AS A FACTOR IN THE DEVELOPMENT OF SMART CITIES

INTELIGENTNA PRZESTRZEŃ MIEJSKA JAKO ELEMENT KSZTAŁTOWANIA ROZWOJU *SMART CITIES*

Abstract

A smart city is a city which, with the use of modern technologies, manages all areas of its functioning in order to optimise results of its development, create new values based on the cultural heritage and natural resources. However, it should be remembered that people create a city; therefore, the technology accompanying the idea of a smart city is only a tool that will be used by society in the process of the development. This paper aims to present the implementation of the objectives of intelligent urban space in the context of the concept of smart growth and the smart city. The author focuses on the analysis of selected approaches to shaping the intelligent city space related to activities within smart environment (blue and green infrastructure) and smart people and lifestyle (activity nodes and local centres). A smart city creates intelligent space.

Keywords: intelligent space, quality of urban life, smart city, environment, local centres

Streszczenie

Smart City to miasto, które dzięki wykorzystaniu nowoczesnych technologii zarządza wszystkimi dziedzinami funkcjonowania w celu optymalizacji działań, tworzenia nowych wartości oraz pomnażania dóbr i zasobów. Jednak trzeba cały czas mieć na uwadze, że miasto tworzą ludzie, dlatego technologia towarzysząca idei miasta inteligentnego stanowi jedynie „narzędzie”, które będzie wykorzystywane przez społeczeństwo. Celem niniejszego opracowania jest przedstawienie realizacji założeń inteligentnej przestrzeni miejskiej w kontekście idei inteligentnego rozwoju (*smart growth*) i inteligentnego miasta (*smart city*). Autorka koncentruje się na analizie wybranych kierunków kształtowania przestrzeni miasta związanych z działaniami w zakresie inteligentnego środowiska (błękitno-zielona infrastruktura) oraz inteligentnego społeczeństwa i stylu życia (węzły aktywności i centra lokalne). Inteligentne miasto tworzy inteligentną przestrzeń.

Słowa kluczowe: inteligentna przestrzeń, jakość życia, *Smart City*, środowisko, lokalne centra

1. Introduction

In the dynamic process of city development, it is important to state that human capital growth does not contribute to meeting the expectations and needs of the growing number of inhabitants, on the contrary, it may make it much more difficult. Scientists try to identify the primary areas in which proper functioning affects the general well-being of a city and its inhabitants. One of the possible solution in this process is the concept of the smart city. Of all its definitions ([7, 8, 10, 13, 14]) there is one which states that “a smart city is a centre which strives to overcome public problems by applying solutions based on information and communication technologies (ICT) as a result of partnership cooperation of interested entities, service providers, at the level of the city’s management” [19]. Celewicz also points out that the smart city “should be understood not only as electronic solutions, [and] application systems but also as efficient management of the city and human resources. No machine or artificial intelligence is now so developed to deal with the complex problems of modern metropolises as opposed to bold visionaries and teams of professionals who deal with the improvement of life and solving problems in urban structures around the world” [4, p. 100–108]. Smart City, therefore, is a city which, thanks to the use of modern technologies, manages all areas of its functioning, to optimize its development and create new economic and social values based on cultural heritage and natural resources. However, it should be kept in mind that is people who create a city. The technology accompanying the idea of a smart city is only a “tool” that should be used by smart society in the process of smart – sustainable development. It is difficult to separate the physical form of the city from the social environment because always there is a relation between space and people – its users. People shape space but also space shapes individuals and entire communities with regard to their creativity and their social and aesthetic identity. The quality of human life depends, to a large extent, on the space in which one lives. These dependencies include environmental, social, spatial and economic factors. In analyses and reports concerning smart cities, a set of six primary areas of activity which make up the smart city are most often distinguished; these are governance, economy, mobility, environment, people and living [7, 19].

This paper aims to present the implementation of the objectives of intelligent urban space in the context of the idea of smart growth and the smart city. Based on the literature analysis and in situ research, the author focuses on the analysis of selected approaches to shaping the city space related to activities in the field of an intelligent environment (blue and green infrastructure) and a smart society and lifestyle (activity nodes and local centres).

2. Intelligent urban space

A smart city creates smart space. Although in many studies on the concept of the smart city, the theme of space is either ignored or treated as a secondary issue, in the context of all the above elements defining smart cities, space is an integral element.

