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## THE CONCEPT OF A SMART CITY IN THE CONTEXT OF AN AGEING POPULATION

### Abstract

The aim of this paper is to highlight the issues of smart cities in the context of a dynamic increase in the number of the elderly. From the point of view of urban development, the discussion about shaping cities in a way that would guarantee a high standard of living of their inhabitants becomes particularly topical. The process of urban planning should take into account the expectations of both citizens and investors. Developing a coherent strategy, based on cooperation between various groups of interest, will allow to create a city tailored to the needs of its "users" as well as to involve citizens in city management. From this perspective, it seems that the primary task of a smart city is to emphasize the significance of building social capital. The study focuses on a detailed analysis of the problems faced by the elderly in urban areas, including the issue of transportation.

**Keywords:** ageing society, smart city, sustainable development, social capital

### Introduction

Urbanization is a process of urban development that involves a growth in urban population, expansion of existing cities, and establishment of new ones. These changes also influence cultural, social, demographic, economic, and spatial transformations. Thus, in order to achieve sustainable development, it becomes necessary to take into consideration all aspects of urbanization processes.

The level of global urbanization, measured as the share of urban population in total population, is constantly increasing. Cities play an increasingly important role in the life of the majority of people and are crucial for global social and economic development. According to UN data, over half of the world's population

live in cities, and by 2050 this percentage will exceed 70% (EYGM Limited, 2013), which will be most visible in developing economies.

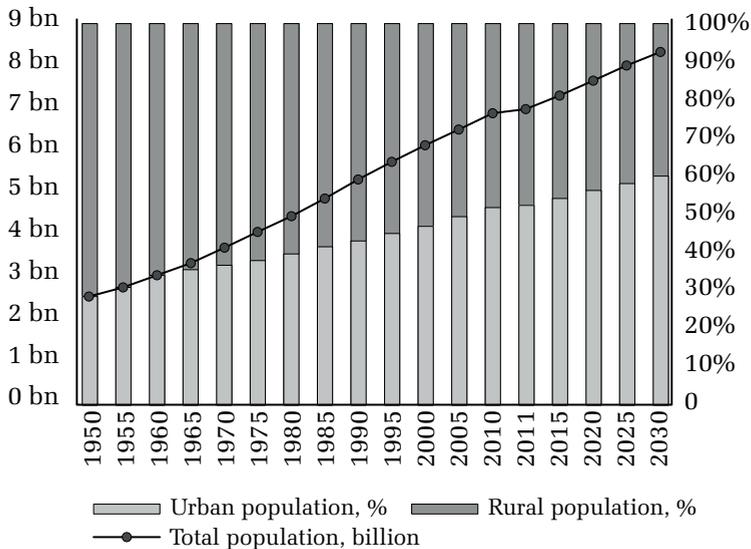


Figure 1. Urban and rural population in the years 1950–2030  
Source: (EYGM Limited, 2013)

The urban population ratio is the highest (above 80%) in both of the Americas; in Europe it amounts to 73% (60.5% in Poland in 2015), in Asia – 47%, and in Africa – 40%. The most dynamic urbanization, however, was recorded in South American, Asian, and African countries (Wojtowicz, 2014).

Increased urbanization reshapes urban structures. We see the emergence of monocentric (based on suburban centres) and polycentric cities (where cities of tantamount importance are connected by a network of roads). Conurbations and megalopolises constitute varieties of polycentric agglomerations where strong municipal centres blend seamlessly, making it impossible to indicate where one city ends and another begins. It is expected that one of the consequences of the dynamic increase of urbanization will be that in the next decade ca. 65% of GDP will be generated by 600 biggest cities in the world (McKinsey Global Institute, 2013).

Along with increased urbanization, the problem of an aging society becomes more and more visible, especially in Europe. According to the 2011 report entitled *Starzenie się społeczeństwa polskiego i jego skutki* [The aging of Polish society and its consequences] (KSBAiD, 2011), in the early 1950s average global life expectancy was 47 years. Currently, it is 65 years, and by 2050 it is expected to be 75 years.

The number of people aged 60 and older is growing. In 1950, there were ca. 200 million people aged 60+ in the world. Currently there are 617 million people aged 65+, which means that seniors constitute 8.5% of the global population. By 2050 the number of the elderly will increase to 1.6 billion, which will

constitute 17% of the global population. The current life expectancy is 68.6 years; by mid-century it will be almost 8 years longer, amounting to 76.2 years.

