

Level of informatization of public administration services in the voivodeships of Poland in 2014-2022

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Abstract— The purpose of the study is to assess the level of differentiation of informatization of public administration services in the voivodeships in Poland. **Research methodology:** The study involved the selection of quantitative variables depicting the level of informatization of public administration in the voivodeships in Poland. The selected variables were analyzed using the TOPSIS linear ordering method. The analysis was based on the data of the Central Statistical Office for the years 2014-2022. The results of the study showed significant disproportions between individual voivodeships, where the voivodeships with the highest level of public administration informatization were the mazowieckie and Pomeranian voivodeships whereas voivodeships with the lowest level of public administration informatization were podkarpackie, opolskie and świętokrzyskie.

Keywords— computerization, information society, public administration, TOPSIS method

I. INTRODUCTION

The digitalization of the economy and social sphere that has taken place in recent decades has changed the operating model of businesses, consumers, public administration, workers, individual economies and the global economy. The digital revolution has become a reality, and it is no longer muscle power or energy that determines development, but information and a professional who, through education and training, has the skills required to function in a post-industrial society (Bell, 1976). According to Bell, the development of information technology in post-industrial society has affected social change in a similar way to the development of industry in industrial society. Knowledge and information have become the most

important resources. For an information society operating during the fourth industrial revolution, the Internet has become the dominant technology that determines a number of socio-cultural processes and thus functions as a tool for knowledge distribution (Szpunar, 2018). New professions are being born, which also require a change in the approach to the training of relevant competencies and society to acquire the skills necessary for everyday functioning in both the private and professional spheres (Siemieniecka, 2021). Lack of or insufficient level of digital skills may lead to digital exclusion, which translates into incomplete participation in socio-economic life, among other difficulties in using public services, which are becoming increasingly digital (Gołaszewska-Kaczan, Kuzionko-Ochrymiuk, 2023). The development of information and communication technologies has not bypassed public administration either. The way public administration offices communicate with citizens and businesses has changed. In many cases, it is already done exclusively using these technologies. Changes in the way public administration provides services take place in all countries of the European Union, but the pace of their introduction varies greatly. The commonly used term e-government (e-administration), "is the use of information and telecommunications technologies in public administration, combined with changes of an organizational nature and the acquisition of new skills in order to improve the quality of public services, strengthen citizen involvement in democratic processes and support for state policies" (Grodzka, 2007, p.1). To assess the level of accessibility and quality of e-services in each country, the European Union has been monitoring progress since 2014 with



the DESI Digital Economy and Digital Society Index, in which digitalization of public services is one of the areas covered (European Union). Since 2023, the DESI index has been included in the reports of a program setting out the digital goals set to be achieved by European Union member states by 2030 - "The Road to the Digital Decade" (European Council, Council of the European Union). The program assumes that by 2030, 100 percent of citizens and businesses will have universal online access to all major public services, 80 percent of citizens will use electronic identification, and all citizens will have online access to their medical records (Council of Europe, Council of the European Union). How does the Union want to achieve these goals? The basis is developed action plans at the EU and national levels to achieve the goals. The European Commission provides annual reports that include ongoing progress and recommendations. There is ongoing cooperation between the Commission and EU countries, where differences in performance emerge and to prevent them, to ensure ongoing progress. Member states align their national action plans with the Commission's recommendations (European Council, Council of the European Union). Poland has come a long way since initiating e-government solutions in 2001 through the enactment of the Law on Access to Public Information. By adapting domestic law to the standards created by the European Union, it has gradually changed the nature of services provided by public administration entities. From the first level of service provision, which is the level called informational, through the introduction of subsequent levels: one-way interaction, two-way interaction, through transaction, i.e., enabling all actions necessary to handle a given official matter electronically, to the personalized level - the highest level of maturity of electronic public service, which assumes that application forms in electronic form are pre-filled with the data of a citizen or entrepreneur in the possession of the entity providing the service, and in the case of services where there is no need to submit an application, the office automatically performs the service to the extent appropriate to the service recipient's life situation, and if there is a need for payment in the procedure, the service provider ensures that the service recipient is redirected to the appropriate intermediary for payment (Andrzejewska *et al.*, 2018). Poland continues to score poorly in the availability of online digital services, according to the European Commission's latest State of the Digital Decade report (European Commission, <https://digital-strategy.ec.europa.eu/pl/library/2023-report-state-digital-decade>). It received 60 points for digital public services for citizens (EU average: 77) and 73 points for businesses (EU average: 84). 63% of Internet users in 2022 used e-government services (EU average: 74%). The mCitizen application continues to be improved, with 9.1 million users in December 2022. For e-health access, Poland achieved a score of 86 in 2022, much better than the EU average (72nd). The Patient Portal provides improved services, building on the successful introduction of e-prescription. The mobile version of the portal is constantly being updated (European Commission, 2023). The Central Statistical Office, which provides data to Eurostat, annually publishes a report entitled "Information Society in

