

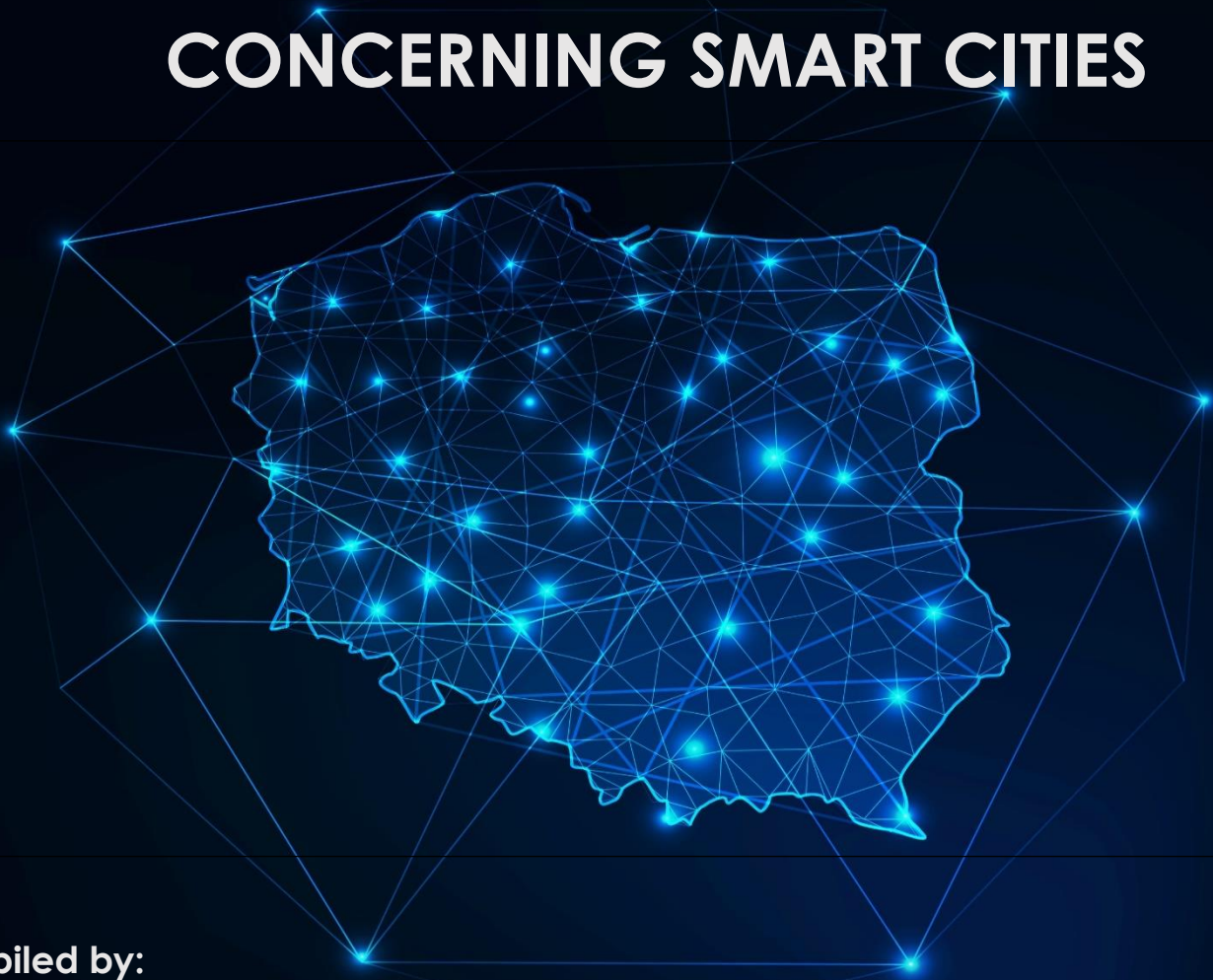


**Politechnika
Śląska**



**UCZELNIA
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INICJATYWA DOSKONAŁOŚCI
Ministerstwo Nauki
i Szkolnictwa Wyższego

REPORT ON POLISH NATIONAL RESEARCH CONCERNING SMART CITIES



Compiled by:

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Ladies and Gentlemen,

This report has been prepared on the basis of nationwide surveys conducted by a team of scientific research workers at the Faculty of Organization and Management of the Silesian University of Technology, including:

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We wish to pass on to you a study containing selected research results, asking you to contact the Faculty of Organization and Management of the Silesian University of Technology in case of specific questions.