The number of people aged 80 and older will also increase dramatically. Currently amounting to 126.5 million, by 2050 it will triple, reaching 446.6 million. In some Asian and Central-American countries it will even quadruple (He, Goodkind, Kowal, 2016).

In Poland, the number of people aged 60 and older constituted 22.7% of the population in 2015 and is on an upward trend. According to AgeWatch Report, by 2030 this share will reach 28.6%, and by 2050 – 39.3%.

The significance of the problem of an aging population has been noticed by the European Union, which designed diversity management programs aimed, i.a., at professional activation of people aged 50 and over. According to 2014 Eurostat data, in Poland the employment ratio of people between the ages of 55 and 64 to overall population was over 42.5% (Eurostat, 2014). This result was below the average for UE-28 (51.8%), and incomparably lower than in Switzerland (71.6%).

If national policy will not take into account the above-described phenomena, in the longer run the quality of life of city dwellers can decrease dramatically. Thus, we currently search for solutions that would allow to better manage urban public transport or improve urban architecture. One answer to the above challenges is the concept of smart cities (Brdulak, Brdulak, 2015, pp. 50–60).

## **1. The concept of a smart city**

There is no unequivocal definition of a smart city (Anthopoulos, 2015, p. 9). It is a combination of an intelligent use of IT systems allowing to actively manage different areas of urban activity with the potential of institutions and active engagement and creativity of the citizens (RWE, 2013).

According to A. Caragliu from the Polytechnic University of Milan, a smart city could be defined as one in which investments in human and social capital and traditional (transport) and modern (based on ICT technologies) infrastructure translate into sustainable economic growth and high quality of life with smart management of natural resources by means of participatory governance (Caragliu, Del Bo, Nijkamp, 2009). One of the main conditions of the development of the cities of the future is therefore the cooperation between local authorities with a wide range of entities in their surroundings which influence the functioning of the city, such as all kinds of social organizations, social initiatives, or groups of activists.

According to the analysts from Frost & Sullivan, the development of the cities of the future means the application of new technologies to urban logistics and improvement of the mobility of different social groups, including the elderly. The cities differ from one another in terms of spatial planning, infrastructure solutions, and location.

Because today's administrative borders constitute a limitation for further development of the cities, in the future their relevance will decrease. Functional areas (communes on the outskirts), bound by a broadly understood shared

social infrastructure, will gain in importance. Polish cities begin to take interest in intelligent solutions, but remain unwilling to experiment. This is confirmed by a preliminary study conducted by the author in the Silesian agglomeration (Brdulak, 2015, pp. 211ff.).

In the Leipzig Charter on Sustainable European Cities from May 2007 we find a description of the role of cities. It indicates their “unique cultural and architectural qualities” as well as “strong forces of social inclusion and exceptional possibilities for economic development.” Cities are “centres of knowledge and sources of growth and innovation.” They face, however, demographic problems, such as “social inequality, social exclusion of specific population groups,” e.g., the elderly, “a lack of affordable and suitable housing and environmental problems.”

Increasing income disparities – the growing gap between the rich and the poor – are responsible for the concentration of inequality in some societies, which takes the form of a low level of education, high unemployment rate, bad housing conditions, and limited access – or lack thereof – to certain services, e.g., ICT, health care, or transportation. This problem is also present in the richest cities, where the phenomenon of social and spatial segregation is especially pronounced. Because of low incomes or marginalization, certain social groups, such as the elderly or the disabled, have difficulty finding affordable apartments. The increasing number of “social outcasts” in many cities and on their outskirts can result in an emergence of closed subcultures hostile towards the rest of the society (UE, 2011, pp. vi–vii). Thus, particular attention should be paid to initiatives preventing the further growth of these disparities.

At this point in time, particular municipal centres attempt to implement certain solutions, but they lack a shared vision of long-term development. This can result from the low level of social capital – especially visible in Poland – which causes unwillingness to cooperate in creating a vision of development and consistently implementing solutions specified in the strategy.

The concept of social capital was popularized in literature by R.D. Putnam (1995, pp. 65–78), and further developed by F. Fukuyama (1997), among others. They emphasised that the process of building social capital should be considered in the long term. It then acquires the character of a public good, promoting social integration and solidarity, preventing discrimination and exclusion, etc. The indicator of social capital is the level of trust, voluntary support of the local community, and openness to others (Czapiński, Panek, 2014, p. 27).

