

CAN A CITY BECOME TRULY SMART WITHOUT INVOLVING ALL GROUPS OF STAKEHOLDERS: A DISCUSSION BASED ON THE EXAMPLE OF “ACOUSTICAL SMARTENING”

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Abstract

The article presents the problem of transforming urbanized space into a so-called “smart” space, paying special attention to the participation of space users in such transformation processes. In the initial part of the article, the author briefly presents a subjective overview of the ways of perceiving the idea of a “Smart City” (chapter 2). The next part (chapter 3) is devoted to a detailed description of urban space user groups, considering not only city residents but also people temporarily staying in the city. Then, based on the conducted research on urban space users, an attempt was made to identify the willingness and scope of involvement of urban space users in the processes of making such space “smart”. Then, specific acoustic phenomena related to the functioning of the urban organism were selected as the area of acoustic phenomena related to the city. The basic assumptions and research methods conducted in this problem area are presented, and selected conclusions from this research are shown. In conclusion, the author presents his intentions for further study of the issues discussed in the article.

Keywords: Management of an urban area; Smart City; S.C. stakeholders; SMART CITY 3.0; acoustic climate in towns.

1. INTRODUCTION

Terms such as “Smart City” or “Intelligent City” are commonly treated as synonymous. It is also believed the concept of a “smart” urbanized space is relatively new. The terms mentioned above were introduced into the scientific dispute by computer scientists, creating the idea of a city functioning as a kind of organism and describing the flow of data in this organism with a humanized model in which all sorts of sensors, and other sources of data are the equivalent of human senses, information transmission networks are the equivalent of the nervous system, and the center of information gathering and processing (and, in somewhat later developments, knowledge gathering) and decision-making is the equivalent of the central nervous system and the human brain. Architects and urban planners peculiarly joined this approach, describing the modern city as a kind of “carrier” of this nervous system, following the above-humanized con-

cept, the skeleton’s equivalent, the muscular system, and skin coating. This has resulted in visions of “garden cities” with futuristic buildings and similar spatial solutions. However, to answer the question in the title of this paper, the author believes it is worth and necessary to look at the smart city much more broadly.

2. A SUBJECTIVE OVERVIEW OF MANNERS TO PERCEIVE THE “SMART CITY” CONCEPT

In the current state of understanding of the “Smart City” concept, the clearly dominant view is that as the basis of all considerations and proposals related to urbanized space defined in this way, it is necessary to accept – as the primary goal of creating and developing such space – the improvement of the quality/comfort of life of its users. Accepting this view, we can easily conclude that projects aimed at realizing

such a goal occur in urban development much earlier than the appearance of IT in the history of human development.

The creation of a system of aqueducts supplying water to cities in ancient Rome was undoubtedly a factor in improving the comfort of their inhabitants, not only by providing those residents with a sufficient supply of drinking water but also by enabling a system of public baths. It is worth noting that these solutions, for various reasons, did not live to see a continuation in the later history of urban space. Indeed, it is hard not to conclude that medieval cities, and even later ones, with systems of gutters for draining wastewater and relying on wells and water bearers as the primary means of providing residents with drinking water, were no more friendly to residents than cities of the Roman Empire era. The launch of Frederick Albert Winsor's gas lamp system on Pall Mall in 1807 had a similar value in improving the quality of life for residents in at least part of 19th-century London.

In the modern world, cities in various parts of the world are outdoing each other in becoming increasingly "Smart". Numerous case studies (e.g., [1], [2], [3], [4]) of the implementation in various cities on all continents of developed information systems, e.g., supporting the management of public transportation in the town or agglomeration, appear in journals. In the opinion of the author of this paper, the authors of such studies pay a little too much attention to attempts to link the Smart City concept with other "fashionable" aspects of the functioning of cities as "social organisms" [5], [6]. We can mention, for example, the models of a town pursuing the goals of "sustainable development" (Sustainable City) [7], [8], [9], Smart City as an ecological city (Green City) [10], [11], [12], Smart City functioning following the paradigm of the "Closed Circuit Economy" [13], [14], [15] or, finally, taking into account in the creation of intelligent urban space the problem of adaptation of metropolitan areas to climate change (Municipal Climate Change Adaptation Plans – MPA), urban "heat islands" [16], [17], [18], [19].