We sincerely thank all Polish cities that wanted to complete our survey and for their time and contribution to the development of research on smart cities in Poland.

We likewise invite you to further joint initiatives and activities for the dissemination and implementation of the Smart City concept in Poland, in all of the areas we have described in this study.

Yours sincerely, the editors of the study:

Dr hab. Izabela Jonek-Kowalska, Professor
of the Silesian University of Technology
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What makes contemporary smart cities different?

The concept of a Smart City (SC) developed at the end of the 20th century. Currently, the interest in its implementation is steadily growing, as shown by the growing number of research and publications in this area, as well as the number of practical implementations of smart city solutions.

Initially, such solutions were provided to cities by entrepreneurs and investors, mainly from the IT industry (Smart City 1.0 model) without analysing the needs and expectations of other stakeholders in this regard, i.e. local government authorities and local communities. This has become the subject of criticism, but also the source of the formulation of the first idea of Smart City 2.0, in which the leader of S.C. local authorities become local authorities, and then the Smart City 3.0 idea, according to which residents actively participate in the processes of developing smart functions of urban space. Therefore, attention is firstly paid to the reversal of the relationship between business and local government, emphasising that the party reporting the need for smart city solutions should be local and regional authorities, not entrepreneurs and investors. Then, city residents are involved in the process of identifying the needs and expectations of cities, who should co-decide about the conditions in which they live.

The deteriorating condition of the natural environment made it necessary to supplement the SC concept with ecological issues. This is how a smart city has become a Sustainable Smart City.

Do Polish cities know the idea of a Smart City?

In 2019, a team of researchers from the Faculty of Organization and Management of the Silesian University of Technology conducted a survey among 280 Polish cities (representative sample). The research concerned six key areas for the development of modern 'Smart Cities':

- quality of life of the residents,

- urban logistics,
- city management,
- developing the awareness of urban communities,
- city ecology,
- evaluation of smart cities.

This report contains selected results and conclusions from the conducted analyses. It is also an invitation to research cooperation with the full set of city stakeholders: **city + business + science + local community + environmental organisations.**

The conducted research shows¹ that most Polish cities know the idea of a *Smart City* (Fig. 1), but only 1/3 is interested in obtaining the official status of an SC and only 28% plan to include this idea in the development strategy.

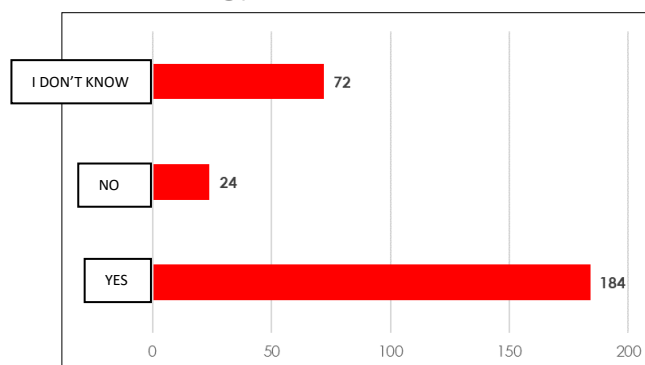


Fig. 1. Distribution of answers to the questions: *Are city authorities familiar with the Smart City concept?*

The implementation of smart city solutions primarily gained interest in large cities and those units whose economic situation is good or very good. However, it is worth emphasising that international analyses show that smart urban infrastructure is not only reserved for 'wealthy and large' cities. It also appears in active towns and villages, where the 'smart' status is an effective form of promotion and an expression of caring for the quality of life of the residents.