The concept of smart space can be defined in a different manner to that which is presented above. According to the original idea of smart cities, smart space can be understood as space in which information technologies are used as tools to improve their functioning. Technology can have an impact on different scales, as it can be applied to individual buildings, individual urban spaces and the whole city. In the field of architecture, we can discuss various types of IT systems for managing high-tech buildings called smart buildings. The main advantage of this type of construction is its efficiency leading to the maximisation of comfort and safety in the use of the building as well as the minimisation of financial and environmental costs associated with the functioning of the building [12, p. 311–322]. Intelligent space is often designed in innovative housing estates or office buildings, which becomes not only *a feature that makes the building more attractive to investors* but is also an example of good design practice combining, for example, commercial investments with ecology. Often, the key aspect of such a space is innovative architecture, for example, architecture that is equipped with multimedia facades¹ which can also perform information and advertising functions. Smart urban spaces may be also related to spaces equipped with innovative design solutions facilitating their functioning or using interactive technologies reacting to user behaviour to, among other, enhance their comfort and safety. The aim of introducing such solutions is often to build a modern image for the given space (and the building itself) and to increase both its commercial and social attractiveness, for example, as a popular, trendy meeting place. Similar objectives can be defined at the planning scale referred to initiatives undertaken in the area of the entire city. A wide range of these activities covers the entirety of the given urban system including those related to technical infrastructure networks, urban transport and the preservation of air quality.

Joanna Bach Głowińska points out that the concept of intelligent space refers to the third² dimension of innovation which is related to the cultural mechanism of innovation [1, p. 19]. She also states that this is the space that should be a universal principle determining the set of actions in space. According to Bach Głowińska: “The starting point of the idea’ is to understand the needs and feelings of man in contemporary space by defining the mechanism of action of external stimuli necessary for him to undertake the effort of compassion and self-fulfillment, as well as internal conditions of the psychophysical base of creativity” [1, p. 201]. In this context, an important issue is the set of elements of urban space that enhance creativity³; this is related to the identification of the needs of city residents. The pyramid of Maslow’s hierarchy of needs, interpreted in terms of the spatial aspect, may indicate the basic need for security and accessibility of space affecting comfort and functionality (e.g. in terms of communication). The social and inspirational role of space in shaping creativity, satisfying social and aesthetic needs and self-fulfilment should be placed higher in the hierarchy (Fig. 1).

¹ This topic was widely analyzed by Celewicz [3, 4].

² The first dimension described by Bach Głowińska refers to the original definition, i.e. a new feature that creates economic value. The second dimension is related to the management of the innovation mechanism in various areas.

³ Ch. Landry wrote about the relationship between human creativity and urban space [9].

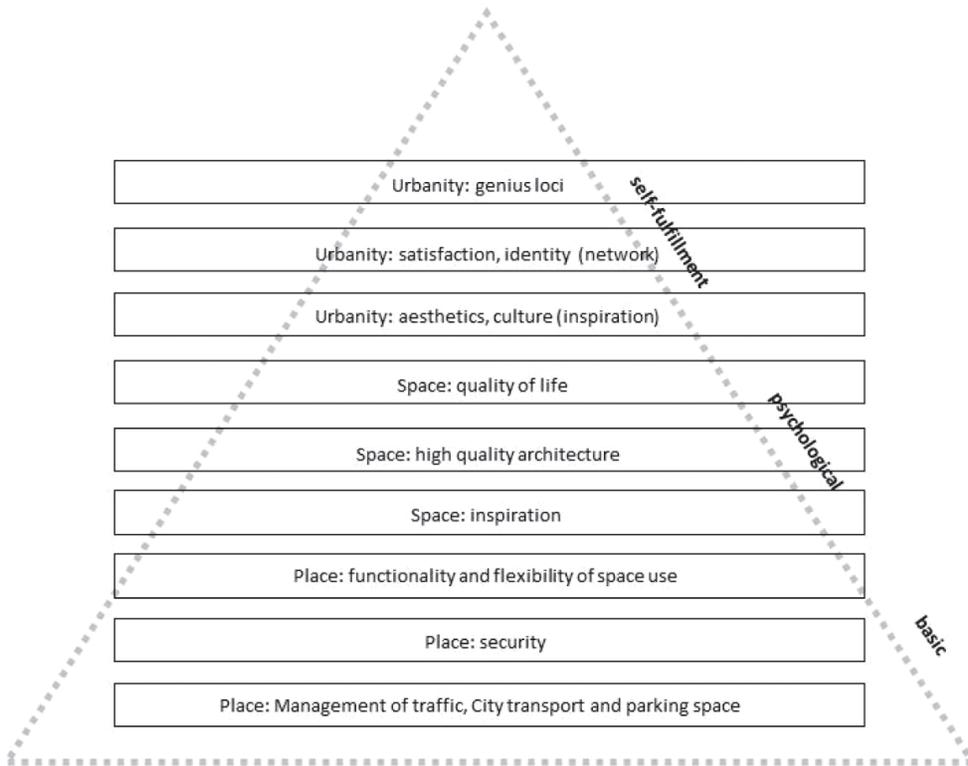


Fig. 1. Hierarchy of social needs in spatial aspects; based on [1, p. 166]

