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# SMART CITY MANAGEMENT FROM THE PERSPECTIVE OF INHABITANTS AS THE CREATIVE CONSUMERS OF URBAN SPACE

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**Abstract.** The purpose of this article is to assess the perception of the idea of about the smart city management by its creative inhabitants. In operationalising the adopted objective, the focus is on the perception of the advantages and disadvantages of the implementation of Internet of things technologies and devices in urban space, based on the residents' convictions and attitudes. The study was conducted using an online survey technique. The most important advantages related to the implementation of Internet of things solutions in the field of smart cities are improved convenience in everyday life (easier access to public services), optimised allocation of urban resources, creating the image of the city as a modern city and economic benefits. On the other hand, the most important disadvantages are unethical use of personal data by public administration representatives, excessive surveillance of residents, increased costs of purchasing public services, loss of control over devices/systems, and increased feeling of insecurity among residents. The variable that differentiates to some extent the advantages and disadvantages perceived by inhabitants is their age.

**Keywords:** creative consumers, information and communications technology, Internet of things, management, smart city, urban space.

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## 1. Introduction

Nowadays it is emphasized the importance of efficient and optimal management of resources in urban areas. This is especially valid in times of economic crisis and rising inflation caused, among other things, by the COVID-19 pandemic. According to the report *Smart Cities: Key Technologies*, *Environmental Impact and Market Forecasts 2022–2026* (Juniper Research, 2022), spending on the development of smart cities will increase to United States dollars (USD) 70 billion by 2026, up from USD 35 billion in 2021. Due to the aforementioned economic problems, these investments are to be related to smart energy networks, which are expected to save more than 1000 terawatt-hours (TWh) of electricity in 2026 (Juniper Research, 2022). One of the main technologies supporting this process is the Internet of things (IoT) (Bibri & Krogstie, 2020; Sánchez-Corcuera et al., 2019). Considering the above, the focus was on capturing this phenomenon from the perspective of one of the most important elements of the smart city – the inhabitant – creative consumer of urban space. The concept of smart city is described in the case of using the IoT technology as a pillar, a basic technological factor in smart city management. It can be used in the smart management of urban systems such as smart administration, smart resource and energy management, pollution reduction system,

system for improving the sense of security, and system for creating a new brand image of the city as a modern and technologically advanced smart place.

In the context of the conditions presented, the purpose of this article is to assess the perception of the idea of about the smart city management by its inhabitants. In operationalizing the adopted objective, the focus is on the perception of the advantages and disadvantages of the implementation of IoT technologies and devices in urban space, based on the beliefs and attitudes expressed by city creative residents (Reimeris, 2016; Stoletov, 2016).

## 2. Theoretical background

### 2.1. Smart city concept

The smart city can be defined as an area where information and communications technology (ICT) is at the service of citizens' prosperity, environmental quality and smart growth (Albino et al., 2015). The "smart city" feature is the use of networked infrastructure to increase the efficiency of the economic and political spheres of city life, as well as to stimulate social and cultural change. Advanced technologies, purposeful improvement and enhancement of "social capital", as well as social and environmental sustainability play a key role in smart city development strategies (Chib et al., 2022). These aspects translate into smart living, which includes improving the quality of life in terms of services and promoting social cohesion and security for residents. This is realized through the development of a good quality housing system and creative cultural space infrastructure, a high level of healthcare, the availability and adequate quality of educational institutions, social services, and public safety tools such as surveillance systems and emergency service networks (Ben Letaifa, 2015), optimizing traffic and reducing the negative effects of mobility (especially pollution) and optimizing resource consumption (Tomaszewska & Florea, 2018).

Regardless of the indicated positives, it should be remembered that the prerequisite for competent smart city management and effective implementation of IoT solutions and facilities in the urban area is the acceptance of this technology by users – in this case, city inhabitants. In this context, an important aspect is the perception of the benefits associated with the implementation of the smart city concept by the creative consumers of urban space, conditioning their acceptance, and on the other hand, their concerns about the perceived risks are also important.