¹ The team examining the general conditions for the functioning of cities was composed of: Prof. dr hab. inż. Jan Kaźmierczak, Dr hab. Izabela Jonek-Kowalska, Professor of the Silesian University of Technology

Quality of life in smart cities

The main goal of designing and developing smart cities is a broadly understood improvement in the quality of life of residents, i.e. their general well being. The level of this well being is determined by a number of interdisciplinary conditions of urban life, which can be organised in accordance with the areas related to the holistic and sustainable development of cities. Therefore, they are determined by the following conditions:

- economic and business, securing the satisfaction of primary living and material needs,
- infrastructure, mainly housing and communal (electricity and heat supply systems; water and sewage systems; IT and ICT systems),
- social, mainly including health protection, social security and public safety, but also social relations and ways of spending free time),
- ecological, relating to, inter alia, the level of pollution, waste management, environmental protection and environmental education.

At the same time, it is worth emphasising that the ambition of smart cities is to improve the quality of life not only on an individual basis, but also, and perhaps above all in a collective aspect, relating to all members of the urban community, including such people as: the elderly, the sick, the disabled or those excluded for various reasons. In studies conducted at the Faculty of Organization and Management², the quality of life in cities was analysed in all of the above mentioned areas. The results of the analyses selected so far justify the conclusion that Polish cities face many challenges in terms of improving the quality of life of their residents. On a five point scale, where 1 meant very poor quality and 5 meant very good quality,



the dominant part of urban living conditions was assessed less than 3.5. Selected data in this regard is presented in Fig. 2.

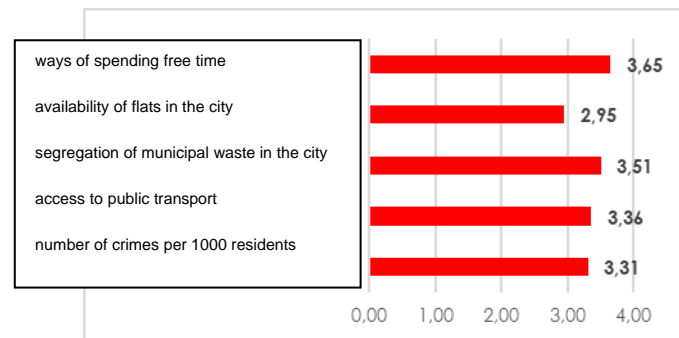
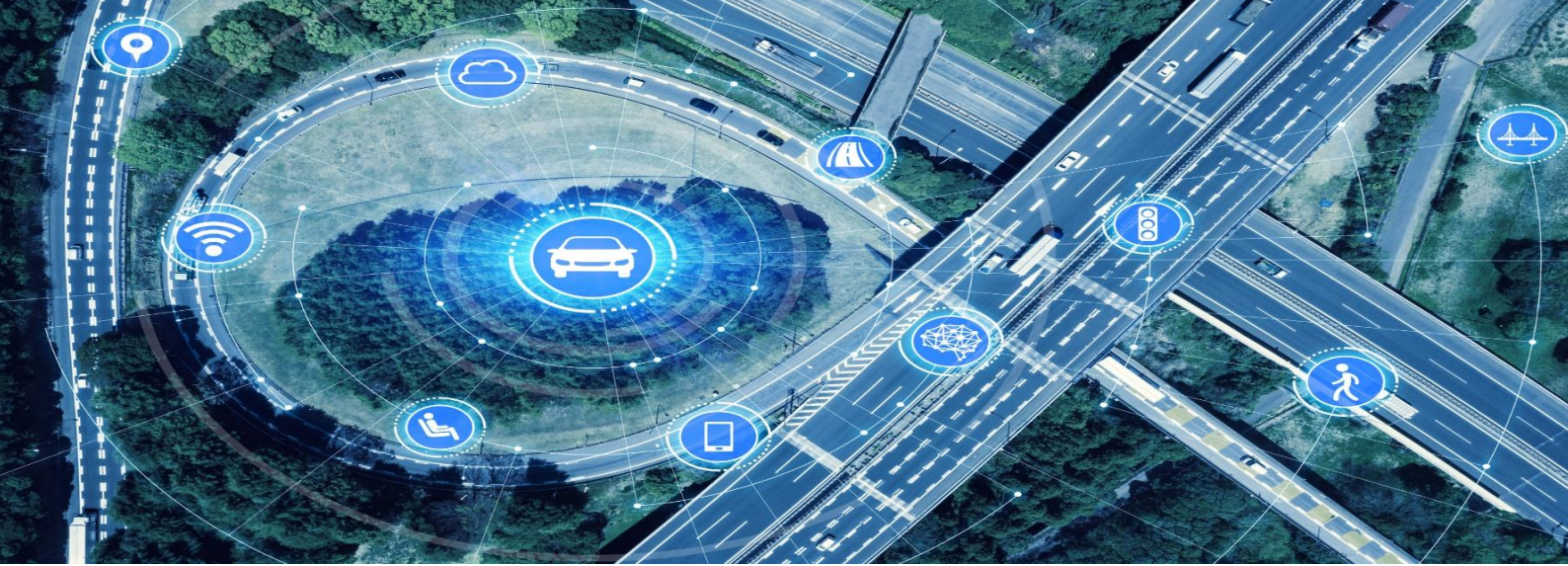


