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OPEN DATA AS A FUNDAMENTAL ELEMENT OF THE DEVELOPMENT OF THE SMART CITY

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Purpose: To determine the state of access to and reuse of public data in Poland, including identifying the reasons for the current level of data access and forecasting for the near future.
Design/methodology/approach: In-depth analysis of secondary data based on reports prepared by "The Expert Team of the Department of Data Management at the Chancellery of the Prime Minister", regarding the reuse of public data in Poland.
Findings: In the year of the implementation of the Act on Open Data and Reuse of Public Sector Information (2022), a significant majority of cities and local government units (JST) do not make their data publicly available in accordance with the law or in any other way (around 60% in cities and over 80% in JST). The main reasons (in addition to lack of finances, tools, knowledge, demand, and employee competence) are the non-restrictive nature of the law, which makes open public data a matter of goodwill rather than an obligation, and even encourages offices to adopt a passive approach. In the near future (within a year), the number of units that provide data on the Dane.gov.pl portal should increase from the current level of nearly one-tenth to one-fourth.
Research limitations/implications: A pattern emerges that the larger the population managed by government units, the more frequently public open data are made available and the greater the quantity of such data. However, the report based on the research of local government units (JST) does not take into account differences related to the population size, as it is the case in the report on city research. Therefore, a research gap becomes apparent, which can be addressed in future studies.
Practical implications: Increasing the level of open data sharing by government offices will contribute to the development of the "smart city" concept.
Social implications: The widespread sharing of open data can bring numerous benefits to society, including increased transparency, civic participation, innovation, improved quality of life, and enhanced collaboration among various stakeholders, such as the public, private, and academic sectors.
Originality/value: Detection of shortcomings in the practice of open data sharing, highlighting the need for education, better legal regulation, and collaboration with research institutions. Also pointing out the potential for increased data sharing and the necessity of providing adequate resources and support, such as training and IT personnel, to effectively meet the requirements associated with open data sharing.

Keywords: management, open data, smart city.

Category of the paper: Research paper.

1. Introduction

In order to increase efficiency and improve the quality of life for residents, many cities are now focusing on the development towards smart cities, utilizing modern technologies and data analysis. One of the key elements in this process is open data from public administration, which enables a more precise and comprehensive approach to urban development.

Open data refers to publicly available information that can be used by anyone without restrictions, creating a foundation for innovative solutions. In the context of smart cities, open data from public administration enables a detailed analysis of residents' needs and identification of areas that require improvement. As a result, cities can manage more efficiently by delivering public services that are better tailored to the needs of the residents.

Open data are also crucial in the context of developing new technological solutions. Access to public data allows for a better understanding of how a city functions, thus enabling the creation of more precise tools and applications that can help solve various problems.

An example of this can be seen in the development of transportation systems based on the analysis of traffic data or the optimization of energy processes through precise monitoring of energy consumption. Another way in which open data can contribute to the development of a smart city is by improving sustainable urban development (Tura, Ojanen, 2022). Access to information about air pollution, noise levels, water quality, or chemical composition of soil can aid in taking actions to protect the environment and residents' health. For instance, if data indicates that a specific neighborhood has high air pollution levels, city authorities can implement measures such as increasing the number of trees, establishing car-free zones, or promoting public transportation to reduce emissions of pollutants (Sa´nchez-Corcuera et al., 2019, p. 9).

It is worth noting that open data brings benefits not only to the public sector but also to private companies and investors. Access to data allows for a better understanding of the needs and preferences of residents, enabling the creation of more tailored products and services. Open data also encourages investment in the city, which positively impacts its sustainable economic development (Manimuthu, Dharshini, 2020, p. 1).

In Poland, since August 2021, the Open Data Act has been in effect, imposing an obligation on public administration entities to provide data on the Dane.gov.pl platform dynamically and through APIs. This is a milestone in the development of open data in Poland, which will help utilize them for building smart cities (Dz.U. 2021, poz. 1641).

The wide availability of open data by public administration entities in one place (Dane.gov.pl platform) is essential for the development of smart cities. By accessing information about the city's functioning, specialists can create applications and tools that contribute to improving the city's operations and the quality of life for its residents. An example

of such an application could be one that utilizes data on traffic congestion to optimize routes for drivers, thus saving time and reducing air pollution.

It is also important for data sharing to be dynamic, which means that the data are updated in real-time. This allows specialists and programmers to have access to the latest information, enabling faster and more precise action. Additionally, it is crucial to provide data through an Application Programming Interface (API), which makes the data adaptable and compatible, facilitating easier usage by programmers and, in turn, more efficient utilization for the development of smart cities.

However, the level of commitment by public administration units to providing so-called open data may vary. Therefore, the aim of this study is to determine the actual state of affairs in this matter, as well as to identify its causes and possible measures to support the "open data" process. To achieve these research objectives, secondary data analysis was conducted using reports prepared by the "Expert Team of the Data Management Department of the Chancellery of the Prime Minister" on the reuse of public data in Poland (Dane.gov.pl/..., 2020-2022).