### 2.2. Advantages and disadvantages related to the Internet of things solutions implementation in the field of smart city

The smart city is a city that uses technology to improve the efficiency and effectiveness of its infrastructure and services (Mohanty et al., 2016). To create a real smart city, it is necessary to understand the city as a complex environment, with smart and safe concepts as interconnected parts (Ristvej et al., 2020). The digitized (digital city) city uses ICT to both process data, exchange information and support communication. The digital city provides a social information infrastructure for everyday urban life (including shopping, business, transport, education, social care, *etc.*), and create public space that support social interaction between people who

live in or visit the city (Albino et al., 2015). The benefits associated with the implementation of IoT smart city solutions can therefore include both pragmatic aspects such as optimized allocation of urban resources, facilitated access to public services or greater convenience and security for everyday residents, but also aspects relating to the satisfaction of higher-order needs, such as access to new virtual forms of entertainment.

The smart city is undoubtedly the intelligent city that is able to create intellectual capital and base growth and prosperity on it (Dameri, 2013). Smart people are one of the elementary characteristics of a smart city and it can be said that to a large extent it is on them that the degree of development of a city directly depends, in particular on their level of education, competence, ability, and willingness to learn throughout life, ability to embrace change, creativity, openness to different cultures, and communities and willingness to actively participate in public life. Smart city management through electronic services, electronic government, and appropriate use of ICT, which will enable citizens to be involved in participatory decision-making, also plays a stimulating role (Chai-Arayalert & Suttapong, 2020). The result is an empowerment of citizens and their involvement in public governance, services and interactions that connect and integrate public, private and civic organizations so that the city can function efficiently and effectively as a single organism. This type of city, referred to as an intelligent city, has a highly educated population, lifelong learners, open to the implementation of new technologies, participating in the management of the city and decision-making on pro-development activities leading towards a techno-city, *i.e.* a city specifically planned and developed in conjunction with major technological and industrial projects. Such cities can come in a variety of shapes and forms, each embodying a specific relationship between technology, urban development, and community concepts (Joss & Molella, 2013). The advantages for residents of a smart city can therefore include the social prestige associated with living in a city that enjoys the image of a modern city – an innovative city, where local conditions and resources are nurtured, empowering citizens (Scheel & Rivera, 2013). Many countries are implementing smart city models to create an image of places that keep up with modernization and cutting-edge technology and, consequently, attract young creative people with unique skills, able to come up with new, unconventional ideas, supporting the scientific and economic development of the city (Harrison & Donnelly, 2011).

It is important to remember that a smart city is not just an area saturated with modern technology. The structure of a smart city is much broader and includes technical, intellectual, and political aspects, but also geographical and environmental aspects. A sustainable city uses technology to reduce carbon dioxide emissions, produce efficient energy and improve building efficiency (Batagan, 2011). Thus, the concept of the smart city also includes the idea of the sustainable city. This is a city that uses ICT to be smarter in its use of resources, produce efficient energy and take care to save energy. The result should be economic benefits from increased efficiency in energy. In all its activities, such a city promotes not only energy efficiency and the use of renewable energy sources, but also environmental solutions, such as reducing private transport and promoting public transport, creating public open green spaces, taking care to protect natural resources (Brilhante & Klaas, 2018). It can therefore be assumed that part of the smart city concept is the green city or eco-city, which goal is to eliminate all carbon waste, to produce energy entirely from renewable sources and therefore

to achieve the benefits of reducing environmentally harmful emissions. At the same time, eco-cities intend to stimulate economic growth, reduce poverty, organize cities so that they have a higher population density and thus higher productivity and improve the health of the population (de Jong et al., 2013).

Based on the literature review, the main advantages related to the IoT solutions implementation in the field of smart city have been defined in Table 1.

However, as already mentioned, successful smart city management is largely conditioned by the acceptance of IoT technology solutions by city residents. Barriers of a behavioral nature may play an important role in the context of the development of systems based on the IoT concept. They relate to aspects such as issues of consumer attitudes in terms of trust or lack thereof towards specific IoT solutions (Wielki, 2016). The perceived risks from the use of the IoT, as perceived by respondents, most often focus on fears related to invasion of privacy or inappropriate or unauthorised use of collected data, security concerns, fears of lack of cost control and fears of surrendering control to devices (Mącik, 2016). Similar concerns can be expected in the area of urban space.

The smart city model is the most acceptable and appropriate model when it comes to the management of large cities (Gavalas et al., 2017) but it can generate some risks, especially related to national and cyber security (Khalifa, 2019). Security is a key priority for every individual, whether it is personal security, corporate security or urban community.