In terms of overall trust, Poland occupies one of the last positions among the countries covered by the European Social Survey (ESS) in 2006 and 2012. According to the ESS, in 2012 18% of the respondents agreed with the statement that “most people cannot be trusted,” and according to a 2013 survey conducted by Czapiński – 12.2%. Since 2003, Poland has recorded a very slight increase in the number of people who trust others (0.7pp). In countries such as Norway, Denmark, or Finland this percentage exceeds 60% (UN, 2013).

In light of the above data it should be mentioned that the concept of smart cities is based mainly on a high level of social capital, involvement of local communities, and willingness of all entities located in a given area to engage in cooperation

(Benevolo, Dameri, D'Auria, 2016, p. 14). These factors contribute to the sustainable development of cities. The key element of this concept is the issue of eliminating barriers to "using" the cities by ensuring access to government offices and socio-cultural institutions as well as the mobility of the elderly. For the purpose of the paper, the author has limited her further considerations to the area of urban mobility of the elderly.

## **2. Smart cities and the elderly**

It has to be noted that smart cities should take into account the needs of all groups of their "users." The possibility to move freely across the city, which depends on suitable urban planning and the availability of public transport, is the key factor influencing the activity of the elderly.

This issue is present in numerous discussions devoted to the topic of smart cities. Senior mobility increases their access to social and health services as well as their level of civic engagement and, therefore, of aware participation in city life.

Focusing on the issue of transportation, we should first take a look at the availability of the means of public transport. According to the result of the research conducted by the World Health Organization (WHO) (2007, pp. 20ff.), the availability of public transport services is satisfactory in almost all cities, but not in all areas.

The elderly citizens of developed and transition economies (e.g. Russian Federation) are more likely to consider the domestic public transportation system as well developed and satisfactory. Despite this declaration and the wide range of transport services in many cities covered in the research (e.g. public and private buses and minibuses, metro, trains, trams, trolleybuses, public and private rickshaws), however, many gaps can be observed which require being filled and adjusted to the needs of the elderly.

The mentioned deficiencies include, i.a., long waiting periods on public transport stops or lack of elevators facilitating getting into or out of the platform.

The above problem is well illustrated by the public transport system in Wrocław, based mainly on tram and bus connections. The main barriers to their use by the elderly include small number of low-floor vehicles, long distances between the vehicle and the platform (passengers often get into the vehicle from the street), and uncooperative drivers, who, upon seeing an elderly person, do lower the vehicle (which is possible only in buses), but do not extend a special platform which creates a footbridge between the floor of the vehicle and the platform. What is more, only selected lines of low-floor public transport vehicles in Wrocław accommodate the needs of the elderly, which means that if they wish to change lines, it can indeed become impossible for them to get to their destination.

An interesting example is the city of Budapest, which has a highly developed network of connections. It is known for the fact that most of its districts are extremely well connected by different means of transport, such as buses, trolleybuses, trams, metro, or suburban trains.

Although the city makes it possible to easily and quickly reach the chosen destination, the elderly who wish to commute by metro encounter a barrier in the form of a lack of elevators between the platforms. Another difficulty, even for younger persons, is posed by fast-moving escalators. Moreover, Line 1 (the oldest metro in Europe) does not accommodate the needs of the elderly or people with limited mobility; lack of elevators and large gaps between the platforms and the vehicles make it impossible for them to use it (authors' research, 2016).

Another barrier to using public transport by the elderly can be the relatively high prices of tickets. Some cities offer subsidies or introduce public transport completely free of charge. For example, in Geneva, Switzerland, the carer of an elderly person can use public transport free of charge. The situation is similar in Dundalk, Ireland, where people aged 66 and over permanently resident in the country can also travel free of charge, as can the carers of holders of the Companion Pass card (Citizens Information).

In some cities, however, public transport is considered too pricy. The elderly in Nairobi complain about price increases charged because of bad weather, public holidays, and peak travel periods (WHO, 2007, pp. 20ff.). In Rio de Janeiro, Brazil, free transport is not provided to the older people who live in the favela, because public transport simply does not service this area. And in the already mentioned city of Geneva, discounted travel can only be obtained if older people purchase a railway season ticket. In most cities, subsidized fares cannot be used for private transport services. An interesting exception from this rule is Dundalk, where free travel passes are accepted on some private bus services.