Poland," in which, among other things, it provides detailed data on the development of specific areas of e-government, analyzing the data by type of entity, with a division into government and local government administration, and by administrative division - discussing the level of advancement of introduced solutions in 16 voivodeships. Even a cursory analysis of the data contained in the reports of the Central Statistical Office in subsequent years shows large disparities in the level of development of selected e-government services at the state and local government levels and in individual provinces. The factors that determine the success of digitization of public administration services are of different nature - technological, organizational, human, economic, social and cultural (Kumar, Mukerji, Butt, Persaud 2007; ; Shareef, Kumar, Kumar, Dwivedi, 2011). Barriers of an external and internal nature are identified in her book, based on a review of the literature Joanna Ejdyś has conducted, listing among the external ones: "limited access of citizens to the Internet, lack of common standards for document exchange, low level of education of citizens in modern information technology, lack of sufficient knowledge and competence by users of the technology, individual characteristics of users (such as age, education, frequency of Internet use), low use of ICT in business processes (e.g., e-commerce, electronic document circulation), concerns about data and information security, problems with electronic signatures, limited level of trust in e-government, preference for personal contact with government employees, lack of awareness of access to such services" and internal: "errors at the design stage, inadequate human resources in the organization, reluctance to change, inadequate information system resources, low network security, lack of security policies, lack of application guidelines and procedures" (Ejdyś, 2018, p.35). A detailed analysis of the spatial variation in the level of e-government development in local governments in the context of their e-government development activity was made in 2014 by Robert Perdał, noting the level of determination and commitment of regional authorities, the investment activity of local governments, the allocation of EU funds aimed at the development of the information society and e-government, and the share of EU funds in ongoing projects. In conclusion, a rather complicated picture of the analyzed issue emerged, as in some voivodeships unfavorable conditions did not correspond to the low level of e-government development of local governments (Perdał, 2014). With the above matter in mind, the authors attempted to analyze the variables affecting the level of informatization of e-government services in the provinces of Poland in 2014-2022.

II. MATERIALS AND METHODS

In order to show how the level of use of e-government services in the provinces of Poland is shaping up, a method was used to compare individual variables adopted in the study.

Changes in the use of e-government services in the provinces were assessed using the TOPSIS linear ordering method. The study considered the following five variables:

X1: the number of people using the Internet in the past 12

months,

X2: number of people using public administration services via the Internet in the last 12 months,

X3: number of people using government services via the Internet in the past 12 months to search for information on government websites,

X4: number of people using public administration services via the Internet in the last 12 months to download official forms,

X5: number of people using public administration services via the Internet in the last 12 months to send completed forms. All of the above-mentioned variables are necessary for the study, as they show the general situation of Internet use (which determines the possibility of using e-government services in general) and show the number of people interested in the implementation of public services via the Internet. In each province, the situation in this regard may vary and may affect the actions of citizens in using e-government services.

In making calculations using the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) linear ordering method, the authors used two methods. The first was to determine the pattern of development for each year separately, which made it possible to order the objects in a given year, while the second way was to determine a common pattern that indicated the directions of the changes taking place during that period. It should be noted that all variables adopted for the study were stimulants - "stimulant - a characteristic whose high values are desirable from the point of view of the essence of the study. The higher the stimulant values, the better the object is qualified" (Młodak, 2006, p.33), and equal weights were applied to all variables.

This study included the following stages (Hwang, Yoon, 1981; Roszkowska, Filipowicz-Chomko, 2016).