The concept of a secure "smart city" includes not only the equipping of households and key urban infrastructure with surveillance cameras, sensors for remote control and management, but also the organization of safe traffic, the safe organization of urban space and information security. The realization of the smart city concept implies the use of special software to analyze huge amounts of data and instantly link them to government databases and security systems. Homes, infrastructure, transport, communications, government, commercial and industrial services, *etc.* are all controlled by smart systems that depend on artificial intelligence and the IoT. If these services were to become the target of a successful cyber-attack, the consequences for national security and people's lives would be enormous (Khalifa, 2019), which

**Table 1.** Advantages related to the Internet of things solutions implementation in the field of smart city (source: created by authors)

| Advantages perceived by inhabitants | Sources |
|---|---|
| Optimised allocation of urban resources | Dameri (2013); Albino et al. (2015) |
| Improved convenience in everyday life – easier access to public services | Mohanty et al. (2016); Chib et al. (2022) |
| Economic benefits – increased energy efficiency | Baran et al. (2022) |
| Access to new, virtual forms of entertainment | Albino et al. (2015) |
| Reduction in environmentally harmful emissions | Baran et al. (2022) |
| Safety considerations for residents | Ristvej et al. (2020) |
| Social prestige for residents | Harrison and Donnelly (2011); Scheel and Rivera (2013) |
| Creating the image of the city as a modern city | Harrison and Donnelly (2011); Scheel and Rivera (2013) |

could result in an increased sense of insecurity for residents. Hacking the traffic system and manipulating traffic lights, for example, could result in serious consequences, *i.e.* casualties paralyzing city traffic, and economic losses. The losses would be even greater if power plants and petrol stations were the targets, as city life depends mainly on energy (Cerrudo, 2015).

Smart city infrastructure depends on smart technologies that require uninterrupted Internet connections. These technologies are used, for example, in power plants, nuclear reactors, factories, hospital systems, financial and banking services, communication and transport systems, air navigation and satellites. In such environments, loss of control of devices/systems can cause heavy losses and poses a significant risk. Unfortunately, the software, cables and devices that are Essential to the existence of a smart city based primarily on technology are susceptible to damage, defects and jamming. The reasons can be technical, but can also be caused, for example, by temperature changes, natural disasters or deliberate intervention to damage the smart city system. Other reasons are defects in the city's software or communication networks, wireless Internet, or Global Positioning System (GPS) (Khalifa, 2019). Delays and malfunctions in the functioning of the indicated systems pose a real threat, can cause disruption to the daily lives of residents and can even paralyze smart city life completely.

Smart cities are vulnerable to risk of system tampering, illegal activities, and technical problems. Those in charge of the system would be able to find out from records of the history of actions performed in the system what actions a resident has taken (David et al., 2015). Credit card information, GPS information, biometric data, medical data, *etc.* are always available to the organizations that manage the smart city. A related threat could be the excessive surveillance of residents, as well as the unethical use of personal data by government officials. Potential targets for such threats are all government services in a smart city, which are based on the smart government model, where citizens can access all services and perform all transactions via smartphones and the Internet (Khalifa, 2019). Many security concerns are also raised by the storage clouds belonging to the centers used to manage smart cities. All the information from sensors throughout the smart city and from many government institutions is stored there. The various pieces of information are linked together to improve decision-making processes and reduce support costs. However, citizens' data, digitized and stored on smartphones, clouds, *etc.*, is always at risk of being breached, whether from inside the city or by organized criminal groups. Residents may also feel uncomfortable about the security cameras that meet them wherever they go. Under such circumstances, the privacy of individuals is one of the most controversial issues concerning smart cities (Elmaghraby & Losavio, 2014).

Based on the literature review, the main disadvantages related to the IoT solutions implementation in the field of smart city have been defined in Table 2.