In parallel with the abovementioned concepts, the problem of formulating a set of principles/rules for creating "smart urban space" is addressed in publications. Several studies have been published, showing proposals for such rules ([4], [20], [21], [22]), in which we can find, for example, the following set of discussed principles:

1. Define your own city model using the "mantra of your city"

2. Analyze the structure of your city and identify priorities
3. Rethink existing city systems, not just improve them
4. Develop the urban economy with current and potential partners
5. Make your city open to change and promote long-term investment
6. Build a resident-friendly city by expanding and improving public spaces
7. Create a human-centered city, use technology for people
8. Create good projects, especially projects that break stereotypes

or another similar one:

1. First principle: balance with nature
2. Principle two: balance with tradition
3. Rule three: appropriate technology
4. Fourth principle: sociability
5. Fifth rule: efficiency
6. Sixth principle: human scale
7. Seventh principle: opportunity matrix
8. Eighth principle: regional integration
9. Ninth principle: balanced movement
10. Tenth principle: institutional integrity

The proposed rules for creating a smart urbanized space differ on many issues but show significant similarities. However, all such proposals fail to provide a clear answer to the key question: who are they aimed at?

In the author's opinion, an attempt to answer this question should be linked to another question: Who and why did, is, or should take part in implementing tasks related to the creation of innovative urban space? Let's try to use the concept of stakeholder, proposed and developed by Freeman [23], [24], and already used by researchers interested in S.C. issues [25], [26], [27].

3. STAKEHOLDERS OF A SMART CITY

According to the author of this paper, an apparent yet debatable influence on the perception of the problem of identifying Smart Cities stakeholders was brought by Cohen, who proposed, according to the current fashion, to divide S.C. projects into three categories: S.C.1.0, S.C. 2.0, and S.C. 3.0 [28], [29]. A key element of this division, according to Cohen's

model, was the assignment of roles in S.C. processes to three stakeholder groups:

- Group 1: S.C. system manufacturers/suppliers,
- Group 2: City authorities/decision makers,
- Group 3: City residents.

According to the author of this study, the above model is consistent up to the point where the description of project implementation includes only the first two groups of stakeholders. In projects of the Smart City 1.0 type, the decisive role is played by stakeholders from the first group (manufacturers/suppliers of S.C. systems), who convince city managers to apply in their area the developed solutions, which in such an arrangement have the value of applicability in various urban systems. In Smart City 2.0 projects, the leading role is assumed to be played by stakeholders from the second group (city authorities/decision-makers) who know [30] what is at the top of the hierarchy of needs and opportunities in their city and, using such knowledge, can order from the manufacturer technical solutions dedicated to their area. Assuming that the first two types of S.C. projects correctly describe the actions and behaviors of the first two stakeholder groups. However, in the concept of Smart City 3.0, there is an assumption that the city's residents will participate in the decision-making processes towards making the city smarter. In the opinion of the author of this paper, this is where Cohen's concept goes completely awry.

First, the S.C. model. 3.0 does not consider the significant diversity of the group defined as "city residents". Let's take a closer look at such differentiation. It seems clear that this group should include not only adults and economically active people but also:

- Children (of all ages), adolescents;
- Adults but not working for various reasons;
- Senior citizens;
- People with disabilities;

In addition to these groups, multi-city residents include:

- Persons temporarily residing in a particular city and renting residential space;
- Residents of gated neighborhoods or residential complexes, often far from the center and respected with the city quite loosely (apart from administrative affiliation);
- Homeless persons;
- Residents of specific parts of the city: far-flung suburbs, areas of the town inhabited by minorities, slums, etc.

Many groups mentioned above are linked to specific problem areas, often supra-local. Researchers from various scientific fields, for example, deal with the phenomenon of homelessness, and considerations on this topic also appear (although not very often) concerning the Smart City concept [31], [32]. Similarly, we can view the problem of an ageing population, which should also be an essential reference in forming increasingly user-friendly, this time elderly users' urban space [33], [34].

In the opinion of the author of this study, it is also worthwhile to introduce links of a "transversal" nature into the classification of city residents shown above, linking representatives of different groups of Smart City stakeholders adhering to specific religions. This postulation means taking into account the specific needs related to religion in the process of creating the S.C. [35]. Finally, it is worth considering in such processes the fact that any city – including a "smart city" – is a space with users who do not fit into the category of "residents", such as people coming to the city for work, family, tourism or religious purposes (pilgrims). In the author's opinion, it would be appropriate – for the considerations presented here – to treat the category of "residents" more broadly, changing it to the category of "users of urban space".