1. construction of a data matrix on variables describing the level of use of e-government services:

$$X = [x_{ij}]$$

where:

x_{ij} – The value of the j-th indicator for evaluating the use of e-government services ($j=1,2,\dots,9$) in the i-th province ($i=1,2,3,\dots,16$).

All selected variables are characterized by universality, meaning the generally recognized importance of the variable in shaping the level of use of e-government services. The variables are also characterized by comparability, making it possible to compare voivodeships regardless of the number of offices located on their territory, the area of the voivodeship or the population.

2. Normalization of the values of indicators for evaluating the use of e-government services carried out for stimulants in the form of (Roszkowska, Filipowicz-Chomko, 2017)

$$z_{ik} = \frac{x_{ij} - \min_i \{x_{ij}\}}{\max_i \{x_{ij}\} - \min_i \{x_{ij}\}}$$

where:

i – number of the voivodeship ($i = 1,2,\dots, n = 16$);

j – indicator number ($k = 1,2,\dots,9$).

3. Determination of weighting factors for indicators where:

$$\sum_{j=1}^m W_k = 1$$

To construct the synthetic measure, equal weights were assumed for all variables (Grabiński, Wydymus, Zeliaś, 1989)

$$W_k = \frac{1}{m_{=9}}$$

4. calculating the Euclidean distance of the voivodeships from the pattern and anti-pattern according to the formula (Roszkowska, Filipowicz-Chomko, 2016):

$$d_i^+ = \sqrt{\sum_{k=1}^m (W_k Z_{ik} - W_k Z_k^+)^2}, \quad d_i^- = \sqrt{\sum_{k=1}^m (W_k Z_{ik} - W_k Z_k^-)^2}$$

where:

$Z_k^+ = (1,1,\dots,1)$ – development pattern,

$Z_k^- = (0,0,\dots,0)$ – the antecedent of development,

5. determination of the value of the synthetic measure of evaluation of the use of e-government services for the i-th voivodeship and linear ordering of provinces according to the value of the calculated indicator according to the formula (Hwang, Yoon, 1981; Roszkowska, Filipowicz-Chomko, 2016)

$$q_{it} = \frac{d_{it}^-}{d_{it}^- + d_{it}^+}$$

III. . RESULTS AND DISCUSSION

A summary of the indicators for each of Poland's voivodeships between 2014 and 2022 is presented in Table 1 Analyzing variable X1 - concerning the number of people using the Internet in the last 12 months, it can be noted that in 2014-2022 the highest number of people used this service in the mazowieckie, zachodniopomorskie and pomorskie voivodeships. The lowest interest in the analyzed years was noted in Lubelskie and świętokrzyskie voivodeships.

Another variable concerned the number of people using public administration services via the Internet in the last 12 months. The mazowieckie, śląskie and pomorskie voivodeships achieved the best results in terms of this variable. Unfortunately, in 2014, the wielkopolskie and świętokrzyskie voivodeships were in the lowest position, with a difference of up to 13.4 p.p. (compared to the mazowieckie voivodeship). In 2015, the smallest number of people used public administration services via the Internet in the świętokrzyskie, kujawsko-pomorskie and opolskie voivodeships. The difference between the mazowieckie and świętokrzyskie voivodeships was 17.5 p.p. In 2016, the Silesian voivodeship was the leader in the use of public administration services via the Internet (36.7%), while the świętokrzyskie (22.6%), warmińsko-mazurskie (25%) and lubuskie (22.9%) voivodeships were in the lowest positions. On the other hand, in 2022, the leading position was held by the Lower Silesian voivodeship (63.8%), while the opolskie voivodeship (44%) was in last place.