Fig. 2. Distribution of answers to the question about the assessment of selected components of the quality of life in the examined cities

Infrastructure (housing and public transport) and social conditions (public safety) were assessed very badly. The ecological conditions and the ways of spending free time were assessed a little better, but the scores were still less than good. Therefore, it can be concluded that in Polish cities, even large ones that are in good economic condition, it is first of all necessary to improve the quality of life in the context of the availability of housing and road infrastructure. Satisfying the needs in this respect at a satisfactory level may only be the starting point for the implementation of more advanced, smart urban solutions.

² The team researching the quality of life was composed of: Prof. dr hab. inż. Radosław Wolniak and Dr hab. Izabela Jonek-Kowalska, Professor of the Silesian University of Technology



Urban logistics

Bearing in mind the above mentioned importance of transport infrastructure and mobility in shaping the quality of life of residents, one of the most extensive research areas was urban logistics related to the flow of resources (material and human) and information within the city. The aim of activities undertaken in this area is effective and efficient control of the indicated flows towards sustainable satisfaction of the needs of all stakeholders of the city. According to the definition of the *Council of Logistics Management (CLM)*, it includes planning, organising and controlling flows: initiated outside the city, originating in the city, passing through the city and carried out inside the city.

A significant part of the questions contained in the faculty survey was devoted to the assessment of the advancement of smart logistics urban solutions relating to the above mentioned flows³. And so, in the case of smart traffic control systems - a fairly well known and recognisable solution - only 26 out of 280 Polish cities declared the use of such a system (Fig. 3). More than a half stated that they do not plan to implement such solutions.

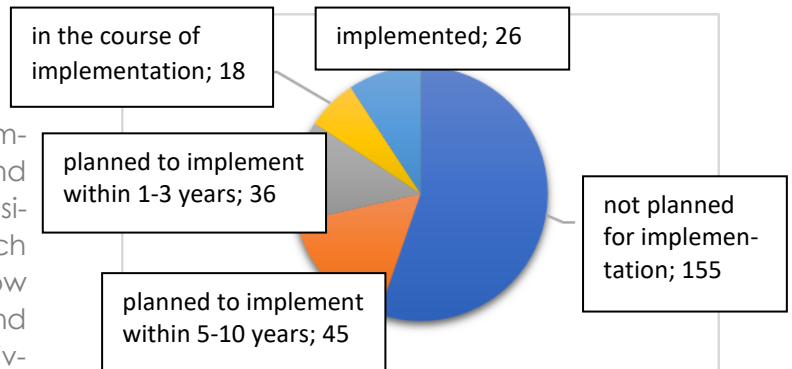


Fig. 3. Distribution of answers to the question about the state of implementation of smart traffic control systems

Even fewer, because only 13 analysed cities implemented smart solutions for excluded people (Fig. 4). However, there are many more plans to take action in this regard in the future.