4. PARTICIPATION OF URBAN SPACE USERS IN S.C. CREATION

According to B. Cohen's concept of classifying Smart City processes cited earlier in this paper, let us now return to the assumption that in the S.C. variant. 3.0 the process of creating a smart urbanized space should actively involve the residents (and – consequently – the users) of such space. In the author's opinion, stemming from his practical experience of city management in Polish conditions as a long-time member of the City Council and deputy mayor, the postulate of such conscious and creative participation currently has the character of wishful thinking. This statement can be supported by considering, for example, the percentage of people eligible to participate in local government elections. In the last such elections in Poland, the turnout was, according to the official announcement of the State Election Commission, only 51.5 per cent of those eligible. This means that almost half of the stakeholders in the "residents" category show no interest in participating, even in the form of participation in the election of local authorities, in creating the development of their city. How does this relate to the concept of S.C. 3.0, according

to which “end users” of urban space should participate in shaping it?

This is true not only in Poland but also in other countries, where such a lack of involvement is a significant problem [36], [37], [38]. Thus, if the decision-making bodies intend to avoid making city users happy “by force”, even with the best of intentions, it is worth first asking and then attempting to answer the following questions:

- 1) Do urban space users want to participate actively in the Smart City process?
- 2) Are such users prepared to actively participate in the process in question?

The answers to these questions should undoubtedly consider the diverse interests of the stakeholder groups listed above. These interests, in particular, may be mutually contradictory or even mutually exclusive. Assuming that we do not consider the variant in which all stakeholders are “put into one bag,” it is worth considering both the method of identifying the reasons for the lack of interest of users of urbanized space in the directions and scope of changes to such space and the technique of increasing such interest.

Many authors, especially those representing the field of social sciences, have published and are publishing studies that point – as a method of including users of urban space in the S.C. process. – to the participatory paradigm [39], [40]. Reading such studies and juxtaposing them with his already cited practical experience, the author gets the impression that either city dwellers in different countries have significantly different approaches to behavior resulting from the participatory model, or the authors of these studies have not tried to implement this model in practice.

From the experience of the author of this study indicated above, it follows that in the Polish reality of local government functioning. However, the legislator even obliges city authorities to consult residents on issues such as introducing changes to the spatial development plan; the indifference of residents expressed through reluctance to participate in such consultations is the rule rather than the exception. As a result, a small group of residents usually engages in a meeting concerning even a significant change in the designation of a piece of urban space. Slightly simplifying, it can be said that such consultation meetings are usually attended by those who are directly interested, that is, the owner or current user of the area covered by the proposed change, the managers (owners) of the land plots adjacent to the area as men-

tioned earlier, and – sometimes – people of the “permanent challenger” type, probably present in every larger community and set on a total criticism of the activities of the authorities. Still referring to the idea of participation of all users of a given city in making important decisions, one should point out, as a positive example of a change, the increasingly common initiatives in Poland referred to by the term “civic budget” [41], [42]. As part of such an initiative, the city authorities declare the allocation of part of the budget for undertakings proposed and approved by residents in the voting process. Such ventures might be, for example, the construction of bicycle paths, the construction of a sports field in a given neighborhood, or the cleanup of an area and its use for recreational and educational purposes. Residents of cities where such initiatives have been launched are usually all the more eager to get involved in both the preparation of the proposal and in gaining votes of support for such a proposal the more it concerns their immediate surroundings. The two examples shown above allow us to formulate the thesis that city residents are the more willing to participate in decisions about changes in the city, the closer to them such changes are to be made, and the more convinced they are that such a change will make their life in the town more straightforward (or more pleasant).

The second question posed above concerns the desired body of knowledge and competence that a user of urbanized space should possess to actively participate in the successive granting of ownership and properties to this space S.C. In the opinion of the author of this paper, this question is somewhat perverse, and there is no one-size-fits-all answer to it. One may be tempted to predict how this question works for the distinguished groups of urban space users. However, we will describe the problem of providing such an answer a little differently: using the example of a selected aspect of the functioning of urban space as perceived by the users of this space. An example of the acoustic dimension of the city is described in the next section of this paper.

