Smart City 4.0 Development

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The concept of the Smart City emerged as an effect of the research into smart urban environments. The term ‘smart city’ is understood as a city having a certain intellectual ability, which refers to innovative sociotechnical and socioeconomic aspects of growth. It has six dimensions: a smart economy, smart mobility, smart environment, smart people, smart living, and smart governance. Smart Cities 4.0 remain hyper-connected, as they use technology, data and engagement of citizens, but they use it to achieve the objectives of sustainable development.

Keywords: Smart City ; public administration management ; project management

1. Introduction

N. Kaminionos proposed three phases of the development of smart cities defined as Smart City 1.0, Smart City 2.0, and Smart City 3.0. [1]. The proposed phases are of an open-ended nature, as there is currently the shaping of another phase —Smart City 4.0, inspired by economics [2].

Smart City 1.0 refers to intelligent cities in the earliest phase of creation. The use of modern technologies is initiated by ICT companies. They implement various solutions irrespective of whether they are necessary for the cities or not. A good example is the city of Songdo in South Korea. This, currently in construction, modern ubiquitous city is the largest private development investment in the world. It should become a business centre comparable to Shanghai, Hong Kong, or Singapore [3][4].

Smart City 2.0 is a phase in the development of smart cities with a predominant role for public administration. The use of modern technologies is initiated by local authorities, and the introduction of new solutions is aimed at improving the citizens’ quality of life. According to the Smart City researcher, Boyd Cohen, today, the majority of cities implementing Smart City projects belong to the 2.0 generation.

Since 2015, a new approach to the creation of smart cities has been observed—the Smart City 3.0 model. Many influential contemporary cities are encouraging the active approach of their citizens to creating further development. The role of local authorities is focused on creating the space for and opportunities to use the various potential of their citizens. This concerns both encouraging citizens to use modern technologies (e.g., by educational projects for digitally-excluded persons) and allowing them to create their own technological solutions (e.g., through open data).

Although Smart City 3.0 still refers to the use of modern technologies to improve the quality of life in cities, the area of its interest has expanded and, apart from projects that were characteristic of the second generation, it includes social, equity, educational, and ecological issues. Smart City 3.0 fits the increasingly popular sharing economy. It often requires courage from municipal authorities to accept the increasingly influential participation of citizens. However, there must be not only a mental shift (authorities–citizens) but also a communication shift. Dialogue, mediation, and deliberation begin to play a dominant role.

With reference to local government practice, an interesting evolution of the approach to a Smart City is presented by researchers of the guidebook for local governments on the scope of the Human Smart City, who, citing B. Cohen, distinguish three levels of development of smart cities.

A challenge currently faced by local governments consists of basing the city’s development on the creative engagement of citizens. In the third generation of Smart Cities, citizens start co-creating their cities, and a significant role is played by projects of a social character: equality, social inclusion, inexpensive housing, etc., [5].

Each modern city is a complex ecosystem [6] comprising many elements including all that connects people, the environment, and technology. What constitutes a distinguishing factor of dynamically developing cities is certainly the

smart municipal infrastructure that serves both citizens and administration. When creating a Smart City 4.0, it should be taken into account the complex network of interconnections that generate actual benefits [7].

To better illustrate the level of security offered and the capabilities of this technology, it is worth giving an example. Blockchain, as a technology, is the technological foundation in cryptocurrency systems. In order for someone to be able to make a transaction with the selected cryptocurrency, the transaction must be sent to the blockchain community [8]. Transaction data contain public passwords, which strictly correspond to private passwords. The transaction concluded via the blockchain is both anonymous and encrypted. When transaction data become public, community members can collect and verify data and try to solve a very difficult computational puzzle that allows them to add transactions to the public ledger [9][10]. The first member (or group of members) in the network to correctly solve the puzzle appends that transaction block to the end of the current blockchain. At this point, all transactions in the new block become permanently part of the public register. It is an extremely secure tool, and due to the fact that individual parts are stored in an extensive network, it cannot be faked. In other words, blockchain is where all transaction data are stored, such as data to confirm ownership of a given cryptocurrency and how new coins are created in that cryptocurrency [11][12].