2. What are open data?

Open data are data that can be freely used, reused, and distributed by anyone, as long as the sources are properly attributed and the data are shared under the principle of "share and govern". The data must be available in their entirety and should not exceed reasonable reproduction costs, preferably in a convenient and modifiable format. Additionally, the data must be provided on terms that allow for their reuse and redistribution, including mixing with other data sets. No one should be discriminated against based on fields of activity or individuals or groups. Examples of open data can include government statistics, weather data, or financial information. It is important to be clear about the definition of open data to ensure interoperability, which refers to the ability of different systems and organizations to collaborate and combine different data sets to develop more advanced products and services. Focusing on the provision of non-personal data, which does not contain information about specific individuals, is crucial. However, some types of government data may be subject to restrictions related to national security (Open Data Handbook).

In Poland, open data are collected and provided by various institutions and organizations, both public and private. The most important ones are:

1. The Republic of Poland's Service - https://dane.gov.pl/en
2. Central Statistical Office - https://stat.gov.pl/en
3. National Digital Archives - https://www.nac.gov.pl/en
4. Public Information Bulletin - https://www.gov.pl/web/en/public-information-bulletin
5. Spatial Information Infrastructure Geoportal - https://www.geoportal.gov.pl/en

When it comes to data provided by the Central Statistical Office (GUS), Poland holds a very high position in the Open Data Inventory (ODIN) ranking in terms of open data availability. In 2022, Poland once again ranked 2nd in the world out of 192 countries. This ranking takes into account the availability and openness of data published by national statistical offices. Poland received an overall score of 87 points, which was 2 points higher than GUS's score in 2020. Poland achieved the highest score in the world in terms of the thematic coverage of published data (81 points) and moved up from 8th to 4th position in terms of data openness level (92 points). Poland has been recognized as a leader among Eastern European countries in both categories. The top performers in the ranking were Singapore (90.0 points), Poland (87.0 points), and Denmark (86.3 points). The ODIN ranking reflects the scale of data availability and the level of openness of the data published by the national statistical office (GUS, 2023).

3. Legislation on open data of public administration in Poland

EU legislation requires the provision of open data in member states. The Directive Of The European Parliament And Of The Council 2003/98/EC was the first (although there were earlier regulations concerning the re-use of public sector information - 90/313/EEC of 7 June 1990 and 92/100/EEC of 19 November 1992) EU directive aimed at implementing uniform and consistent principles for the re-use of public sector information in all member states (Directive Of The EP And Of The Council, 2003/98/EC).

In 2013, the EU Council adopted a directive on the re-use of public sector information, which imposes an obligation on member states to provide and re-use public sector information. This directive establishes principles for the dissemination of public sector data, including the principle that such data should be available free of charge or at a low cost to facilitate their re-use by external entities. Additionally, the directive sets standards for data quality, formats, and dissemination procedures to facilitate the re-use of such data (Directive Of The EP And Of The Council, 2013/37/EU).

In 2019, the EU Council adopted the latest directive on open data and the re-use of public sector information, which replaces the previous directive from 2013 and introduces more stringent standards regarding the openness and re-use of public sector data (Directive Of The EP And Of The Council, 2019/1024/EU).

In Poland, the process of creating laws regulating the provision and reprocessing of data in the public sector has been ongoing since the 1990s. For example, the "Code of Practices for Accessible Intranet Offices" or the "Code of Practice of the Tax Office" were established.

In 2001, a law was passed regulating the right to access public information and the principles of providing public documents (Journal of Laws of 2001, No. 112, item 1198).

Subsequently, in 2002, a law was enacted on the principles of providing services electronically by public authorities and private entities (Journal of Laws of 2002, No. 144, item 1204).

In 2005, the Act on the Computerization of the Activities of Entities Implementing Public Tasks was passed, which, among other things, imposed an obligation on these entities to provide public information in electronic form and establish a Public Information Bulletin (Journal of Laws of 2005, No. 64, item 565).

In 2011, the Parliament adopted the Act on the Reuse of Public Information, which aimed to facilitate access to public information and increase its use. This law introduced, among other things, the obligation to provide public information in electronic form and defined the principles of public data sharing (Journal of Laws of 2011, No. 204, item 1195).

In 2016, the Parliament adopted the Act on the Computerization of Activities of Entities Implementing Public Tasks, which aimed to streamline the operations of public institutions through the use of modern information technology. This law introduced, among other things, the obligation to provide public data through Application Programming Interfaces (APIs) (Journal of Laws of 2016, item 352).

In 2018, the Parliament adopted the Act on the Reuse of Public Sector Information, which aimed to standardize and streamline the rules for the provision and reuse of public data in Poland. This law introduced, among other things, the obligation to provide data in an open format, allowing for easy processing and analysis. The law also established principles regarding fees for data provision and defined requirements for the protection of privacy and personal data in the context of public data sharing (Journal of Laws of 2018, item 1243).

In 2019, in Poland, the Act amending the Act on the Computerization of Activities of Entities Implementing Public Tasks and certain other acts was passed. This law introduced new provisions regarding the provision of public data. According to the law, public data are to be made available free of charge, in an open format, and in a manner that allows for their reuse, including for commercial purposes. The law also introduced the obligation for public entities to create and make available a register of public data and mandated entities to provide data in a bulk manner, such as through the provision of APIs (Journal of Laws of 2019, item 1446).