In the context of considerations regarding the perception of benefits and concerns related to the implementation of the smart city concept by urban space consumers, it should also be noted that although the use of modern technologies is now well perceived socially, the best results of the absorption of IoT technologies are largely observed among representatives of the younger generations (who are undoubtedly the most open to them). Age can create a mental barrier in the use of new technologies (Morbitzer, 2013, p. 22), so it is worth considering the role of this feature in the context of the attitudes of inhabitants representing

**Table 2.** Disadvantages related to the Internet of things solutions implementation in the field of smart city (source: created by authors)

| Disadvantages perceived by inhabitants | Sources |
|---|---|
| Increased feeling of insecurity among residents | Khalifa (2019); Cerrudo (2015) |
| Excessive surveillance of residents | Elmaghraby and Losavio (2014) |
| Loss of control over devices/systems | Cerrudo (2015) |
| Increased costs of purchasing public services (*e.g.* components for public solutions such as a public Wi-Fi network) | Zhang et al. (2019) |
| Unethical use of personal data by public administration representatives | Khalifa (2019) |
| Disruption to the daily lives of residents | Khalifa (2019) |
| Delays and breakdowns in the operation of systems | Khalifa (2019) |
| Increased feeling of insecurity among residents | Khalifa (2019); Cerrudo (2015) |

the older and younger generation. Certain research results may also suggest differences in the perception of benefits and concerns related to the implementation of IoT in the case of women and men (Mącik, 2016). Based on the above assumptions, the following research questions were formulated:

- RQ1: Which advantages related to the IoT solutions implementation in the field of smart city are perceived as the most important among residents?
- RQ2: Which disadvantages related to the IoT solutions implementation in the field of smart city are perceived as the most important among residents?
- RQ3: Do basic resident characteristics such as gender and age differentiate perceptions of the advantages related to the IoT solutions implementation in the field of smart city?
- RQ4: Do basic resident characteristics such as gender and age differentiate perceptions of the disadvantages related to the IoT solutions implementation in the field of smart city?

## 3. Research design

To complete the research sample an online survey technique was used. Due to the lack of a sampling frame, the snowball sampling method (Goodman, 1961) was used. The advantages of this technique were: obtaining a fairly large sample in a short time and its low costs. The main disadvantage was the possibility of the incorrect classification of subsequent participants, while identifying respondents similar in many respects. There is also the disadvantage of an unrepresentative sample, which does not allow for generalization of the results.

All measures in the main part of the questionnaire regarding, *e.g.* advantages or disadvantages implementing IoT solutions in smart city were measured using a five-point Likert scale (where 1 = "strongly disagree" and 5 = "strongly agree"). The specific statements in the field of advantages and disadvantages were prepared on the basis of the literature review. In the metrics section of the questionnaire, respondents were asked about characteristics such as gender, age, level of education, place of residence size, and material situation.

The survey received a total of 146 responses from respondents. In the research sample, 61% were women and the rest were men (39%). The predominant majority of the group was aged between 18 and 29 (76.7%), 17.8% of respondents were aged between 30 and 39, 3.4% were aged between 40 and 49 and the remainder (2.1%) were aged over 50. Considering the material status of respondents – 4.1 % have a worse than average situation (3.4% have bad situation, 0.7% have very bad material status). 28.1% have an average level of wealth in the surveyed group, almost 57% have a good situation and 11% have a very good material status. The study group is quite varied in the area of place of residence. The largest number of respondents (39.75%) live in large cities with more than 500 000 inhabitants. More than 10% live in cities with between 200 000 and 500 000 inhabitants, 11% in cities with between 50 000 and 200 000 inhabitants. However, the remaining respondents live in small towns with up to 50 000 inhabitants and villages 21.9% and 17.1% respectively. 76% of the surveyed group have a higher level of education – 40.4% have an academic degree at Master's degree (higher academic level), 35.6% have Bachelor's degree (higher vocational level). The maximum secondary education among the surveyed subjects is 21.9%, 0.7% of the group has an education at the basic vocational level, while 1.4% of the surveyed individuals are characterized by an education at the primary level.

## 4. Results

In an attempt to determine the importance of the specific advantages associated with the implementation of IoT solutions in the smart city field, respondents were asked to assess 8 proposed statements. The results are presented in Table 3.

Considering the total research sample each of the individual statement have means above middle point of the scale. The highly perceived advantages are: improved convenience in everyday life – easier access to public services (M = 4.16; SD = 0.819), optimized allocation of urban resources (M = 4.09; 0.862), creating the image of the city as a modern city (M = 4.08; SD = 1.041), and economic benefits (increased energy efficiency) (M = 4.03; SD = 0.905). The advantages of the lowest importance were social prestige for residents (M = 3.42; SD = 1.275), access to new virtual forms of entertainment (M = 3.78; SD = 1.073), safety considerations for residents (M = 3.86; SD = 1.035), and reduction in environmentally harmful emissions (M = 3.93; SD = 1.008).