5. SOME REMARKS ON THE ACOUSTIC DIMENSION OF THE FUNCTIONING OF AN URBAN ORGANISM

If, as assumed in this article, striving to create smart urban space means striving to make such space as friendly and comfortable as possible for its users, then it is worth considering how such users experience this friendliness or comfort. The author of this

study suggests that we first consider people's experience of their surroundings through the senses. So, we experience the quality of our surroundings through vision, touch, smells, and, last but not least, through what we hear. The claim that the range of sounds we hear causes us to recognize our surroundings as a city needs no further justification. However, let's try to consider what sounds a person will recognize and interpret as related to an urbanized space.

Traditionally, when talking about the presence of sounds in the human environment and in their impact on that human, we think of the adverse effects, referred to by the term "noise" [43]. Also, concerning urban space, the primary considered type of acoustic impact on humans is noise from various sources, including those generated by transportation and industrial activities. At the beginning of the current century, the Directive 2002/49/EC of the European Parliament and Commission [44], referred to commonly as the "Noise Directive", appeared in the legislative circulation, imposing on cities in the European Union member states the obligation to create and then update within a certain period the so-called strategic noise maps and to prepare, based on the maps as mentioned earlier, municipal programs for environmental protection against abnormal noise.

For further discussion in this paper, it is necessary to clarify the meaning of such terms as "sound", "acoustic effect," and "noise". The first two of these terms refer to an objectively occurring physical phenomenon involving acoustic wave generation by various sources. In contrast, the term "noise" comes from ergonomics and is evaluative (subjective). According to the generally accepted definition, noise is "unwanted, annoying, harmful sound that can affect human health".

During the period of preparation of the EU Directive as mentioned above and in the initial period of its implementation, the author of this study led several research projects aimed at preparing local authorities in Polish cities, obliged to prepare noise maps, to carry out the related tasks [45], [46], [47], [48]. Twenty years after the entry into force of the aforementioned EU Directive, the research team involved in the implementation of the preparatory projects outlined above attempted to carry out research aimed at evaluating the usefulness of noise maps and environmental protection programs against abnormal noise by city authorities in Poland, subject to the obligation to create and update the documents as mentioned earlier. The results obtained from this research are presented in more detail in [49].

Taking advantage of contacts with Polish city authorities, the research team also attempted to solicit opinions from residents of Polish cities on the acoustic environment in their living space. Assistance, consisting primarily of posting links to the survey prepared for this study on the cities' websites, undoubtedly contributed to more than a thousand survey responses. Considering that the responses were provided by residents of large (over 100 000 inhabitants) Polish cities, the number of responses obtained should be regarded as representative.

The paper [50], presented in proceedings of the Euronoise 2021, shows a preliminary analysis of the processing of these responses. The basis for this analysis was the responses to the first seven questions posed to respondents (Table 1). The results were presented using a typical statistical approach.

Considering this study's basic purpose and substantive assumptions, special attention should be paid to question No. 2, shown in Table 1. In particular, a question arises about the information in the last column of Table 1. Twenty-six descriptors were presented for respondents to choose from in this survey questionnaire. The survey description in [50] did not present information on how these descriptors were selected. Since it is relevant to the considerations presented here, the method of this selection should be presented here.

The complete list of descriptors for question 2, as shown in Table 1, is introduced in Table 2.

This list results from a brainstorming discussion among the research team members. Before the meeting to create this list, these individuals canvassed family and friends living in the cities for suffering and ideas. Since, as a result of the discussion, none of the participants dared say that the list created was complete, it was decided in question 2 of the survey to allow respondents to submit their own opinions in the area in question. The adoption of such an arrangement yielded results relevant to the following considerations.

The number of respondents who took the "open option" (the last descriptor in question 2) was relatively small, less than 5% of the completed questionnaires. However, from the content of this study's point of view, the list of these responses should be the starting point for further research focused on the problem of the participation of all stakeholder groups in the creation and development of smart features of urbanized space.

To clarify the above statement, let's choose as an exam-

Table 1.
List of questions in a survey addressed to residents of Polish cities concerning sounds in urban space