In 2021, another law was passed (the most recent and currently in force) - the Act on the Reuse of Public Sector Information (ISP). This is a law that implements EU regulations on open data in Poland. This law defines the principles of providing and reusing public data and requires public entities to create data sharing plans. The law also introduces an obligation for public entities to publish information about data that is not available in an open format, along with an explanation of why this is the case. Additionally, the law introduces new penalties for violations of provisions regarding the provision and reuse of public data, such as financial penalties or contractual penalties (Journal of Laws of 2021, item 1641).

All these laws aimed to facilitate access to public information and increase the use of public data, which is an important step towards improving the quality of life for citizens and fostering knowledge-based economic development.

4. The method of providing open data on the website of the Polish government administration (https://dane.gov.pl/pl)

The main platform for presenting and providing open data from administrative units in our country (Local Government Units - LGUs) is the Polish Republic Service (portal: Dane.gov.pl).

Data are made available here statically, in the form of interactive tables, charts, and maps. Users can browse through the available datasets, search for relevant information, and download them in various formats (such as CSV, XLS, or JSON) without any charges or licensing restrictions. This means that anyone can access and utilize the data in their projects.

The website also enables dynamic data sharing through the use of an Application Programming Interface (API). An API is a set of rules, protocols, and tools that allow programs to communicate with each other and exchange data. It allows developers to create applications that can utilize the functionalities of existing systems or services (API Standard, www.gov.pl/...).

API allows, for example, sending queries and retrieving data from web services, enabling the use of that data in applications or websites. With APIs, developers can also integrate their applications with other systems, such as social platforms, online payments, or map services (Jacobson, Woods, Brail, 2015).

API is crucial in today's times as it enables the creation of more advanced and complex applications that utilize various data sources (often stored in the cloud - Big Data in the Cloud - BIC) and services. This allows users to access the required information more easily and quickly and make use of various online services (Manimuthu et al., 2021).

5. The idea of a smart city

In Polish, the main translations used are the direct ones, such as „intelligent city" or „wise" as well as the English adjective „smart" (Gotlib, Olszewski, 2016; Stawasz, Sikora-Fernandez, 2015). Research conducted in the United Kingdom showed that only 4% of the surveyed residents could name a local initiative that meets the smart city standards (Ryba, 2017). The word „smart" in the context of devices is translated as „ intelligent" but the concept of a smart city is not limited solely to the technological aspect (Kaur, Maheshwari, 2016,

pp. 1-5). Using the original English adjective is justified because it is already widely used and has a chance to become part of the Polish language.

Considering the above, I propose translating the definition of a smart city into Polish as „A city tailored to fit" (a city tailored to fit), as the solutions applied in it should be like a suit made for an individual, as not all IT, technical, and technological solutions are necessary or feasible for a given city, and their suitability will vary (ChuanTao et al., 2015, p. 4).

The concept of a smart city emerged in the early 21st century, but the idea of intelligent cities integrated with modern technologies has been gradually developing over many years. The first attempts to create smart cities appeared in the 1980s and 1990s, but they were mainly experimental projects rather than comprehensive concepts of future cities. The term "Smart City" began to emerge in the early 21st century, and the concept gained popularity with the advancement of information and communication technologies and the growing demand for solutions that enhance the quality of life in cities (Pięta-Kanurska, 2019, pp. 59-70).

Smart city is a developing concept that attracts more researchers worldwide, including in Poland. In cities, especially in Barcelona, Vienna, and Copenhagen, there is a growing number of projects implemented under the banner of "smart." Traditionally, Smart City involves the integration of the latest information technologies into urban spaces to improve the quality of life for city residents. However, this concept also relies on IT solutions (Information Technology) tailored to the specific needs of each city, which help make more efficient real-time decisions for city users.

According to T. Nam and T.A. Pardo, a smart city is a city that utilizes information to improve its physical infrastructure. As a result, the city becomes more mobile, efficient, and energy-saving, while also improving air and water quality. Additionally, the city has the ability to quickly identify and address issues and effectively utilize resources (Nam, Pardo, 2011).

Within the concept of smart city, increasing importance is placed on the development of smart people and smart governance. Both of these elements are equally important as technological advancements because technology alone is not sufficient to achieve a higher quality of life in cities and address disparities.

Currently, a relational approach to smart city is being promoted, where city residents participate in the city management process, particularly in decision-making and implementing smart projects. The goal of smart city is to manage a city where the relationships between local government, IT providers, academia, and city residents are crucial (Pięta-Kanurska, 2019, p. 59).

A. Meijer writes about four perspectives in smart city governance: governing the smart city, making smart decisions, smart administration, and smart urban collaboration (Meijer, Bolivar, 2016).

In summary, smart city governance is an approach to city management aimed at achieving sustainable development, well-being, and citizen engagement through various forms of social participation. Local governments should invest in city infrastructure such as sanitation,

electrical systems, public transportation, and other components to achieve social inclusion of residents. The goals of smart governance should be specific to each city, depending on the needs and priorities of its residents. Creating a better environment for knowledge and innovation development, such as through open data sharing, is also an important aspect. Policies regarding data collection and sharing should consider principles of confidentiality, intellectual property rights, and personal data protection.