Thanks to this level of security, blockchain can be used in concepts such as the Internet of Things (IoT) or a Smart City. The implementation and use of a network of IoT devices in smart city environments has resulted in a very large amount of data. In cities and metropolises, these data are held by many sources that use independent systems for collecting, storing, and using data. Such dispersion makes it difficult to take full advantage of their value. Blockchains, as distributed registers, can be used, for example, to develop a universal system for collecting and distributing data. Smart contracts can be used to automate all processes of such a network.

Shaping a Smart City 4.0 is strongly related to other industrial revolutions dominated by robots, artificial intelligence, nanotechnology, the Internet of Things (IoT), and autonomous vehicles. Profound technological changes [13] of significant social and economic consequences for cities and the natural environment are embedded in the process of sustainable development [14], which sets high standards for citizens [15].

One of many foundations of the idea of a Smart City is the well thought out and properly implemented smart municipal infrastructure. Put simply, it aims to use the integrated infrastructure of the Internet of Things [16] to increase the effectiveness of operations conducted by municipal services and companies and, finally, to improve the lives of citizens [17][18]. Properly introduced solutions comprising the holistic conception of a Smart City also have an impact on increasing the effectiveness of municipal investment and greater sustainable development of the city [3][19]. This results in changes noticeable by all [20][21].

One joint system of Smart IoT that is being implemented in an increasing number of Polish cities covers many basic services available to each citizen. It controls water supply and consumption measurement, energy saving LED lighting with a management system, city bike systems, smart monitoring and management of parking places, waste collection and recycling, and/or electricity supply. The above list can be extended to air and water quality sensors and so-called smart benches, which are located in the urban space in order to provide access to the Internet and to charge mobile devices, smartphones, and tablets, which draw energy generated by solar panels.

For all of the above to be possible, the consistent activities of municipal authorities and their cooperation with the suppliers of Smart systems who have the relevant knowledge, experience, and technologies, are necessary [22][23][24].

In the ESI ThoughtLab research conducted in 2019, S. Wray [25] named twenty global cities ‘Cities 4.0’. These are cities that are advanced both in terms of progress in the implementation of the UN Sustainable Development Goals and in the effective implementation of digital technologies and data. These cities are: Aarhus, Athens, Baltimore, Barcelona, Berlin, Birmingham, Boston, Copenhagen, Helsinki, London, Los Angeles, Madrid, Moscow, New York, Orlando, Paris, Philadelphia, Singapore, Tallinn, and Vienna.

The comparative research on Smart City Solutions for a Riskier World conducted by the ESI ThoughtLab was based on a survey conducted in 167 leading cities from 82 countries across the world, in combination with data concerning municipal services and the quality of life from the World Bank, Numbeo, IESE, and other sources [26]. The report stated that Cities 4.0 usually implement 14 smart city projects on average, in comparison to about seven in other cities, and have better infrastructure, public transport, roads, parks, healthcare, and digital communication.

Furthermore, Cities 4.0 made the most progress toward the achievement of the Sustainable Development Goals generating 86% progress toward all 17 goals. The share of funds for technological investment in all urban areas,

especially in digital infrastructure, mobility and transport, public security, health, education, sustainable development, as well as energy and water, has grown.

The researchers believe that the first phase of Smart Cities 1.0 was driven by technology. Smart Cities 2.0 brought the belief that technology has to serve people, and Smart Cities 3.0 strived for ‘hyper-connection’, on which the ESI ThoughtLab focused in its research, in 2019. This hyper-connectedness concerned not only technology but also the engagement of citizens and partnerships.

The goals of sustainable development constitute the priority of the future. ESI ThoughtLab researchers found that presidents/mayors of cities were using the conclusions drawn during the pandemic to set a path toward achieving the Sustainable Development Goals. They have reported that they achieved the most with the Sustainable Development Goals related to people, including a lack of poverty (91% of cities), good health and wellbeing (89%), decent work (86%), and good education (86%). Moreover, survey respondents identified obstacles to the achievement of sustainable development objectives in the nearest three years, including complex policies and regulations (52% of cities), finding an appropriate partner or supplier (50%), as well as managing data security and privacy (44%) [9].