This approach to smart space design corresponds to the principles of smart growth, i.e. the urban and social development of the city, which serves to meet objectives reflecting basic human values. The general objectives and assumptions *are as follows*:

- ▶ the need for the functional and social diversification of districts and housing estates, which will also have a *positive* impact on the development of greater activity in these areas;
- ▶ the creation of compact developments ensuring greater vitality and a sense of security of the area by increasing the number and activity of people on the street and helping to reduce the costs of technical infrastructure, including transport;
- ▶ providing housing for people with different levels of income;
- ▶ using existing resources, inter alia, by revitalising urban areas;
- ▶ the protection of green open spaces which have significant benefits for the quality of the environment and health;
- ▶ the reduction of the environmental and financial costs of the development of the city;
- ▶ reducing the need to use individual transport in favour of walking and cycling;
- ▶ care for the quality, accessibility and safety of public spaces;
- ▶ respect for local identity and traditions, inter alia, in the design of buildings and public spaces;

- ▶ striving for dialogue and cooperation with all stakeholders of a given space with regard to decisions concerning its development [16].

The scope of these efforts depends on the inhabitants, authorities and persons responsible for design and investment and must be adapted to the development standards of individual cities. A. Duany, J. Speck and M. Lydon in their handbook [5] presenting activities in the field of the smart growth, indicate the need for action at different scales of design. This range includes the regional scale, the neighbourhood scale, the street scale and the building scale. Within the region, the authors define the development guidelines, the construction of the regional plan and the transport system. The scale of the neighbourhood is determined by the natural context (e.g. greenery, natural corridors), the components of the neighbourhood (e.g. housing density and diversity), and its spatial and functional structure. In the context of the street space, five level of analyses were defined: thoroughfare network and design, public and private streetscape and parking solutions. In the case of buildings, however, the authors identified the types of buildings, the ecological factors of the buildings and a set of possible architectural design patterns. All of these elements of the basic stages of designing the spatial development of the city and must be analysed in the context of local conditions.

3. Cities for people

As previously mentioned, modern cities should offer optimal conditions to meet the needs of their residents. The extent to which the process of providing optimal conditions for living, resting and working is satisfied, determines the quality of life of city dwellers⁴. The quality of urban life should be expressed by a number of criteria that are individually formulated for each city. The criteria should depend on the size of the city and its local development determinants. They should also consist of adjusting the level of the development of the urban infrastructure and the spatial and functional structure of the city to the needs of the inhabitants and their activity.

The objective of the smart city concept is not only the creation of a high quality city space but also the development of an efficient city on an administrative and economic level. Its growth is very strongly focused on the development of a sustainable and innovative city which will be resilient to climate changes. This goal can be achieved through the integration of both modern technologies and social participatory tools in the shaping of the entire process (Fig. 2).

The area of activities within the smart city concept which directly refers to space is the natural environment (smart environment). Here, its objectives should be understood as the sustainable development and management of natural resources in urban areas, which allows maximisation of their current social and economic potential while respecting their values and resources.

⁴ Sociologists point out that the assessment of the functionality and quality of a city's space is assessed by its inhabitants in close relation to the neighbourhood where they live. Public space is produced by society in the process of using, perceiving, valorising and giving appropriate meanings, as described by Prof. B. Jałowiecki among others in the theory of social space production.