Question No.	Content of the question	Structure of the answer to the question
1	Do you perceive your place of residence as: very noisy, noisy, rather noisy, rather quiet, quiet, very quiet	Closed-ended question, six answer options to choose from
2	What sounds do you hear most often where you live? Mark all relevant answers and evaluate by putting an X in the column on a scale of 1 to 5 (1-unpleasant, 2-somewhat unpleasant, 3-obnoxious, 4- rather pleasant, 5- pleasant)	There were twenty-six types of sound sources (acoustic effects) to choose from, plus an "Other" answer. The list of source types included in this question is shown in Table 2.
3	Do the sounds of the city matter to you? Answers: yes, no, don't know	Closed-ended question, three answer options to choose from
4	Would you like to change the sounds of your city? Answers: definitely yes, only some of them, definitely no, hard to say	Closed-ended question, four answer options to choose from
5	Can you characterize your place of residence (please select all matching answers)	Choice of ten descriptors of the respondent's place of residence; possibility to indicate more than one of them in the answer (list of descriptors shown in Table 3)
6	When deciding where to live, did you think about the acoustic value of your place of residence? Responses: did not make a decision about where to live; yes, it was very important to me; yes, but it was not the most important factor for me; no, I was not interested in these issues, but now I think it was a mistake; no, I was not interested in these issues and would not continue to consider them	Closed-ended question, six answer options to choose from
7	If you spend your leisure time in the city, in which spaces do you spend your leisure time most often? Responses: I do not spend my leisure time in the city; pubs, cafes, restaurants, city square; surrounded by nature, city parks, city allotments; in commercial spaces (galleries, shopping centers, arcades); other – what?	Open question. In addition to the proposed descriptors, it allows you to enter your own descriptor
8	Are there places in your city that you avoid because of the sounds (noise) there? Answers: no; yes (state which ones?)	Open question

ple the problem identified in several responses concerning the inconvenience of pedestrian crossing signaling systems operating in densely built-up city centers, using acoustic signaling in addition to traffic lights.

Acoustic signaling at a pedestrian crossing may include, for example:

- (1) Pulsating acoustic signal during the period when a red light is on for pedestrians (prohibition of entering the roadway),
- (2) Continuous signal when the light is green (you can cross the road),
- (3) A pulsating signal of variable frequency and intensity combined behind a yellow or orange light (leave the roadway, as the light will soon turn red).

Such a signaling system is undoubtedly friendly to pedestrians, increasing their safety when crossing the road. Audible signaling also considers the needs of people with visual impairments. At the same time, the reception of such acoustic signals, usually active for 24 hours and all days of the week, can be very inconvenient for people who live or work near such a marked crossing.

The list of descriptors, which is shown in Table 3, should, according to the survey design methodology, be part of the so-called survey fiche since it does not include a question about the respondent's opinions but allows positioning of this respondent by gender or age group, among others. However, since the information from the answers to this question was considered substantively relevant, this list is the third part of question 5 in this survey. The list in Table 3 was created similarly to the list of descriptors for question 2 (see above).

A detailed analysis of the results of the survey, as mentioned above, has given at least a few interesting statements:

1. In the surveyed sample of respondents, the majority perceived the presence of sounds as an essential element in the "life of urban space." Thus, in the opinion of the author of this study, the question in the title should be answered in the negative: no, the urban space being transformed to be a "Smart space" will not be fully friendly to users of this space, if acoustic factors affecting the quality of life of residents are not considered in the S.C. project.

Table 2.**List of descriptors for question 2 in the survey as in Table 1**

Descriptor No.	Content of the descriptor
1	The sound of cars and other means of transportation
2	Sounds of traffic signal system / pedestrian crossing
3	Bicycle Bells
4	Signal of a passing ambulance, police or fire truck
5	Sounds of road/repair work (including tool sounds e.g. impact hammer, drill).
6	Car horns
7	Low-flying aircraft, helicopters, drones
8	Hustle and bustle of moving people/groups of people
9	The buzz of children playing
10	Loud talking / shouting / arguing
11	The sounds of parties, discos, etc...
12	Noise of dining establishments (sounds of dishes, cutlery, sounds of people eating and talking)
13	Music of musicians / street performances
14	Sound of cell phone rings, SMS notifications and more
15	Rumble of gunshots at recreational and sports shooting ranges
16	Rumble of fireworks being set off
17	The clatter of women's heels on the sidewalks
18	Barking dogs and the sounds of other pets
19	Sounds of farm animals
20	Bird noises
21	The clatter of horses' hooves, the sound of horse-drawn vehicles (e.g., carriages)
22	Sounds (buzzing) of insects
23	The sound of flowing water (streams, cascades, fountains)
24	Sounds of precipitation (e.g., rain, hail)
25	Other atmospheric phenomena (high winds, thunderstorms)
26	Other (what kind?)