6. Open data in the service of smart city

Open data are essential elements of the smart city concept, enabling the efficient collection, analysis, and utilization of information about the city, accessible to all interested parties. This allows city residents to better understand how their environment functions and what problems need to be addressed (Jara, Genoud, Bocchi, 2014).

Various types of data are utilized in the development of smart cities, including data on traffic, air quality, energy consumption, water consumption, as well as data on public services such as public transportation, healthcare, and education. These data originate from various sources, such as sensors, traffic management systems, air quality monitoring systems, and Internet of Things (IoT) devices, such as smart energy meters and devices related to urban transportation (Azrour, Mabrouki, Guezzaz, Kanwal, 2021; Din, Guizani, Rodrigues, Hassan, Korotaev, 2019).

The sharing of this information and data also has a positive impact on citizen participation in the city management process, as it allows them to actively engage in decision-making and driving change. Openness of data also enables collaboration among different institutions, leading to better resource utilization and coordination of city-level actions. Implementing smart city projects based on open data contributes to better resource utilization, improved quality of life for residents, and more efficient city management (Nuaimi et al., 2015, p. 11).

7. Research Methodology

In this study, a secondary data analysis method was employed based on data from three reports prepared by the "Expert Team of the Data Management Department of the Chancellery of the Prime Minister" on the topic of reusing public data in Poland (Dane.gov.pl/..., 2020-2022).

Report No. 1: A survey report on the provision of dynamic data by cities through application programming interfaces (APIs) - (the survey was conducted in 2021 before the implementation of the Act on Open Data and Reuse of Public Sector Information - Journal of Laws No. 1641). The aim was to analyze the extent to which Polish cities provide dynamic data through application programming interfaces (APIs). Questions were sent to 108 cities with a population of over 40,000 to determine how many of them provide data through APIs. 84 cities responded to these questions, indicating that the study was conducted at a level of 77.77%.

Distribution of the research sample by city size:

- Cities with 40,000 to 49,999 inhabitants - 21.4%.
- Cities with 50,000 to 99,999 inhabitants - 42.9%.
- Cities with 100,000 to 299,999 inhabitants - 27.4%.
- Cities with 300,000 or more inhabitants - 8.3%.

Report No. 2: Experiences of Local Government Units (LGUs) in data provision and utilization - a report on a study conducted in Local Government Units (carried out from October 3 to November 10, 2022, i.e., after the implementation of the Act). The aim of the study was to assess the level of advancement in the process of opening data in local government units at the level of district offices and provincial assemblies.

For the online survey (by posting the questionnaire in the attachment), 330 units (314 districts - excluding cities with county rights - and 16 provincial assemblies) were invited, and responses were obtained from 96 units (90 districts and 6 provincial assemblies), resulting in a research completion rate of 29.09%.

Report No. 3: Evaluation of the Dane.gov.pl portal - a report on a study conducted among users of this portal. The online survey was conducted from May 22, 2020, to January 18, 2022. The questionnaire, which was placed on the Dane.gov.pl portal, was completed by 384 users.

These research reports are presented to identify and describe the actions taken in the area of providing and reusing public data in Poland. Furthermore, the aim of this study is to compare the states before and after the implementation of the „Act of August 11, 2021, on Open Data and Reuse of Public Sector Information", as well as to determine the size of the market and trends and preferences of users of the Dane.gov.pl portal.

8. In-depth research analysis of Reports No. 1, 2, and 3

8.1. Status of open data sharing by Polish cities through API (Report No. 1, 2021)

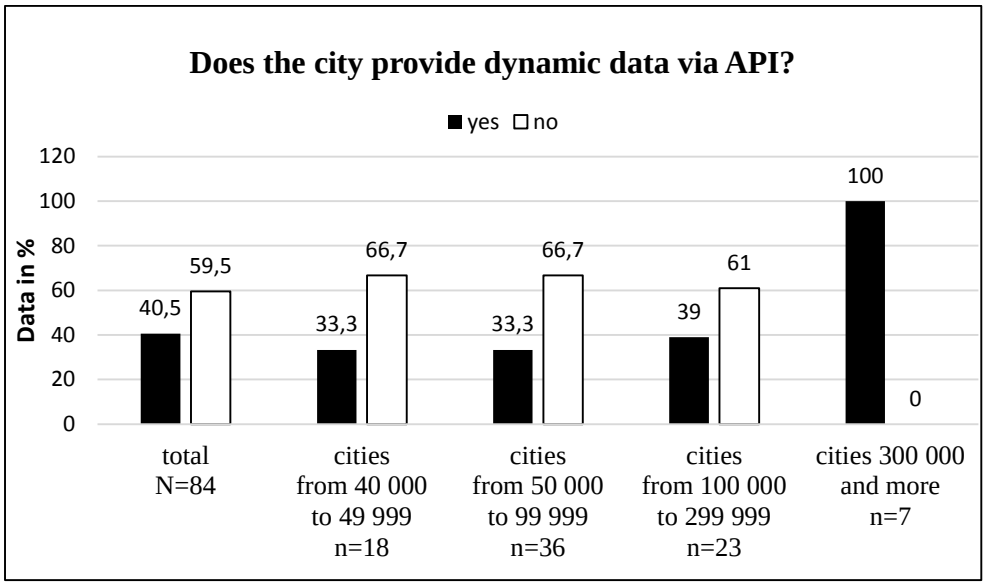

Figure 1. Scale of dynamic data sharing in the examined cities.