Going further, leaders of cities can use the research conducted by the ESI ThoughtLab as a roadmap to become Cities 4.0. They can also take four steps, which have been taken by Cities 4.0 in order to develop their SDG programme: (1) regularly monitor and assess SDG efforts, (2) ensure broad support for SDG programmes across the whole government, (3) appoint a department, which will lead the efforts toward the SDGs and (4) conduct a voluntary local review of progress in the implementation of the SDGs.

Furthermore, the research indicated that these cities invested in a series of smart technologies. The largest investments are currently made in the cloud (87% of cities), mobile telephony (85%), IoT (81%), biometry (72%), and AI (66%). In the next three years, technologies generating the highest increase in investment will be digital twins (+164%), 3D printing (+125%), and augmented reality/virtual reality (+63%), as well as data warehousing (+50%) [27].

Cities are becoming increasingly more complex and multidimensional urban systems, which are of key significance for human life on the planet. The significance thereof is proven by the global belief that people are living in an era of planetary urbanisation [28].

Apart from advanced technologies, the significance of soft potentials, including technology, talent, tolerance, and trust, is growing. From the point of view of the Smart City Conception, it is crucial to base it on these four pillars—4T potentials: Technology, Talent, Tolerance, and Trust; the advancement of these in a city defines its smartness, entrepreneurship, and innovativeness [29]. An advanced share of 4T in smart city management determines the quality of life of its citizens and its competitive position in the metropolis.

Cities treat their urban innovative systems as a priority moving from the traditional urban character to an innovative ‘green’, ‘smart’, and ‘open’ city, striving for sustainable environmental and social development [30].

2. A Model for Smart City

A tried and tested model to create a Smart City is a development model based on the innovative technical and economic infrastructure, learning organisations, and a strong university. This model works in metropoles that have a large population, are characterised with a high GDP and GDP per capita [31][32], and are seats of large corporations, where business centres and public sector institutions are located. In order to achieve this goal, smart cities are organisations creating innovative economic sectors, improving the quality of life of citizens with an effective management centre.

In order to be called a Smart City, a city has to be a centre with the highest level of technological advancement. The basic features of its characterisation are as follows:

- Technology (innovativeness),
- Talent,
- Tolerance,
- Trust.

A Smart City requires a concentration of social and economic factors which are crucial for a permanent increase in the competitiveness of a smart city characterised by an innovative management culture and permanent absorption of this culture by citizens.

The research results have important implications for public sector organisations, decision makers, HR specialists, and organisational leaders. Public sector organisations will, in the future, face growing difficulties with attracting, developing, engaging, and retaining competent employees without a practical strategy of talent management. This, in turn, can limit the capability of these organisations to compete for talents with the private sector, which often manages them well. As indicated by the research, HR managers face the challenge of identifying talents [33].

Classifying persons on the basis of their results and potential constitutes the talent management matrix. The talent management matrix allows determining standards upon the fulfilment of which employees are considered talents. These standards can be used as ‘benchmarks’ in employee assessment, employment, employee promotion, or making decisions on dismissals. Determining standards concerning persons considered talents facilitates identification of employees [34].

It seems that there are broader issues such as adjusting values, team development, and HR policy, which public sector organisations should work on as a prerequisite for future initiatives concerning talents. It should be noticed that a lack of funds and insufficient internal specialist knowledge in the scope of initiatives concerning talents are challenges that require solving with other measures. Talent identification should be treated as a priority and should be supported by the senior management of the organisation.

Technology is the most underlined factor in the goals and directions of development of the analysed cities of the Metropolis GZM. In a slightly smaller scope, human resource development is emphasised, i.e., the sphere of talent, whereas the issues of trust and tolerance are areas of a significant deficit.

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