Table 3.**List of descriptors for question 5 in the survey as in Table 1**

Descriptor no.	Descriptor content: I live ...
1	in the very center of the city
2	in one of the neighborhoods around the center
3	on the outskirts of the city
4	in a block of building (multi-family housing).
5	in a single-family house (detached, terraced, semi-detached)
6	on a busy street
7	by the railroad line
8	by the tramline
9	at an industrial plant
10	within range of other dominant sounds, i.e.

- In the survey sample, a clear majority of respondents saw the need for changes in their city's acoustic climate.
- Responding to the question about the annoyance of specific sounds occurring (recorded) in their surroundings, respondents confirmed the annoyance of sounds typical of the city, i.e. the acoustic effects of street and rail traffic, the proximity of the airport and the associated acoustic effect caused by planes taking off and landing, construction and repair work carried out in their immediate vicinity using "noisy" machinery and equipment (e.g. jackhammer)
- In their responses to the same question, respondents also mostly pointed to the nuisance nature of neighborhood-related sounds, so resulting, for example, from having neighbors prone to holding

loud parties, settling family problems through loud arguments, or the presence in the neighborhood of crying babies or very active and loud older children, barking dogs, etc.

6. CONCLUSIONS AND SUMMARY

Making an attempt to summarize the results of research to date on the presence of sounds in urban space and – above all – the impact of the acoustic component on the quality of life in such space, it is necessary, first of all, to repeat the statement already formulated in the earlier part of the article that urban space will not be fully user-friendly if, in the process of its transformation, the participation of the end users, especially the residents of this space, is neglected or marginalized.

Answering the question in the title of this paper: the author realizes that as the complexity of the system increases, and as the number and diversity of stakeholder groups in this system increase, the postulate of fully satisfying all stakeholders becomes less and less realistic. On the other hand, however, in the current state of thinking about the functioning of society, it is difficult to agree to solutions based on the satisfaction of the majority or the satisfaction of the “average stakeholder”. The results of studies of the specific problem of the presence of an acoustic component in the functioning of “urban organisms”, presented in the author's earlier works and in this paper, indicate quite clearly that we are usually unable to satisfy all stakeholders (vide the example shown in the previous section of the use of an audio component in signaling systems at pedestrian crossings). At the same time, however, identifying areas of collision of needs and expectations among different stakeholder groups requires the active involvement of these stakeholders both in the processes of identifying needs and in the search for the best possible solutions, particularly using the latest scientific and technological developments.

For a significant part of acoustic problems, urban users cannot rely solely on city managers, who, by definition, make decisions that are good for the majority but not necessarily appropriate for some users.

In the author's opinion, many problems of organizing urban life, including issues of an acoustic nature, can and should often be solved without the participation of city authorities. The author of this paper intends to propose solutions, taking into account the diversity of urban space stakeholders and their needs and expectations, for use in the processes of creating Smart Cities in his further research.