There were only few significant differences in perception of advantages from IoT solutions implementation in the field of smart city in groups defined by residents' gender and age – optimized allocation of urban resources is perceived as more important by men (M = 4.21; SD = 0.84) than women (M = 4.01; SD = 0.872), while the representatives of the group aged 30 and over perceives it better (M = 4.38; SD = 0.697) than the representatives of the younger group (M = 4; SD = 0.89) (difference statistically significant, $p < 0.05$). Regarding the improved convenience in everyday life (easier access to public services) gender does not differentiate the level of importance and it is perceived similarly by women (M = 4.16; SD = 0.796) and men (M = 4.16; SD = 0.862), while in terms of age – the group of older representatives (M = 4.47; SD = 0.662) perceives this advantage better than the younger group (M = 4.06; SD = 0.841) (difference is statistically significant, $p < 0.05$). Economic benefits

**Table 3.** Advantages related to the Internet of things solutions implementation in the field of smart city according to the residents (n = 146) (source: created by authors)

| Advantages perceived by inhabitants | TOTAL | | Gender | | | | Age | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Female | | Male | | 18–29 | | 30+ | |
| | Mean | Standard deviation | Mean | Standard deviation | Mean | Standard deviation | Mean | Standard deviation | Mean | Standard deviation |
| Optimised allocation of urban resources + | 4.09 | 0.862 | 4.01 | 0.872 | 4.21 | 0.84 | 4 | 0.89 | 4.38 | 0.697 |
| Improved convenience in everyday life – easier access to public services + | 4.16 | 0.819 | 4.16 | 0.796 | 4.16 | 0.862 | 4.06 | 0.841 | 4.47 | 0.662 |
| Economic benefits – increased energy efficiency | 4.03 | 0.905 | 4 | 0.941 | 4.09 | 0.851 | 3.99 | 0.915 | 4.17 | 0.869 |
| Access to new, virtual forms of entertainment | 3.78 | 1.073 | 3.91 | 1.041 | 3.58 | 1.101 | 3.77 | 1.074 | 3.82 | 1.086 |
| Reduction in environmentally harmful emissions | 3.93 | 1.008 | 3.87 | 1.047 | 4.04 | 0.944 | 3.9 | 1.048 | 4.03 | 0.8 |
| Safety considerations for residents | 3.86 | 1.035 | 3.84 | 1.086 | 3.89 | 0.958 | 3.87 | 1.044 | 3.85 | 1.019 |
| Social prestige for residents | 3.42 | 1.275 | 3.42 | 1.278 | 3.44 | 1.282 | 3.44 | 1.3 | 3.38 | 1.206 |
| Creating the image of the city as a modern city | 4.08 | 1.041 | 4.17 | 1.003 | 3.95 | 1.093 | 4.07 | 1.02 | 4.12 | 1.122 |

*Note 1:* to the low counts of the different age groups, the age scale was aggregated to two groups: respondents aged 18 to 29 were included in the first group, while respondents aged 30 and older were assigned to the second group.
*Note 2:* Mean measured on a five-point Likert scale (described: 1 – completely disagree and 5 – completely agree).

*Note 3:* The significance of differences in the study subgroup variables: gender and age, was verified using the non-parametric Mann–Whitney U test.

*Note 4:* + means differences at the significance level $p < 0.05$ for the age variable.