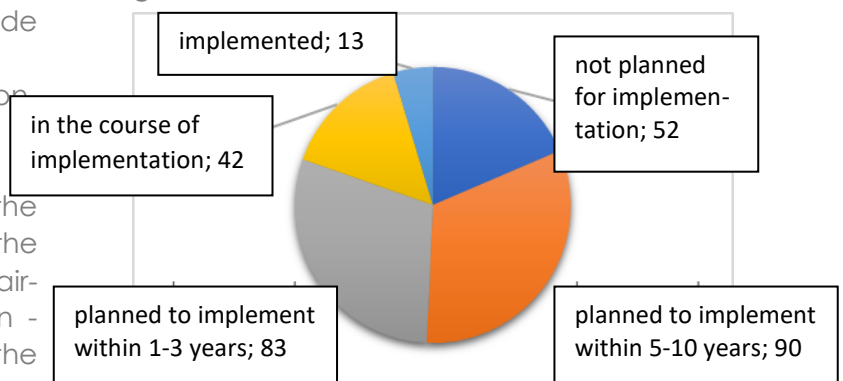


Fig. 4. Distribution of answers to the question about the state of implementation of smart logistics solutions for excluded people (the elderly, the disabled)

³ The team researching city logistics was composed of: Dr hab. inż. Marzena Kramarz, Professor of the Silesian University of Technology, Dr hab. inż. Katarzyna Wybieralska, Professor of the Silesian University of Technology and, Dr inż. Edyta Przybylska.



Technical systems and noise pollution in smart cities

Providing a high level of public services is undoubtedly the advantages of every smart city. From a technical point of view, the quality of the services provided depends on the condition of the municipal infrastructure, which should be characterised by adequate efficiency and reliability, therefore it is important to acquire, collect and manage information to support the implementation of the commune's own tasks in terms of:

- identification of problems related to the operation of urban infrastructure,
- monitoring its condition and the effective response to removing faults with technical systems,
- maintenance and forecasting of operational readiness of network technical systems (water, sewage, gas, heating, energy),
- improving the quality of public services provided by means of urban infrastructure,
- cost optimisation in the field of utilities supply and operation of network technical systems,
- the assessment and prediction of noise pollutions risk in an urbanised environment.

Modern digital technologies in conjunction with appropriate model solutions enable effective support of the above mentioned tasks. The advantage of digital technology application solutions is supporting decision making both in the short and long term.



Therefore, the acquisition, collection, processing and sharing of digital information in creating smart solutions becomes crucial⁴.

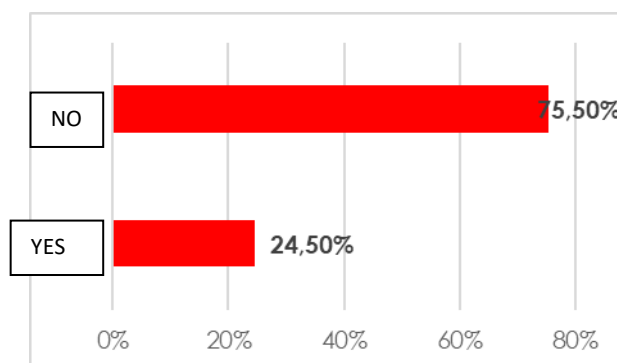


Fig. 5. Distribution of answers to the question about the availability of digital information, taking into account the location and operation status of network technical systems for quick removal of faults

Fig. 5 shows that in the case of 24.5% of the examined cities, there is a problem with the availability of digital information for the purpose of removing faults in municipal network technical systems. It mainly concerns water and sewage networks, which implies the need to improve the availability of digital information in order to increase the efficiency and reliability of the functioning of these networks.

The research also shows that over 6% of the surveyed cities consider noise pollution to be the basic problem diminishing the quality of life of its residents. This means that despite many actions undertaken in recent years in this area, it is still an important challenge that requires effective and durable infrastructure solutions, including: construction of roads with 'quiet' surfaces, designing noise barriers taking into account the subjective assessments of noise from residents or designing noise friendly modern housing estates.