TABLE1. VARIABLES SHOWING THE LEVEL OF USE OF E-GOVERNMENT IN POLAND IN 2014 - 2022 BY VOIVODESHIP

| voivodeship | 2014 | | | | | 2015 | | | | | 2016 | | | | | 2017 | | | | | 2018 | | | | | 2019 | | | | | 2020 | | | | | 2021 | | | | | 2022 | | | | |
|-----------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | X1 | X2 | X3 | X4 | X5 | X1 | X2 | X3 | X4 | X5 | X1 | X2 | X3 | X4 | X5 | X1 | X2 | X3 | X4 | X5 | X1 | X2 | X3 | X4 | X5 | X1 | X2 | X3 | X4 | X5 | X1 | X2 | X3 | X4 | X5 | X1 | X2 | X3 | X4 | X5 | X1 | X2 | X3 | X4 | X5 |
| dolnośląskie | 72.8 | 30.8 | 24.5 | 18.8 | 17.8 | 72.6 | 27 | 23.2 | 17.6 | 18.8 | 75.2 | 27.1 | 19.7 | 16.9 | 20.6 | 78.2 | 36.2 | 19 | 19.4 | 21.2 | 76.6 | 37.1 | 26.5 | 22.9 | 24.4 | 83.4 | 45.9 | 28.4 | 26.9 | 36.9 | 87.4 | 47.1 | 29.1 | 35.9 | 36.9 | 90.9 | 54.4 | 34.9 | 33.9 | 47.9 | 89.9 | 63.9 | 32.9 | 34.9 | 49.9 |
| kujawsko - pomorskie | 48.4 | 22.7 | 17.9 | 14.6 | 11.7 | 49.9 | 17.8 | 13.5 | 11 | 10.1 | 71.5 | 25.6 | 19.2 | 13.8 | 15.7 | 76.6 | 31 | 22 | 20.2 | 21.9 | 79.7 | 32.5 | 21 | 23.2 | 22.5 | 83.4 | 39.6 | 26.4 | 21.1 | 39.1 | 86.5 | 37.6 | 24.8 | 24.8 | 38.4 | 90.4 | 50.1 | 30.9 | 27.1 | 45.1 | 90.7 | 58.1 | 30.5 | 28.7 | 54.1 |
| lubelskie | 64 | 24.4 | 18.4 | 13.6 | 11.5 | 66.4 | 25.1 | 18.1 | 14.3 | 13.7 | 71.6 | 28.5 | 21.2 | 17.6 | 17.9 | 71.6 | 26.7 | 17.7 | 14.4 | 15.2 | 72.8 | 31.2 | 23.1 | 19.3 | 18.4 | 77.1 | 31.1 | 21.4 | 20.1 | 23.1 | 79.1 | 36.1 | 21.1 | 19.1 | 26.1 | 82.1 | 35.1 | 21.1 | 18.1 | 28.1 | 84.1 | 41.1 | 21.1 | 18.1 | 31.1 |
| lubuskie | 47.2 | 22.5 | 17.1 | 14.2 | 11.5 | 76.5 | 23.4 | 16.7 | 13.2 | 13.9 | 76.9 | 22.9 | 14.7 | 13.4 | 13.4 | 76.5 | 26.8 | 17.2 | 17.4 | 12.4 | 78.9 | 27.2 | 18.9 | 16.7 | 18.3 | 81.9 | 32.1 | 17.1 | 21.1 | 20.1 | 82.1 | 31.1 | 21.1 | 21.1 | 20.1 | 83.1 | 41.1 | 21.1 | 24.1 | 24.1 | 85.1 | 41.1 | 21.1 | 26.1 | 24.1 |
| łódzkie | 45.9 | 26.1 | 18.9 | 14.2 | 13.5 | 65.5 | 24.3 | 15.2 | 14.7 | 12.1 | 72.9 | 26.5 | 19.4 | 16.9 | 16.3 | 77.4 | 29.3 | 16.8 | 18.1 | 16.6 | 80.2 | 32.3 | 21 | 20.2 | 19.6 | 81.2 | 48.2 | 25.2 | 20.2 | 20.2 | 83.2 | 48.2 | 25.2 | 21.2 | 21.2 | 85.2 | 48.2 | 25.2 | 21.2 | 21.2 | 87.2 | 48.2 | 25.2 | 21.2 | 21.2 |
| małopolskie | 47.9 | 29.5 | 22.8 | 19.7 | 17.4 | 66.8 | 29.8 | 21.9 | 21.4 | 19.9 | 75.9 | 34.8 | 29.4 | 22.8 | 22.4 | 75 | 29.4 | 21 | 20.1 | 22.9 | 78.7 | 37.8 | 26.2 | 23.4 | 24.9 | 80.9 | 34.9 | 24.9 | 24.9 | 24.9 | 82.9 | 39.9 | 26.9 | 26.9 | 26.9 | 84.9 | 47.9 | 29.9 | 26.9 | 27.9 | 86.9 | 55.9 | 19.9 | 22.9 | 48.9 |
| mazowieckie | 73.2 | 34.1 | 28.2 | 22.8 | 20 | 74.2 | 33.1 | 24.2 | 22.2 | 19.4 | 78.7 | 36.4 | 30.1 | 25.4 | 22.1 | 80 | 34.5 | 24.9 | 24.4 | 24.9 | 83.5 | 41.9 | 32.1 | 27.4 | 29.4 | 83.9 | 45.9 | 33.9 | 31.9 | 35.9 | 84.9 | 41.9 | 32.9 | 31.9 | 35.9 | 85.9 | 41.9 | 32.9 | 31.9 | 35.9 | 86.9 | 41.9 | 32.9 | 31.9 | 35.9 |