REFERENCES

- [1] de Wijs L., Witte P., Geertman S., (2016). How smart is smart? Theoretical and empirical considerations on implementing smart city objectives – a case study of Dutch railway station areas. *Innovation*, 29 (4).
- [2] Karwot J., Kaźmierczak J., Wyczolkowski R., Paszkowski W., Przysłanka P., (2016). Smart water in smart City: A case study. 16th International Multidisciplinary Scientific Conference SGEM2016 Conference Proceedings, Book 3, Section 12, 1–8. (ISBN 978-619-7105-61-2 / ISSN 1314-2704).
- [3] Palomo-Navarro Á., Navío-Marco J., (2018). Smart city networks' governance: The Spanish smart city network case study. *Telecomm Policy*, 42(10).
- [4] Mora L., Deakin M., Reid A. (2019). Strategic principles for smart city development: A multiple case study analysis of European best practices. *Technological Forecasting and Social Change*, 142, 70–97.
- [5] Cronin G. (2021). The Social Organism. In: *Disenchanted Wanderer: The Apocalyptic Vision of Konstantin Leontiev*, Chapter 6.
- [6] Forbus K.D. (2016). Software social organisms: Implications for measuring AI progress. *AI Magazine*, 37(1).
- [7] Hatuka T., Rosen-Zvi I., Birnhack M., Toch E., Zur H. (2018). The Political Premises of Contemporary Urban Concepts: The Global City, the Sustainable City, the Resilient City, the Creative City, and the Smart City. *Planning Theory and Practice*, 1–20.
- [8] Martin C., Evans J., Karvonen A., Paskaleva K., Yang D., Linjordet T. (2019). Smart-sustainability: A new urban fix?, *Sustainable Cities and Society*, 45, 640–648.
- [9] Aelenei L., Ferreira A., Monteiro C.S., Gomes R., Gonçalves H., Camelo S., et al. (2016). Smart City: A Systematic Approach towards a Sustainable Urban Transformation. *Energy Procedia*, 91, 970–979.
- [10] Jiang H., Jiang P., Wang D., Wu J. (2021, June 1). Can smart city construction facilitate green total factor productivity? A quasi-natural experiment based on China's pilot smart city. *Sustainable Cities*, 69.
- [11] Hasmawaty, Utami Y.T., Antoni D. (2022). Building Green Smart City Capabilities in South Sumatra, Indonesia. *Sustainability* (Switzerland), 14, 7695.
- [12] Łaźniewska E., Janicka I., Górecki T. (2021). Green smart city as a new paradigm of local development. *Problemy Ekorozwoju*, 16(2).
- [13] Dincă G., Milan A.A., Andronic M.L., Pasztori A.M., Dincă D. (2022). Does Circular Economy Contribute to Smart Cities' Sustainable Development? *Int J Environ Res Public Health*, 19(13).
- [14] Formisano V., Iannucci E., Fedele M., Bonab A.B., (2022). City in the loop: assessing the relationship between circular economy and smart sustainable cities. *Sinergie*, 40(2).
- [15] Soo A., Wang L., Wang C., Shon H.K., (2023). Machine learning for nutrient recovery in the smart city circular economy – A review. *Process Safety and Environmental Protection*, 173, 529–557.
- [16] Levermore G., Parkinson J., Lee K., Laycock P., Lindley S. (2018). The increasing trend of the urban heat island intensity. *Urban Climate*, 24, 360–368.
- [17] Akbari H., Cartalis C., Kolokotsa D., Muscio A., Pisello A.L., Rossi F., et al. (2016). Local climate change and urban heat island mitigation techniques - The state of the art. *Journal of Civil Engineering and Management*, 22(1).