⁴ The team researching technical systems and noise pollution in an SC was composed of: Dr inż. Waldemar Paszkowski.



Society in a smart city

One of the key postulates of sustainable development of smart cities is taking into account the needs of the urban community in the process of planning and implementing smart city solutions. At the same time, the participatory approach to all members of this community, including, and perhaps above all, the sick, the disabled and the elderly is extremely important in this case. In smart cities of the highest generation (so-called SC 3.0), urban communities co-create and share smart solutions through participatory budgets, sharing economy, open data systems, as well as through dialogue and mediation with city authorities and other city stakeholders.

Bearing in mind the above guidelines, the questionnaire survey prepared at the Faculty of Organization and Management of the Silesian University of Technology includes the question about the manner and scope of participation of the city's residents in deciding on its development⁵. The distribution of answers to this question is presented in Fig. 6. The obtained data shows that a significant part of cities consult with their residents on some or all strategic decisions, such as: creating a city development strategy, development plans, development policy or key investments in smart city infrastructure. Participation in strategic decisions takes place in the form of public consultations or a referendum. It is also worth emphasising that only in 4 cities, no decisions are consulted with the local community. The obtained results show the understand-

ing of the role of residents in creating the city's development.

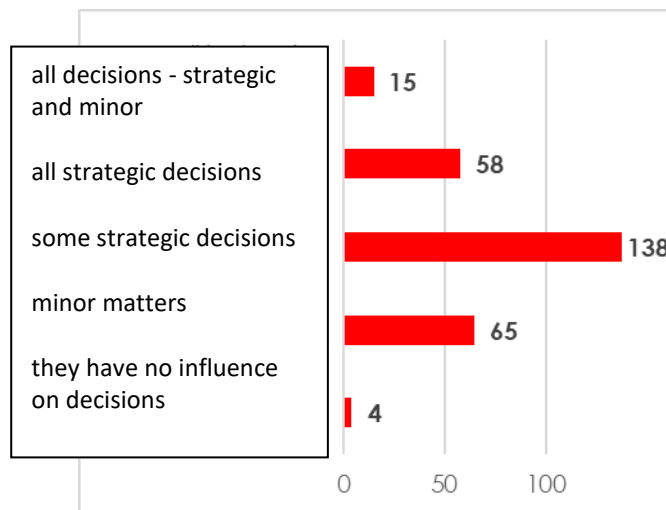


Fig. 6. Distribution of answers to the question about the scope of residents' influence on decisions made by city authorities

The above conclusion is also confirmed by the fact that over 30% of the surveyed cities conduct research on the quality of life, and over 17% monitor the level of trust of the local community towards municipal authorities. The aforementioned values are perhaps not too high, but allow, at least partially, to positively assess the scope of residents' participation in co-creating and assessing living conditions in Polish cities. It should also be clearly emphasised that only an approach that takes into account the needs of the urban community can guarantee the harmonious development of the city and the expected improvement in the quality of life of all its stakeholders.

⁵ The team researching the social aspects of an SC was composed of: Dr hab. Aleksandra Kuzior, Professor of the Silesian University of Technology, Dr hab. Grażyna Osika, Professor of the Silesian University of Technology and Dr Barbara Rożałowska.

Management in smart cities

Creating smart sustainable cities requires proper and effective planning and coordination of activities in all areas defining the limits of its functioning. This task rests with the city authorities, to whom theory and practice assign a leading role in the process of managing technical and social urban infrastructure. It is particularly important for the development of modern cities due to the empirically proven benefits of implementing smart city solutions, which include, among others:

- more dynamic economic growth,
- increase in the efficiency of public services,
- improvement in the quality of life of residents,
- greater social and environmental sustainability.

Research also shows that in developing countries, the creation of smart cities has a positive impact on the national economy, which results in: employment growth, new foreign investments and an increase in the availability and use of state-of-the-art technologies.