| opolskie | 49.7 | 22.7 | 18.3 | 16.9 | 9.8 | 72.6 | 22.4 | 16.7 | 13.4 | 14.5 | 76.8 | 28 | 19.2 | 17.6 | 15.5 | 80 | 29.9 | 18.7 | 21.6 | 15.2 | 77.5 | 29.9 | 19.5 | 17.2 | 21.2 | 82.7 | 32.7 | 20.7 | 24.7 | 21.7 | 83.7 | 32.7 | 20.7 | 24.7 | 21.7 | 84.7 | 32.7 | 20.7 | 24.7 | 21.7 | 85.7 | 32.7 | 20.7 | 24.7 | 21.7 |
| podkarpackie | 45.3 | 22.5 | 17.6 | 13.5 | 13.6 | 48.6 | 25.3 | 23.2 | 14.5 | 13.6 | 74.8 | 25.3 | 21.3 | 14.4 | 14.1 | 77.2 | 25.3 | 16.6 | 12.9 | 14.5 | 77.8 | 24 | 12.6 | 12.9 | 18.8 | 79.1 | 31.1 | 17.1 | 15.1 | 23.1 | 81.4 | 31.1 | 17.1 | 15.1 | 23.1 | 84.4 | 31.1 | 17.1 | 15.1 | 23.1 | 87.4 | 31.1 | 17.1 | 15.1 | 23.1 |
| podlaskie | 72.1 | 22.4 | 16.3 | 13.8 | 10.3 | 76.9 | 27 | 17.7 | 18.4 | 18.1 | 74.3 | 27.9 | 20.4 | 17.4 | 12.4 | 78.8 | 24.7 | 18.4 | 15 | 12.7 | 78.5 | 24.7 | 25.4 | 22.6 | 24 | 80.4 | 41.1 | 17.1 | 25.1 | 32.1 | 80.6 | 36.6 | 20.6 | 22.1 | 22.1 | 81.6 | 36.6 | 20.6 | 22.1 | 22.1 | 82.6 | 36.6 | 20.6 | 22.1 | 22.1 |
| pomorskie | 75.1 | 32.3 | 25.2 | 21.7 | 16.1 | 74.2 | 23.7 | 15.4 | 15.3 | 13 | 77.8 | 32.9 | 23.8 | 25.2 | 19.9 | 80.9 | 36.1 | 24.2 | 25.6 | 26 | 84.1 | 41.7 | 24.3 | 23.2 | 28.8 | 86.9 | 49.9 | 26.9 | 31.9 | 40.9 | 86.4 | 40.4 | 21.4 | 33.4 | 33.4 | 87.4 | 40.4 | 21.4 | 33.4 | 33.4 | 88.4 | 40.4 | 21.4 | 33.4 | 33.4 |
| śląskie | 47.4 | 27 | 19.8 | 15.8 | 14.6 | 48.7 | 29.4 | 19.7 | 16.9 | 18.7 | 77 | 36.7 | 25.3 | 23.3 | 23.1 | 79.3 | 32.9 | 22.4 | 23.5 | 21.8 | 79.4 | 39.4 | 27.2 | 23.4 | 27.9 | 81.9 | 36.9 | 23.9 | 28.9 | 31.9 | 83.9 | 36.9 | 23.9 | 28.9 | 31.9 | 85.9 | 36.9 | 23.9 | 28.9 | 31.9 | 87.9 | 36.9 | 23.9 | 28.9 | 31.9 |
| świętokrzyskie | 45.4 | 30.8 | 23.3 | 13 | 12.4 | 64 | 15.6 | 10.2 | 7.1 | 7.5 | 70 | 22.6 | 14.4 | 13.6 | 12.2 | 70 | 26.5 | 11.8 | 18.5 | 20.6 | 76 | 32.9 | 19.5 | 18 | 23.2 | 85.2 | 35.2 | 30.2 | 30.2 | 85.2 | 35.2 | 30.2 | 30.2 | 30.2 | 86.2 | 35.2 | 30.2 | 30.2 | 30.2 | 87.2 | 35.2 | 30.2 | 30.2 | 30.2 | |
| warmińsko - mazurskie | 48.2 | 24.7 | 18.8 | 15.8 | 15.3 | 68.6 | 25.5 | 18.6 | 14.1 | 15.3 | 71.8 | 25 | 17.4 | 15.2 | 17.4 | 79.1 | 31.5 | 20.9 | 16 | 21.8 | 79.2 | 34 | 24.1 | 23.8 | 24.7 | 79.4 | 31.4 | 16.4 | 15.4 | 23.4 | 81.4 | 31.4 | 16.4 | 15.4 | 23.4 | 83.4 | 31.4 | 16.4 | 15.4 | 23.4 | 85.4 | 31.4 | 16.4 | 15.4 | 23.4 |
| wielkopolskie | 49.5 | 20.7 | 14.4 | 11.8 | 10.5 | 67.2 | 24.8 | 18.3 | 15.4 | 18.9 | 72.8 | 27.1 | 21.1 | 16.5 | 16.5 | 75 | 30.9 | 22.9 | 21.6 | 21.3 | 80.5 | 33.9 | 23.5 | 22.4 | 23.9 | 81.3 | 35.3 | 24.1 | 21.1 | 21.1 | 81.6 | 35.3 | 24.1 | 21.1 | 21.1 | 81.9 | 35.3 | 24.1 | 21.1 | 21.1 | 82.2 | 35.3 | 24.1 | 21.1 | 21.1 |
| zachodniopomorskie | 47.4 | 23.5 | 15 | 16.9 | 14.4 | 78.3 | 25.9 | 14.2 | 11 | 17.9 | 80.4 | 32.5 | 20.4 | 20.6 | 22 | 84.8 | 35.4 | 18.2 | 27.2 | 29.6 | 79.7 | 33.7 | 21.6 | 22.5 | 23.6 | 79.5 | 41.5 | 25.5 | 27.5 | 84.8 | 35.4 | 18.2 | 27.2 | 29.6 | 84.8 | 35.4 | 18.2 | 27.2 | 29.6 | 84.8 | 35.4 | 18.2 | 27.2 | 29.6 | |