Source: Report No. 1 (2021).

A significantly higher number of examined cities (59.5%, or 50 cities) state that they do not share dynamic data via API compared to cities that do (40.5%, or 34 cities). The analysis of the results, taking into account the size of the examined units, shows that larger cities (with a population above 100,000) are more likely to share data through API than smaller cities (with a population below 100,000). Among the nine largest cities in Poland (with a population above 300,000), seven of them responded to the survey questions and all of them declared sharing dynamic data via API. In the group of cities with a population from 100,000 to 299,999, 39% of the examined units share data (9 cities). In cities with a population from 50,000 to 99,999 and from 40,000 to 49,999, 33.3% of the examined cities in each category declared data sharing, which corresponds to 12 cities in the first group and 6 cities in the second group.

When it comes to the shared thematic scope, the respondents primarily indicated the categories listed in Table 1 in descending order of overall indications.

Table 1.
The number of datasets shared by cities, divided into thematic categories of dynamic data shared via API - overall and by city size (data in numbers)

The surveyed entities could indicate more than one category of data, and within each category, more than one dataset	**cities providing data - overall**	**cities from 40,000 to 49,999**	**cities from 50,000 to 99,999**	**cities from 100,000 to 299,999**	**cities 300,000 and above**
	n=34	**n=6**	**n=12**	**n=9**	**n=7**
data regarding public transportation	**17**	2	4	3	8
data concerning air quality	**10**	3	3	2	2
data regarding address points	**10**	2	5	2	1
data concerning local spatial development plans	**9**		4	1	4
geodetic and cartographic data	**9**	1	2	5	1
environmental data	**8**	4	3		1
map services	**6**		1	2	3
tourism and recreation data	**6**	2	2		2
parking system data	**5**	1		1	3
meteorological data	**5**	1	1	1	2
election data	**5**	1	3		1
data on registers maintained by the city office	**4**		1	2	1
data on the availability of city bikes	**3**	1			2
real estate data	**3**	1		1	1
school district data	**3**	1	1		1
municipal services implementation data	**3**	2	1		
data on city events	**2**			1	1
data on city interventions	**2**			1	1
transportation and traffic data	**2**		1	1	
data from municipal library catalogs	**2**		2		
data from municipal heritage records	**2**	1	1		
other data (grave search engine, QR code generation, job recruitment announcements, queue reservation system, land use, investment offers, taxes, installations generating electromagnetic fields, streetlights and energy consumption points, playgrounds)	**10**	4	3	1	2
total number of datasets provided	**126**	**27**	**38**	**24**	**37**

Source: Report No. 1 (2021).

The respondents indicated that the largest number of datasets (17) contains dynamic data related to urban transportation, such as real-time schedules, vehicle locations, and delay information. Cities with a population of 300,000 or more provide the highest number of datasets in this area (8). In second place, in terms of the number of datasets, are data related to air quality and address points (10 datasets each). Furthermore, there are 9 datasets available in the areas of local spatial development plans, geodesy and cartography, as well as environment and environmental protection. There are 6 datasets each for map services and tourism and recreation data, and 5 datasets for meteorological data, election data, and parking systems (e.g., the number of available parking spaces). The remaining categories received fewer than 4 mentions as being available in the API.

8.2. Open data in Local Government Units (Report No. 2, 2022)

In the study of Local Government Units, 96 entities participated, out of which:

- 8 entities (8.9%) provide data on the Dane.gov.pl portal. Therefore, a staggering 55 out of 96 (91.1%) surveyed Local Government Units do not provide any of their data on the portal in any way.
- 17 entities provide data through an API.
- 16 entities do so dynamically.

Since the datasets - API, dynamic data, and those posted on the Dane.gov.pl portal - are not mutually exclusive, the study revealed that 6 units provide their data dynamically through the API, and one unit does the same on the portal. Only one of the surveyed entities provides data through both the API and the portal. It is noteworthy that no Local Government Unit was found to provide data in all three ways simultaneously: API, portal, and dynamic data.

Sharing data on the Dane.gov.pl portal

Representatives of offices cite the following reasons for the observed lack of data sharing on the Dane.gov.pl portal: the most common reason is a lack of knowledge about the data that can or should be shared (22% of responses). 15.9% of units indicated staffing shortages or deficiencies as the reason for not sharing data, and 13.4% cited a lack of appropriate data to share. 9.8% of respondents emphasized a lack of demand or interest in the data held by their office, while nearly 7.3% pointed to technical barriers that hinder data sharing.

Furthermore, 11% of respondents claim that despite not currently sharing data, work is already underway to enable data sharing on the Dane.gov.pl portal. Half as many respondents (4.9%) indicate that their institution is planning to introduce an open data policy, which may lead to data sharing on the portal in the future (approximately one year from the survey, i.e., in 2023).