Another already mentioned barrier is the frequency of public transport services. It is one of the key factors determining the age-friendliness of a city. There are, however, a number of reports from cities at different stages of development that public transport services are not frequent or reliable enough. In Istanbul, for example, the elderly indicate that travelling by public transport takes a very long time. In certain areas of Melbourne, Australia, there is no bus service from Saturday afternoon until Monday morning. The elderly living in the Ruhr metropolitan area, Germany, face a similar difficulty, claiming that public transport to the outer areas of the city and at night is not frequent enough. In Wrocław the connections are also less frequent during the weekends and public holidays, as well as summer and winter breaks; the city clearly adjusts frequencies mainly to the needs of children and students, forgetting about the elderly.

The convenience of using public transport depends largely on whether one is able to reach the chosen destination, which, in turn, is contingent upon appropriately adjusted rolling stock, frequency and punctuality of services, density of connections, and optimal coverage of the urban space. An equally important role is played by the urban infrastructure, i.e., stops and platforms adjusted to the needs of the elderly, which maximizes their safety as they wait for, get in, and get out of the vehicle.

In this context, the main ways of minimizing the barriers to the use of public transport include:

- appropriate construction of public transport vehicles, accommodating the needs of the elderly with limited mobility (wheelchair ramps, lowered and functional steps, appropriate design of handrails and chairs),
- stops located in the vicinity of public buildings,
- information charts inside the vehicles and at the stops – easy to understand, legible, suited to the needs of poorly sighted and blind (Braille, large text, audio recordings) with particular focus on public spaces.

Among private transport solutions we should list:

- signposts pointing the way to public offices – visible, coherent, and well located,
- parking spaces – their location (vis-à-vis entrances to public buildings), signage, and size (Wolniak, Zasadzień, Skotnicka-Zasadzień, 2016, p. 524).

When implementing the above solutions, particular attention should be paid to consulting them with associations of the elderly, organizations cooperating with them, and the target group itself. It is also worth to draw on the experiences of highly-developed countries with high percentage of the elderly, such as the countries of Scandinavia or Germany. It will make it possible to adjust cities to the actual needs of the elderly instead of those who design such solutions.

### 3. Global organizations' support for the concept of smart cities

Analysing the issue of sustainable development of cities, it should be pointed out that in the European context there exists a well-described Smart City Model and the raking of cities ([www.smart-cities.eu](http://www.smart-cities.eu)). Significant support in this area is provided by the programs of institutions not only from Europe – such as the European Commission's Horizon 2020 program "Smart Cities and Communities solutions integrating energy, transport, ICT sectors through lighthouse (large scale demonstration – first of the kind) projects" – but also from all around the world.

One example is the WHO which, in the 2007 document *Global age-friendly cities: A guide*, indicated areas that require particular attention in the context of the increasing ratio of the elderly to the overall urban population.

An interesting initiative is the program inaugurated in September 2015 aimed at meeting the recommendations of the United Nations General Assembly (UNGA). It specified seventeen sustainable development goals, including good health and well-being of people, affordable and clean energy, industry, innovation, infrastructure, or climate action.

In light of the discussed problem it is especially worth taking a closer look at the eleventh goal, i.e., sustainable cities and communities. A specially designed program will serve to evaluate Polish cities in terms of the realization of sustainable development criteria. The undertaken activities will be aimed at:

- reducing negative influence of citizens on the environment, with particular attention to air quality,
- ensuring easy access to affordable, safe, and sustainable transport systems and improving road safety,
- ensuring access to safe and inclusive green public spaces for all.

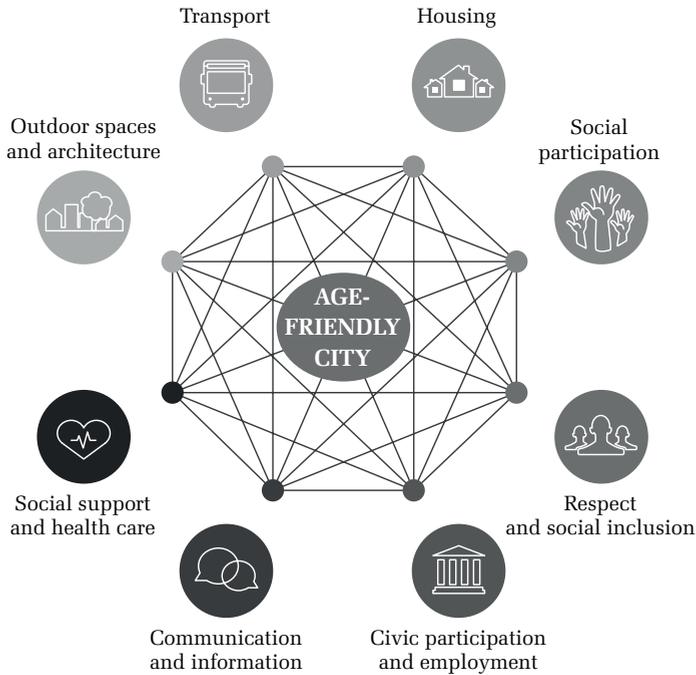


Figure 2. Dimensions of an age-friendly city  
Source: (WHO, 2007)