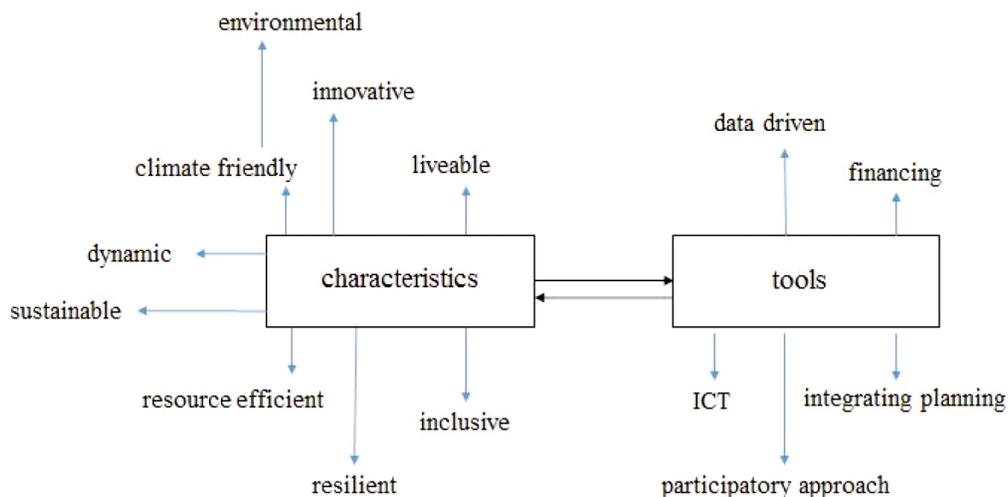


Fig. 2. Characteristics and tools of the smart city concept; based on [6]

Primary areas of activity (defined in the smart city concept) which concern the social layer of the city are Smart People and Smart Living. The development of the city also depends on its inhabitants and their awareness and involvement in the process of implementing projects and initiatives, in this case, the concept of a smart city. Social participation is the main factor influencing the outcome of the changes, people must be willing to use and participate in smart solutions. It is also important to address individual social groups in all actions, as balancing the needs of different interest groups can become the biggest challenge. Activities within individual areas complement each other in many aspects because the quality of the environment has a direct impact not only on the air quality and aesthetics of urban space, but also fosters the positive environment for the physical and mental health of the inhabitants. Research proves that urban areas with a reputation for cohesion, legibility and aesthetics can have a similar regenerative effect on the human body as natural landscapes [15]. Components that co-create these features of urban space are, in environmental terms, the natural layer created by blue and green infrastructure, and in social terms, activity nodes and local centres as generators of identity and human relationships. All these factors influence the sustainability and quality of life in the city.

3.1. Blue and green infrastructure

In the context of the planning and development of blue and green infrastructure, a long-term perspective is important. Its development and maintenance should be included as priority actions in planning documents indicating the manner of shaping and using the entire natural layer of the city, i.e. water and greenery. Moreover, this planning should be integrated and interdisciplinary. Firstly, it is about maintaining a balance between harmony, aesthetics and functionality of the existing or newly created infrastructure. Secondly, for long-term investments, it is necessary to plan with the participation of all stakeholders in

a given space: residents, investors, city authorities and experts (including urban planners, economists, sociologists, etc.). Different cognitive perspectives enable the proper planning of infrastructure taking into account the needs of different social groups. The positive impact of the elements of the blue and green infrastructure on the improvement of the quality of urban space and the life of the inhabitants is undeniable due to their aesthetic and/or health values (e.g. air quality, physical activity). Meanwhile, the role of these elements in economic (e.g. tourism, investment attractiveness) and social development (e.g. places of recreation and integration) should be emphasised. Therefore, in the processes of planning and managing urban development, the need to include and intensify activities aimed at increasing the condition and quality of green and water spaces in the city has become indispensable.

Urban space design should include the management of water systems. Depending on the nature of these spaces, water systems can create both natural and artificial elements such as wetlands, ponds and retention basins. These systems are often associated with the surrounding greenery and can also create green connectors that may become corridors between green systems. In addition to their aesthetic value, these systems can be used for rainwater management. In terms of urban planning, design solutions should be implemented which improve the quality of the natural environment and enable rainwater retention within the scope appropriate for the specificity of a given area. This is particularly important in projects conducted in areas with high building intensity, where the percentage of impermeable areas is very high, and in areas constituting the direct environment of watercourses.

Another important element of the blue and green space idea is the development of urban waterfront areas, which should include strategies relating to the management of flood events. These solutions are also becoming increasingly important in the face of climate change, which perhaps constitutes the most important challenge faced by contemporary cities. It should be stressed that actions should be undertaken at different scales and types of space: municipalities, public spaces, districts and housing estate scale, as well as the development of individual private plots. The key issue here is to determine the indicators of development and biologically active area in local spatial development plans, which should correspond to the optimal intensity of development related to the spatial and functional character of a given fragment of the city.

Intelligent urban space is about exploiting the potential to create a multidimensional urban space. Examples in Krakow include the use of a hydrographic network with accompanying greenery as a system of river parks, as well as the creation of green spaces using even the smallest available areas (see Figs. 3 and 4). These activities not only improve the natural environment of the city and rainwater management but also provide an opportunity to create a functional network throughout the city, ensuring better accessibility of green areas to its inhabitants; this in turn brings great social and health benefits⁵.

⁵ The relationship between health and the urban space is analysed by J. Kobylarczyk.