The study revealed that another reason why Local Government Units do not share data on the Dane.gov.pl portal is that the data are available elsewhere or in a different manner. 18.3% of respondents indicated that their data are shared on other portals, websites, or in other places, such as BIP, Geoportal, or through domain-specific systems. Respondents also mentioned data being transferred to other entities, which subsequently share the data, as well as their own open data portals.

Data Sharing through APIs

More than half, specifically 53.1% of the surveyed units, do not share data through application programming interfaces (APIs). Only less than one-fifth of the surveyed units (17.7%) declare data sharing through APIs, while information regarding this aspect was not provided in nearly one-third of the surveys (29.2%).

Table 2.
Reasons for not sharing data through APIs

N=51	N	%
lack of tools, lack of technical capabilities, lack of software integrating with the API, absence of launched applications, absence of API, lack of interface installation	18	35,3
lack of knowledge about data sharing, insufficient knowledge about what data can or should be shared	6	11,8
lack of finances	5	9,8
lack of interest from residents, lack of demand	5	9,8
lack of data to be shared	3	5,9
lack of human resources	3	5,9
lack of possibilities, lack of adequate preparation	2	3,9
lack of legal basis, no legal obligation	2	3,9
lack of integration of domain systems	1	2,0
data are shared in other ways (through BIP, on Geoportal, upon request)	5	9,8
ongoing work related to the possibility of data sharing through APIs	1	2,0
no reason indicated	3	5,9
responses unrelated to the topic	2	3,9

The percentages do not add up to 100% because respondents were able to indicate more than one reason.

Source: Report No. 2 (2022).

The surveyed units do not provide data through API mainly due to a lack of technical capabilities, indicated by 35.3% of respondents. Lack of knowledge about which data can or should be made available through this method, lack of finances, and lack of interest in this means of data sharing were also mentioned as reasons. Approximately 10% of respondents stated that they do not provide data through API because they do so in another way, such as through BIP, Geoportal, or upon request. Insufficient personnel and lack of data suitable for API sharing are additional reasons for not providing data in this manner. Other reasons received less than 4% of responses.

Provision of dynamic data

The study results indicate that only about one-sixth of the surveyed local government units (16.7%) provide dynamic data, while a significant majority, as much as 83.3%, do not provide this type of data.

Only 5.6% of the units that currently do not provide dynamic data have taken steps to start sharing it. In contrast, 94.4% of respondents stated that they have not taken any actions to provide dynamic data, which is a common phenomenon.

The majority of respondents (64.4%) do not see any obstacles to providing dynamic data, while 35.6% identified such barriers. The most frequently mentioned barriers were financial constraints (25 responses), personnel limitations (24 responses), and technical challenges (19 responses), such as equipment and software deficiencies. Other obstacles, such as lack of training, procedures, legal barriers, or awareness issues, received isolated mentions.

63.8% of the respondents do not have information about products, services, or applications that utilize data from their office and can be helpful for residents or businesses. On the other hand, just over one-third of the surveyed individuals (36.2%) are aware of the existence of such products or services that have been developed using data from their office. When asked to

provide examples of services, products, or applications that utilize data from their office, representatives of the surveyed institutions most frequently mention the Geoportal or the district Geoportal (18 mentions). The portal with geodetic services, such as surveyor services and an online geodetic store, is mentioned less frequently (5 mentions), as well as queue management systems like „queue machines" (3 mentions). Other services, products, or applications were mentioned only once.

On the Dane.gov.pl platform, a category related to Ukraine has been created, where various information about refugees, border movement between Poland and Ukraine, and the number of Ukrainians in Poland is provided. It turned out that one-fourth of the surveyed local government units have similar data that could be included there, while the vast majority (74.7%) does not have such information.

Barriers to data sharing by local government units (JST)

The most commonly indicated difficulties in data sharing by JST are shown in Table 3.

Table 3.
The most significant barriers to sharing public data/information by the office/authority

N=96	N	%
Insufficient financial resources for building a portal for public data/information	48	51,1
Lack of knowledge regarding which data can or should be made available	47	50,0
Lack of interest in public data/information from stakeholders (such as residents, entrepreneurs, representatives of foundations, scientists, journalists)	43	45,7
Inadequate competencies for preparing data in open formats	31	33,0
Lack of or minimal interest in the topic of sharing public data/information within the office/authority	25	26,6
Other barriers	4	4,3
- Lack of data*	2	-

The data does not sum up to 100% because respondents were able to indicate more than one reason.
* - excluded from the percentage base.

Source: Report No. 2 (2022).

Most often, representatives of the surveyed offices indicated a lack of funds for building a data portal (51.1%) and a lack of knowledge regarding which data can or should be made available (50.0%). A similar number of responses (45.7%) were obtained for the lack of interest in public data from stakeholders such as residents, businesses, non-governmental organizations, scientists, and journalists. For one-third of respondents (33.0%), a significant barrier is the lack of staff competence in preparing data in open formats, and for one-fourth (26.6%), it is the low or no interest in the topic of data sharing within the office itself.