Bearing in mind the importance of management issues in the functioning of Polish cities, a significant part of the research conducted by the Faculty of Organization and Management was devoted to these issues. The described survey focuses on two key aspects of smart city management, which are: (1) creating a city development strategy and (2) creating conditions for the emergence of innovative technologies⁶. The conducted research shows (Tab. 1) that almost half of the examined cities define ways to support local innovative technology enterprises at the strategy level.

⁶ The team researching the management aspects of SC was composed of: Dr hab. inż. Piotr Kułyk, Professor of the Silesian University of Technology and Dr inż. Mirosław Matusek.



Nevertheless, only 14% of respondents offer entrepreneurs organisational support in the form of a separate organisational unit acting for innovation. And only 9% propose budgetary financial support necessary for the implementation of ambitious business ventures.

Table 1. Distribution of answers to the question about how to implement the support strategy for local innovative technology enterprises

Method of support	Number of indications	Percentage of indications
inclusion in the city development strategy	134	48%
having a separate strategy	16	6%
functioning of a separate organisational unit in the city hall	40	14%
allocating dedicated funds in the city budget	24	9%
carrying out continuous monitoring based on the developed system of strategic measures	6	2%
Others, which:	5	2%

The obtained results prove the awareness and scope of planning support for the development of innovative technologies, but it seems that the strategic planning phase does not ultimately translate into operational activities, and consequently into actual economic results. This may constitute a serious barrier to the development of technological entrepreneurship and the implementation of modern solutions in cities, and may hinder those cities from applying for the status of a 'smart city'.



Environmental protection in smart cities

Currently, one of the key priorities in the development of smart cities is care for the natural environment, which not only manifests itself in ongoing activities to monitor and prevent pollution of the urban environment, but also in long-term initiatives that are to guarantee future generations the possibility of using smart urban infrastructure. Such actions undoubtedly include:

- reducing low emissions through the implementation and financing of renewable energy sources,
- supporting eco-mobility,
- inspiring eco-innovation,
- implementing the principles of the circular economy.

Environmental education of city residents is equally important, as only a collective effort by the city authorities and its residents can significantly improve the environmental conditions and quality of life in the city.

The topic of environmental protection was a separate part of the conducted survey research⁷. Among the questions posed in this regard was a request to indicate barriers to the implementation of smart solutions in the field of environmental protection (Fig. 7).

The most serious of them concern the high costs of implementing the solutions in question and the lack of financial incentives for their implementation. A significant problem is also the lack of awareness of the residents about the benefits of such implementations.

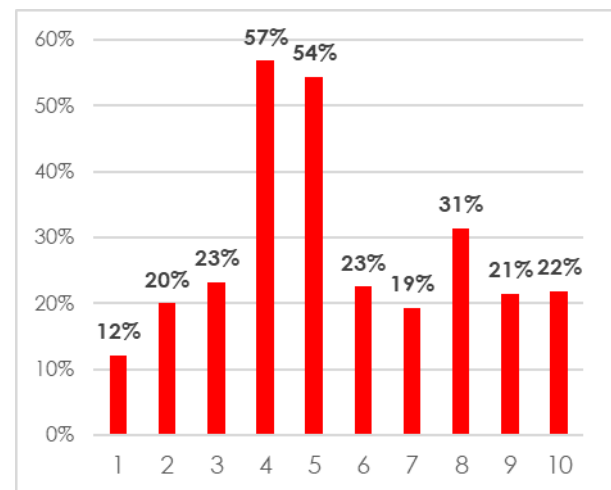


Fig. 7. Distribution of answers to the question about the barriers to implementing smart solutions in the field of environmental protection(1: lack of these solutions in city strategies; 2: necessary cooperation of many entities; 3: lack of legal provisions regulating the multifaceted nature of smart solutions; 4: high implementation costs; 5: no financial incentives ; 6: passing costs on to users; 7: lack of good practice; 8: lack of awareness of benefits among residents; 9: residents' fear of interfering with the private sphere; 10: resistance to change)

⁷ The team researching the aspects of SC environmental protection was composed of: Dr Jolanta Ignac-Nowicka, Dr inż. Agnieszka Janik, Dr inż. Adam Ryszko and Dr inż. Marek Szafraniec.