The effect of the evaluation will be a ranking of Polish cities and resorts prepared based on problem areas crucial from the point of view of sustainable development. The program envisages achieving the set goals by 2030 (GCNP, 2016).

The issues related to urban transport are also discussed in the 2011 White paper on transport. The document points to the need to change the existing model of transport usage. In particular, it highlights the necessity of developing passenger transport, introducing ICT solutions to the traffic management system, designing vehicles to accommodate people with limited mobility, and using technological solutions that will allow to reduce fuel consumption or use alternative energy sources. It also emphasizes the significance of the quality, accessibility, and reliability of transport services.

In the context of the progressive aging of the European population, the possibility to acquire reliable information about travel time, alternative routes, or different means of public transport becomes especially important. It should also be highlighted that the main features of high-quality services are: attractive frequencies, comfort, accessibility, reliability of services, and intermodal integration.

## Conclusions

The dynamic urbanization all across the world presents authorities with new challenges. They are particularly important in the context of an increase in the number of the elderly. Maladjusted infrastructure, which has to ensure water, energy, and mobility of the citizens, becomes a problem. Cities should “grow” as the needs of their citizens increase. On the one hand, they should guarantee safety; on the other hand, they should allow them to lead comfortable lives, accommodating each and every one of them.

Smart cities are developing dynamically. All around the world, metropolises are being established based on new technologies, which serve to achieve the goals of sustainable development. In this context, it would be interesting to determine to what extent modern solutions decrease the degree of exclusion of particular social groups, such as the discussed elderly, disabled, or parents with small children. It would also be worth to investigate the degree of mutual compatibility of the implemented systems, so that the elimination of one problem would not imply the need to face another one.

Development cannot be prevented. We should consider, however, in what direction should we steer it for it to be beneficial for the three areas of sustainable development: environment, economy, and society. The analysis of the solutions implemented by the cities can cause concern that the costs will, at some point, exceed their budgetary capabilities. It seems that to solve this issue city authorities make more and more use of new technologies to adjust city architecture to the needs of people with limited mobility.

Examples of such technologies include intelligent transportation systems (ITS) that allow to adjust traffic lights to the current traffic density, city monitoring system that increases the safety of citizens and facilitates locating current failures, energy-harvesting pavement tiles, systems created for selected social groups, such as carers of children or the elderly, which allow them to monitor their wards in the defined safety zone, as well as a number of other currently designed and implemented solutions which fit into the idea of smart cities. Cities aim to be smart and are more and more successful in doing so.

It is worth asking ourselves if Polish cities can be smart as well. If so, this would undoubtedly be a chance not only to manage metropolises more effectively, but also to build social capital by engaging all citizens, irrespectively of their age, in discussions about the issues that concern them. A social dialogue would allow for more aware changes in the urban space and an improvement in the living comfort of all social groups, including the elderly and disabled.

The improvement of the living conditions of the elderly citizens can be ensured by the funds from the budget of the European Union available for that purpose. Presently, however, the factor hindering the development of smart cities in Poland is the fragmentary implementation of projects, which results in weak coordination of particular sectors and limited cooperation between entities (Frost & Sullivan, 2014). As long as there is no one compatible platform to manage information, the authorities will not be able to effectively manage the city, and its citizens will

encounter different obstacles in the form of, e.g., lack of information about tram or bus failures and diversions, lack of single ticket for all means of transportation, lack of adequate transport infrastructure, solutions for the users of bicycle lanes, or unavoidable traffic jams.

These are pressing issues – not to mention the elements of urban infrastructure, such as semaphores and quality and height of pavements, which make it impossible to easily cross the street not only for the elderly and disabled, but also for parents with bogies or small children. The potential for implementing modern solutions in this area is enormous. First, however, the actual needs of the users should be considered in detail and in depth, by involving them in a dialogue with the authorities.

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