Fig. 3. Marian Eile`s square as a part of Superpath project in Cracow – source: author



Fig.4. Linear park in Ruczaj area in Cracow – source: author

3.2. Activity nodes and local centres

The city centre is both an important component of the spatial and functional structure of the city and an image of its identity and cultural heritage. The relationship between social needs and the principles of urban planning is very important in the new interpretation of beauty, which is nowadays combined with the need to meet the social and cultural needs of local communities [11, p. 21]. The relationship between spatial organisation and human settlements is of key importance for the development of a sustainable and innovative urban space in contemporary cities. Due to their different locations in the city structure, centres can have different functions and spatial forms that determine the scale of their impact as nodes of social activity; these can be local, urban or metropolitan. It should be noted, however, that from the point of view of improving the quality of the living space of the city's inhabitants, local centres seem to be the most important⁶. They shape not only the arena of their everyday activities, but also build their sense of belonging to the local community. These centres are often existing urban systems which are important public spaces for local communities or have the potential to become such spaces. The aim of activities undertaken in areas of local urban systems is not only to recover the spatial values created by them, but also to strengthen their social and economic role. This is particularly important in the processes of shaping the development of modern cities, where the creation of people-friendly spaces that give the possibility to establish social contact is treated as a priority. Categories of analysis should take into account both spatial, cultural and natural values, as well as functional, social and economic diversity, especially in the context of creating *different* patterns of behaviour and social activity. Apart from local centres, a special role as nodes of activity is fulfilled by large-format commercial, retail, service, commercial and office facilities. However, these are often dominated by commercial functions and are lacking in social functions open to all people who would like to use them.

⁶ An example of conducted projects aimed at defining local city centres can be found in Warsaw, which is implementing the project: 'Warsaw local centres' [21].

On the basis of the leading functions of urban activity nodes, they can be divided into the following groups:

- ▶ social (local centres),
- ▶ commercial (shopping centres, shopping malls),
- ▶ communication, often in combination with a commercial and service function,
- ▶ business, e.g. business parks, technology parks⁷,
- ▶ scientific, e.g. university campuses,
- ▶ cultural and entertainment,
- ▶ sports.

As a result of the requirements of different conditions, there is no single universal recipe for successful, high-quality public spaces⁸, especially in a case of a local centre or activity node. However, analysis of good practices allows the formulation of general conclusions and recommendations. When strengthening the local development potential, the use of the spatial and social values of city space should be the main elements of each city development, especially in the case of city renewal processes which are based on the existing urban structures. As an example of the local centre development process can be found in Warsaw, which is implementing the project ‘Warsaw local centres’. The main goal of this initiative is the creation of the significant public space of the selected city areas which are important for local communities. The design process is conducted with all users of the space who participate in every project stage. The developed design solutions are taken into account when preparing planning documents by the city planning agency (see Fig. 5). That is undoubtedly a prospect of implementing all of the established changes.



Fig. 5. Local spatial management plan of the railway station area of of the district of Włochy in Warsaw (Konsepca mpzp rejonu PKP Warszawa Włochy); two design concepts of the local centre with a multifunctional building which will serve as a suburban railway station, a service and office building – source: http://architektura.um.warszawa.pl/sites/default/files/files/PKP_WLOCHY_KONCEPCJA%20tekst.pdf (10.07.2019)

⁷ The role of technology parks in the city structure is broadly analysed by M. Wdowiarz-Bilska.

⁸ D. Wantuch- Matla gives a broad perspective of contemporary, high-quality public spaces.

4. Conclusions

In the process of shaping the development of contemporary cities based on the priorities of intelligent and sustainable development, the key factors are social and environmental aspects. No development is possible without people and people need living space that not only create conditions for their physical regeneration but also provide inspiration to create the development. A smart city today should be understood not only as an innovative place based on advanced technology but also as a healthy and aesthetic place that provides its inhabitants with optimal living and working conditions.

The discussed directions of the development of the spatial and functional structure of cities related to the formation of centres and nodes of social activity, and the design and management of resources of blue and green infrastructure are part of the concept of intelligent cities and their development. The aim of the undertaken actions is not only to stop the negative urbanisation processes related to, inter alia, the overflow of buildings on suburban areas but also to shape the development of cities with respect for and enhancement of their values, including natural and cultural values. The above-mentioned activities are certainly not the only remedy for the problems of modern cities, but rather important factors of their development.

Regardless of the ideological assumptions of individual concepts, the most important stage is their implementation and the monitoring of their effects because the provisions contained within the strategic documents will not change anything by themselves.

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