- [18] Satterthwaite D., Huq S, Pelling M., Reid H., Lankao P.R. (2007). Adapting to Climate Change in Urban Areas. *Human Settlements*, 58, 103.
- [19] Lwasa S. (2010). Adapting urban areas in Africa to climate change: The case of Kampala. *Current Opinion Environmental Sustainability*, 2(3), 166–171.
- [20] Song H., Srinivasan R.S., Sookoor T., Jeschke S. (2017). *Smart Cities: Foundations, Principles, and Applications*. John Wiley & Sons, Inc. ISBN:9781119226390 Online ISBN:9781119226444 DOI:10.1002/9781119226444.
- [21] Khavarian-Garmsir A.R., Sharifi A. (2023). Smart cities: Key definitions and new directions. *Urban Climate Adaptation and Mitigation*. Elsevier, 49–67.
- [22] Guallart V. (2021). The Digital Reindustrialisation of Cities. *Architectural Design*, 91(5).
- [23] Freeman E.R. (2005). *Strategic Management: A Stakeholder Approach*. John Wiley & Sons, Inc.
- [24] Freeman E.R. (1998). A Stakeholder Theory of the Modern Corporation. *The Corporation and Its Stakeholders: Classic and Contemporary Readings*, edited by Max Clarkson, Toronto: University of Toronto Press, 125–138.
- [25] Axelsson K., Granath M. (2018). Stakeholders' stake and relation to smartness in smart city development: Insights from a Swedish city planning project. *Government Information Quarterly* 35(4), 693–702.
- [26] Mayangsari L., Novani S. (2015). Multi-stakeholder co-creation analysis in Smart city management: An Experience from Bandung, Indonesia. *Procedia Manufacturing*, 4, 315–321.
- [27] Alamoudi A.K., Abidoye R.B., Lam T.Y.M. (2022). The Impact of Stakeholders' Management Measures on Citizens' Participation Level in Implementing Smart Sustainable Cities. *Sustainability* (Switzerland) 14(24).
- [28] Cohen B., (2018). Blockchain Cities and the Smart Cities Wheel. <https://boydcohen.medium.com/blockchain-cities-and-the-smart-cities-wheel-9f65c2f32c36>
- [29] Cohen B., (2014). Smart City Index Master Indicators. Smart Cities Council.
- [30] Kaźmierczak J., (2024). How to Manage Knowledge Supporting Stakeholders of Smart Cities? In: Marquez G.F.P., Sanchez L.R.V. (editors) *From Theory of Knowledge Management to Practice*. IntechOpen London, 1–21.
- [31] Yadav V., (2021). Assessing the State of Homeless People to Plan Inclusive Smart Regions. In: Sharma, P. (ed) *Geospatial Technology and Smart Cities*. The Urban Book Series. Springer, 289–296.
- [32] Khayyatkoshnevis P., Choudhury S., Latimer E., Mago V., (2020). Smart City Response to Homelessness. *IEEE Access*. 8, 11380–11392.
- [33] Loos E., Sourbati M., Behrendt F., (2020). The role of mobility digital ecosystems for age-friendly urban public transport: A narrative literature review. *Int J Environ Res Public Health*, 17(20).
- [34] Gudowsky N., Sotoudeh M., Capari L., Wilfing H. (2017). Transdisciplinary forward-looking agenda setting for age-friendly, human centered cities. *Futures*, 90, 16–30.
- [35] Kazmierczak J., Knosala B. (2023). Smart City as a Place to Pray. *Proceedings of 2023 IEEE International Smart Cities Conference, ISC2 Bucharest, Romania*, 1–6.
- [36] Frandsen G.A. (2002). Size and electoral participation in local elections. *Environ Plann C Gov Policy*, 20(6).
- [37] Cormack L., (2019). Leveraging Peer-to-Peer Connections to Increase Voter Participation in Local Elections. *Politics and Policy*, 47(2).
- [38] Wu L, Rogers B, Wang G. (2023). Explaining voting participation gaps in local government elections in rural China. *Asian Journal of Comparative Politics*. 8(1).
- [39] Simonofski A., Asensio E.S., De Smedt J., Snoeck M. (2017). Citizen participation in smart cities: Evaluation framework proposal. *Proceedings of IEEE 19th Conference on Business Informatics (CBI), Thessaloniki, Greece*, 227–236.
- [40] Bull R., Azennoud M., (2016 August). Smart citizens for smart cities: Participating in the future. In: *Proceedings of Institution of Civil Engineers: Energy*. Thomas Telford Services Ltd; 169(3), 93–101.
- [41] Dubicki P. (2021). Budżet obywatelski jako element partycypacji społecznej. *Studia z Polityki Publicznej* 8, 1–29, (in Polish).
- [42] Dąbrowska M. (2022). Aktywność społeczna w kształtowaniu budżetu obywatelskiego. *MAZOWSZE Studia Regionalne* 40(40) (in Polish).
- [43] Burrows A.A., (1960). Acoustic Noise, An Informational Definition. *Human Factors*, 2(3), 163–168.
- [44] European Commission (2022). Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002, relating to the assessment and management of environmental noise. *Official Journal of the European Communities*, 189(25).
- [45] Kaźmierczak J., Lipowczan A., Batko W. (2006). GIS-class systems of spatial information as the base for creating strategic acoustic maps of urban areas. *Archives of Acoustics* 31(4), (Supplement), 261–274.
- [46] Kazmierczak J., Lipowczan A. (2005). GIS-based system for acoustic mapping of urban areas: Introduction of the research project. In: *Proceedings of the 12th International Congress on Sound and Vibration 2005, ICSV 2005, Lisbon, Portugal*. paper 465(4), 3393–3400.

- [47] Kaźmierczak J., (2011). Network-based system for supporting administrators of strategic acoustic maps of urban areas. In: Proceedings of the 18th International Congress on Sound and Vibration 2011, Rio de Janeiro, Brasil. 4, 2639–2644.
- [48] Kaźmierczak J., (2012). Research on supporting administrators of acoustics maps of urban areas. In: Proceedings of the European Conference on Noise Control, Prague, Czech Republic, 370–375.
- [49] Kaźmierczak J., Lipowczan A., Paszkowski (2020). How do the City Authorities in Poland evaluate the duty of creating and using the strategic acoustic maps due to the EU regulations? In: Proceedings of 28th International Congress on Sound and Vibrations. Singapore, 1–8.
- [50] Kaźmierczak J., Rożałowska B., Bartnicka J., Stecuła K., Paszkowski W., Kuboszek A. (2021). How do the City Authorities in Poland evaluate the duty of creating and using the strategic acoustic maps due to the EU regulations?, In: Proceedings of Euronoise 2021, Madeira, Portugal, 441–446.