Analytics and evaluation of smart cities

In connection with the development of the concept of smart cities in the world, the process of collecting data and developing indicators and information describing this development has started. Over time, they have become the basis for regional and international comparisons of cities, including, in particular, the level of their advancement in the implementation of smart urban solutions. These comparisons increasingly take the form of standardised compilations and publicly available rankings. Their popularisation becomes a form of promoting the city and creating its image on a large scale.

The circumstances indicated above causes an increase in the information needs of cities. Their satisfaction is necessary to conduct holistic analytics and evaluation of the city in the following dimensions: technological, economic, social and environmental. It is also a necessary condition to be included in national and international rankings, the fulfilment of which is worth striving for for image reasons.

The above mentioned issues constituted one of the areas of the research survey. They show that only 18% of cities would like to undergo a comprehensive assessment (Fig. 8).

Moreover, only 15% are assessed as 'smart' in terms of self-evaluation (Fig. 9).⁸

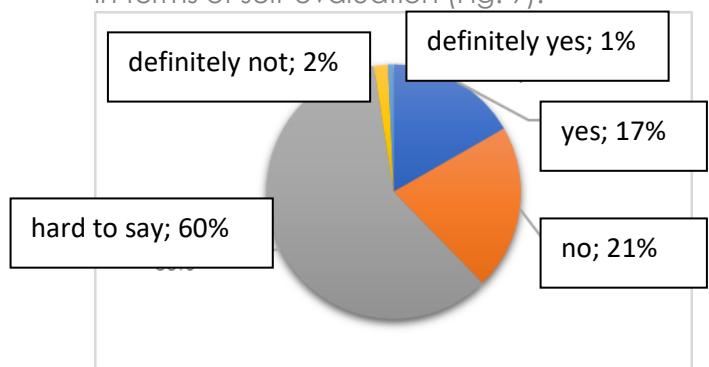


Fig. 8. Distribution of answers to the question about the need to conduct an evaluation in terms of being 'smart'

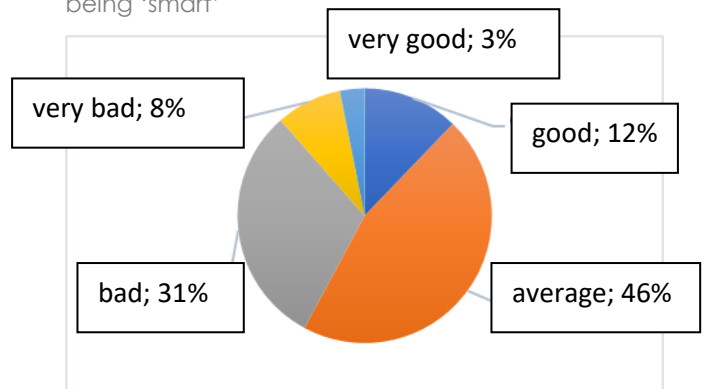


Fig. 9. Distribution of answers to the question about the evaluation in terms of being 'smart' in the evaluation area

The identified evaluation gaps not only indicate the deficiencies of cities in striving to be 'smart', but may also constitute a difficulty in assessing the results of strategic and operational activities.

⁸ The team researching the analytical aspects of an SC was composed of: Dr inż. Tomasz Owczarek, Dr Adam Sojda and Dr inż. Maciej Wolny.

A CALL TO JOINTLY CREATE SMART CITIES IN POLAND

Offer of cooperation:

- research on the quality of life of residents,
- development of city development strategies and plans,
- preparation of entrepreneurship and eco-innovation support programmes,
- eco-efficiency assessment,
- environmental education,
- urban regeneration planning,
- research on technical network systems,
- noise pollution assessment and prediction,
- public opinion polls,
- identifying and planning directions for social participation,
- assessment of the financial condition and profitability of investment projects,
- city analytics, city evaluation at national and international level.

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