(increased energy efficiency) are perceived better by men (M = 4.09; SD = 0.851) than women (M = 4; SD = 0.941), while in terms of age – the representatives of the older group estimate it higher (M = 4.17; SD = 0.869) than the younger group (M = 3.99; SD = 0.915). Access to new, virtual forms of entertainment – is perceived better by women (M = 3.91; SD = 1.041) than men (M = 3.58; SD = 1.101), while considering the age of respondents it is the older group (M = 3.82; SD = 1.086) that perceives it better than the younger group (M = 3.77; SD = 1.074). Reduction in environmentally harmful emissions as a benefit is perceived better among men (M = 4.04; SD = 0.944) than women (M = 3.87; SD = 1.047) and better among older (M = 4.03; SD = 0.8) than younger (M = 3.9; SD = 1.048) respondents. In the case of advantage – safety considerations for residents, the differences in perception are small, with men (M = 3.89; SD = 0.958) rating this attribute slightly better than women (M = 3.84; SD = 1.086) and slightly better perceptions among the younger interviewees (M = 3.87; SD = 1.044) than the older one (M = 3.85; SD = 1.019). Considering social prestige for residents – men (M = 3.44; SD = 1.282) rated this attribute slightly better than women (M = 3.42; SD = 1.278), while in terms of age, the representatives of the younger group (M = 3.44; SD = 1.3) rated this benefit better than the older group (M = 3.38; SD = 1.206). In terms of the last

proposed advantage – creating the image of the city as a modern city – women (M = 4.17; SD = 1.003) assessed it as more important than men (M = 3.95; SD = 1.093), and in terms of age, this characteristic is better rated by people aged 30 and over (M = 4.12; SD = 1.122) than younger respondents (M = 4.07; SD = 1.02).

Similarly, to the advantages assessment, respondents were asked about disadvantages related to implementing IoT solutions in the fields of smart city. The results are presented in Table 4.

Considering the total research sample the following disadvantages have means above middle point of the scale: unethical use of personal data by public administration representatives (M = 3.92; SD = 0.943), excessive surveillance of residents (M = 3.58; SD = 1.1), increased costs of purchasing public services (*e.g.* components for public solutions such as a public Wi-Fi network) (M = 3.37; SD = 1.175), loss of control over devices/systems (M = 3.23; SD = 1.175)

**Table 4.** Disadvantages related to the Internet of things solutions implementation in the field of smart city according to the residents (n = 146) (source: created by authors)

| Disadvantages perceived by inhabitants | TOTAL | | Gender | | | | Age | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Female | | Male | | 18–29 | | 30+ | |
| | Mean | Standard deviation | Mean | Standard deviation | Mean | Standard deviation | Mean | Standard deviation | Mean | Standard deviation |
| Increased feeling of insecurity among residents | 3.04 | 1.162 | 3.08 | 1.189 | 2.98 | 1.126 | 2.99 | 1.127 | 3.21 | 1.274 |
| Excessive surveillance of residents + | 3.58 | 1.1 | 3.56 | 1.033 | 3.61 | 1.206 | 3.49 | 1.09 | 3.88 | 1.094 |
| Loss of control over devices/systems | 3.23 | 1.175 | 3.21 | 1.133 | 3.26 | 1.247 | 3.18 | 1.141 | 3.41 | 1.282 |
| Increased costs of purchasing public services (*e.g.* components for public solutions such as a public Wi-Fi network) | 3.37 | 1.175 | 3.52 | 1.169 | 3.14 | 1.156 | 3.37 | 1.162 | 3.38 | 1.231 |
| Unethical use of personal data by public administration representatives | 3.92 | 0.943 | 3.97 | 0.859 | 3.84 | 1.066 | 3.9 | 0.91 | 3.97 | 1.058 |
| Disruption to the daily lives of residents | 2.66 | 1.135 | 2.71 | 1.13 | 2.58 | 1.149 | 2.58 | 1.12 | 2.91 | 1.164 |
| Delays and breakdowns in the operation of systems | 2.9 | 1.32 | 3.03 | 1.318 | 2.7 | 1.309 | 2.84 | 1.326 | 3.12 | 1.297 |

*Note 1:* Due to the low counts of the different age groups, the age scale was aggregated to two groups: respondents aged 18 to 29 were included in the first group, while respondents aged 30 and older were assigned to the second group.

*Note 2:* Mean measured on a five-point Likert scale (described: 1 – completely disagree and 5 – completely agree).

*Note 3:* The significance of differences in the study subgroup variables: gender and age, was verified using the non-parametric Mann–Whitney U test;

*Note 4:* + means differences at the significance level $p < 0.05$ for the age variable.

and increased feeling of insecurity among residents (M = 3.04; SD = 1.162). Indicated aspects are more important for the respondents than the remaining issues, *i.e.* disruption to the daily lives of residents (M = 2.66; SD = 1.135) and delays and breakdowns in the operation of systems (M = 2.9; SD = 1.32).