8.3. User opinions about the Dane.gov.pl portal (Report No. 3, 2020-2022)

According to the research results, users of the Dane.gov.pl platform prefer the PDF format as the most useful for themselves (47.7%). In second place, but with much less popularity, are the XLS and XLSX formats with a result of 38.3%. The next format, which received over one-third of the responses, is CSV (35.4%). The JPEG, PNG, JSON, XML, DOC, and DOCX formats achieved results of about one-fourth of the responses, while the HTML format was

indicated by just over one-tenth of the respondents (12%). RDF and ODS obtained the lowest results, with 5.7% and 3.4% respectively. The remaining formats account for a total of 16.1% of the responses, with the SHP format being the most frequently mentioned, followed by several other formats such as GML, SWDE, TIFF, DXF, WMS, GEOTIFF, KMZ, KML, GEOJSON, and DB3.

Users most commonly expect the publication of public data in the following categories: Health; Economy and Business; Public Transport and Communication; Environment; Geodetic, Cartographic, and Locational Data; Socio-Demographic Data; Science and Education; Security; Culture; Justice and Penitentiary System; Defense and Military.

It turns out that the most common motivation for users to access public data, is the desire to acquire or expand their knowledge. This reason was indicated by over 40% of the respondents (44.7%). Just over one-fifth of the users (19.5%) stated that they use public data out of curiosity and a desire to explore the possibilities hidden in that data. Approximately 10% of portal users utilize public data in their scientific activities, including for research purposes (12.2%), while nearly one-tenth use it for creating applications (7.8%) or building databases (7.5%).

The majority of portal users (58.3%) consider access to data through an API interface to be significant - 39.3% of respondents consider it important, and 19% consider it very important. Only 14.4% of respondents find the API less significant but still use it, while 27.3% do not find it important because they do not use this data retrieval method.

9. Results from research reports

Based on the data presented in research reports on urban public administration (regarding the provision of open data in APIs) and local government units (provision in APIs and on the Dane.gov.pl portal, as well as dynamically), it can be concluded that:

- The majority of cities and local government units do not provide their data through APIs: less frequently in cities (around 60%) and more frequently in local government units, with over 80% (when adding 53.1% of responses stating "no" and 29.2% of surveys with no response).
- There is an observed pattern that the larger the unit serving a population, the more likely it is to provide its public data through APIs (e.g., in cities with over 300,000 residents, 100% of units provide data; in cities with 40,000 to 299,999 residents, it ranges from 33.3% to 39%; while in local government units, it is only 17.7%).
- In cities with 40,000 residents or more, data are most frequently provided in categories related to: public transportation, air quality, address points, local spatial development plans, geodesy and cartography, environment, map services, tourism, and recreation.

In local government units, access to geodetic data (Geoportal), address information of companies (BIP), and queue systems (queue machines) are mentioned.

- In light of the new Act on Open Data and Reuse of Public Sector Information from August 2021, 18.4% of surveyed cities state that actions are already being taken to enable the provision of dynamic data through APIs; 30.6% plan to take actions to enable the provision of dynamic data according to Article 24 of the act; 40.8% only express the intention to work towards the goal of providing data through APIs without specifying specific solutions, and 10.2% have no plans for such actions. Among the surveyed local government units that currently do not provide dynamic data, only one in twenty (5%) has taken actions towards enabling the provision of dynamic data, while 10.2% do not plan to take actions to enable the provision of dynamic data through APIs (the reasons were not specified for three cities).
- Among the most commonly mentioned barriers (reasons) for not providing data by local government units (JST), the lack of appropriate tools, knowledge, finances, and demand for data are cited (90% of units use their own data resources, while only about 10% of surveyed units rely on data placed on the Dane.gov.pl portal).
- Users of the Dane.gov.pl platform consider the PDF format as the most useful for them (47.7%), followed by XLS, XLSX (38.3%), CSV (35.4%), JPEG, PNG format (26.6%), JSON (25%), XML (25%), DOC, DOCX (23.4%), HTML (12%), RDF (5.7%), ODS (3.4%), while other formats collectively account for 16.1%.
- 58.3% of users of the Dane.gov.pl portal consider access to data through the API interface to be significant; 14.4% of respondents consider the API to be of little importance but still use it, and 27.3% do not consider it important because they do not use this data retrieval method.

10. Discussion

The provision of public data by local government units in Poland is currently a legal obligation. In the year the law was enacted (2022), a significant majority of cities and local government units (JST) do not publicly provide their data in accordance with the law or in any other way.

A concern may arise from the dismissive attitude towards the law exhibited by public administration employees in cities and local government units (10.2%) who casually declare a lack of planned actions towards data sharing through API. "Article 23 - [Criminal liability for failure to provide public information] - Access to public information" clearly indicates the consequences of neglect in this area: "Anyone who, contrary to their obligation, fails to provide public information is subject to a fine, restriction of liberty, or imprisonment for up to one year"

(Journal of Laws 2022.902) - however, upon careful reading of the 2021 Act, it turns out that this refers only to providing information upon request. Therefore, legislation in the discussed scope has its various shortcomings: it does not clearly specify which data should be provided upon request and which should be obligatory for online disclosure. There is a lack of specific indication of a "basket of free public data" available online, to which authorities would be unconditionally obliged. Article 10.1 of the 2021 Act states: "The obligated entity, **if possible**, provides or transmits public sector information as open data for reuse." Consequently, currently, it is sufficient to demonstrate that a public entity obligated to provide data openly has encountered difficulties in doing so in order to be exempt from responsibility. The non-restrictiveness of the law means that open public data are subject to the goodwill of officials rather than being an obligation, and it even encourages authorities to adopt a passive approach.