Considering the gender and age differences of the respondents for the first perceived disadvantage – increased feeling of insecurity among residents – women (M = 3.08; SD = 1.189) perceive it more than men (M = 2.98; SD = 1.126), while older residents (M = 3.21; SD = 1.274) assess this disadvantage as more important than younger one (M = 2.99; SD = 1.127). Excessive surveillance of residents is more important disadvantage for men (M = 3.61; SD = 1.206) than women (M = 3.56; SD = 1.033). In regard to age groups – older people (M = 3.88; SD = 1.094) assess this as a more serious threat than younger people (M = 3.49; SD = 1.09) (difference statistically significant, $p < 0.05$). The third disadvantage – loss of control over devices/systems – is perceived as more important by men (M = 3.26; SD = 1.247) than women (M = 3.21; SD = 1.133), while older (M = 3.41; SD = 1.282) respondents are more concerned about this threat than younger one (M = 3.18; SD = 1.141). Another of the proposed disadvantage – increased costs of purchasing public services (*e.g.* components for public solutions such as a public Wi-Fi network) – is perceived as more important by women (M = 3.52; SD = 1.169) than men (M = 3.14; SD = 1.156), while in the case of age, older respondents (M = 3.38; SD = 1.231) slightly more perceive this feature than younger respondents (M = 3.37; SD = 1.162). Unethical use of personal data by public administration representatives as a disadvantage is perceived more by women (M = 3.97; SD = 0.859) than men (M = 3.84; SD = 1.066) and by older respondents (M = 3.97; SD = 1.058) than younger respondents (M = 3.9; SD = 0.91). Disruption to the daily lives of residents is perceived as more important by women (M = 2.71; SD = 1.13) than men (M = 2.58; SD = 1.149) and more among older respondents (M = 2.91; SD = 1.164) than younger respondents (M = 2.58; SD = 1.12). The last proposed disadvantage – delays and breakdowns in the operation of systems – is assessed as more important by women (M = 3.03; SD = 1.318) than men (M = 2.7; SD = 1.309) and older (M = 3.12; SD = 1.297) than younger (M = 2.84; SD = 1.326) respondents.

## 5. Discussion and conclusions

In recent years, smart city projects have become increasingly popular and widespread around the world. The continuous growth of city populations and the complexity of urban management are driving local governments to make strong use of technology to support higher quality urban spaces and better public service offerings. A modern "smart city" implies not only the development of an ICT-based infrastructure of spaces, but also the open interaction of government, business structures and the population. Smart city residents have a high level of education and a degree of use of "smart" technologies in their daily lives (Albino et al., 2015).

To prepare the basic infrastructure of a smart city, various types of enabling technologies are necessary, among which the IoT is considered one of the most important (Park et al., 2018). According to the results of our study the most important advantages related to the implementation of IoT solutions in the field of smart cities are: improved convenience in everyday life (easier access to public services), optimised allocation of urban resources,

creating the image of the city as a modern city and economic benefits, which is in line with the findings presented in the literature (Dameri, 2013; Scheel & Rivera, 2013).

On the other hand, despite their various advantages, smart cities have many concerns about the safety and well-being of their inhabitants (Khalifa, 2019). These concerns are reflected in the results of our research in light of which the most important disadvantages perceived by residents are unethical use of personal data by public administration representatives, excessive surveillance, increased costs of purchasing public services, loss of control over devices/systems and increased feeling of insecurity.

The limitations of the study, including the relatively small, non-random selection of the sample, as well as the disproportions in sizes of the individual age groups, require approaching the interpretations of the results with a certain caution. However, considering the slight differences in the perception of the advantages and disadvantages related to the implementation of IoT solutions in the area of smart city expressed in the in distinguished age groups (younger and older respondents) some assumptions were made based on the obtained results. It would be advisable to regard this study as a preliminary research and to formulate some hypotheses on the perception of the IoT in smart city appliances in the context of intergenerational differences. Verification of the hypothesis formulated in this way should form the initial framework of further research undertaken on a larger sample, which should be representative and therefore randomly selected. It would also be worth taking into account other residents' characteristics, such as education level or the size of their place of residence. In such a study, it would be worth taking into account the influence of these variables as moderating variables.

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