Based on the responses in Report No. 2 (regarding JST), it can be inferred that in the near future, the number of entities that provide data on the Dane.gov.pl portal should increase from the current level of nearly one-tenth to one-fourth (24.8% - including those that already provide data, are undergoing implementation efforts, or plan to adopt an open data policy). Researchers emphasize that by referring to the near future, they mean within a year, which is confirmed by the survey participants' responses indicating that their offices plan to start sharing data on the portal in 2023.

However, the surveyed representatives of local government units pointed out various ways to increase the efficiency of the data sharing process in their offices. According to them, the most helpful would be workshops, meetings, conferences, and the exchange of best practices in the field of data sharing (75.5% of responses), as well as training, both in-person and online (71.3%). For half of the respondents (52.1%), educational materials would be helpful, and one-fifth (21.3%) suggested appointing a data openness representative in each office. On the other hand, appointing a representative is the least popular among the respondents.

Sharing open data on the Dane.gov.pl portal dynamically through API is not an easy task but requires appropriate tools in the form of electronic hardware and software, such as Appmaster (https://studio.appmaster.io/), but above all, a well-prepared workforce to take on such challenges. The logic of the free market suggests that the salary offered in public administration may not be sufficient to attract the most highly qualified IT professionals who opt for the private sector. Therefore, it is necessary to create an internal organizational climate and provide adequate external support (e.g., training) so that the current employees in public administration can cope with the new obligations imposed by the legislator.

It would also be worth considering the possibility of utilizing the experience of opinion research centers, led by the Central Statistical Office, whose ratings in data collection and dissemination are very high (as mentioned earlier in the ODIN ranking).

Data provided through APIs is targeted towards IT professionals, and users with average IT knowledge do not have access to them. Therefore, in line with the preferences of users accessing the Dane.gov.pl portal, it would be advisable to provide data in the most popular formats, such as .pdf, .xlsx, and .docx. To achieve this, a tool like Google Forms could be utilized, allowing for dynamic data extraction into a .csv file (which can easily be converted to .pdf or .xlsx).

As mentioned earlier, in the absence of appropriate (non-fictional) legislation and support infrastructure (financial, tool-based, training, etc.) from the ministry and the cooperation of the government side responsible for the Dane.gov.pl portal with institutions experienced in data collection, processing, and dissemination, it is difficult to expect any revolution in the near future regarding the provision of public data by government offices.

11. Summary

The concept of a smart city originally referred to cities that utilize intelligent technology in urban services. This concept has been expanded to include additional dimensions, such as Smart People or Citizens; Smart Governance; Smart Environment and Resource Management; Smart Homes, Buildings, and Living; Smart Education; Smart Transportation, Parking, and Traffic Lights; Smart Healthcare; Smart Grid and Energy; Emergency and Public Safety; and Cybersecurity Management (Sarker, 2022). The implementation of smart products and services necessitates the development of these additional dimensions.

Open data has the potential to support innovative technological solutions and increase citizen engagement in decision-making processes. Examples of smart cities demonstrate that they are characterized by high citizen mobility, the implementation of solutions that contribute to the reduction of carbon dioxide and other pollutant emissions, and the creation of green cities that promote healthier living environments. In other instances, by providing crime maps to the public, the involvement of the community has led to a decrease in crime rates (Haarstad, Wathne, 2019).

The implementation of the smart city concept varies across different cities, influenced by a range of factors, including the provision and utilization of public data. However, it is worth noting that to maximize the benefits for residents in the development of smart cities, it is necessary for authorities to adopt appropriate policies that promote data sharing, enabling data-driven decision-making (Neves, de Castro Neto, Aparicio, 2020).

City managers responsible for selecting and deploying smart products and services must think beyond inclusivity. Restricting access to data for external economic entities and individuals would hinder their involvement in the development and life of these cities. Open data not only allows for responding to the needs of city residents and local businesses but

also provides conditions for coordinating various activities, leading to cost reduction and profit maximization (Sarker, 2022, p. 6).

Even with limited financial resources, especially in smaller cities, local authorities should focus on implementing modern technology in urban products and services, while considering long-term financial forecasts regarding available budgetary funds. An important tool for developing strategic city management for the advancement of smart cities is access to public data. Obtaining information about the city, its population, and the functioning of public systems can support the development of more effective public policies and better organization of transportation and environmental protection (Bibri, 2018, pp. 2-3).

In summary, open data from public administration plays a crucial role in the development of smart cities. However, in order to effectively utilize this data, it is necessary to have wide-ranging sharing by public administration units in accordance with applicable law. Yet, mere data sharing by public administration is not sufficient for smart city development. It also requires broad social engagement and collaboration among the public, private, and academic sectors to ensure the most efficient and beneficial use of this data for the well-being of city residents.

The implementation of an open data policy should be preceded by proper training of residents to help them understand the benefits and significance of data sharing. Additionally, appropriate tools and processes should be provided to ensure the effective and ethical use of this data.

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