Source: Central Statistical Office, Use of information and communication technologies in households in 2014 - 2022 [accessed 27.11.2023].

In 2014-2022, the mazowieckie voivodeship ranked first in terms of the number of people using the Internet to obtain information from public administration websites (X3). The świętokrzyskie voivodeship, on the other hand, recorded the lowest values of these indicators, in 2014-2017 and 2019-2021 while the podkarpackie voivodeship was in last place in 2018 and the małopolskie voivodeship in 2022. The difference between the mazowieckie and świętokrzyskie voivodeships in 2014 was 15.9 p.p., in 2021 it was 21.3 p.p., while in 2018 the difference between the mazowieckie and podkarpackie voivodeships was 19.5 p.p.

Analysis of the data on variable X4 - the number of people using public administration services via the Internet in the last 12 months to download official forms, shows that the highest position was occupied by the mazowieckie voivodeship (2014, 2018 and 2019, 2021, 2022), małopolskie voivodeship (2015), pomorskie voivodeship (2016), dolnośląskie voivodeship (2020) and zachodniopomorskie voivodeship (2017). The lowest places were occupied by the provinces of wielkopolskie (2014), świętokrzyskie (2015 and 2022), warmińsko-mazurskie (2016 and 2019), podkarpackie (2017 and 2018), ppolskie (2020) and lubelskie (2021). The difference in 2014 between the leader and the province in last position was, as much as 11 p.p., while in 2022 it was 15.7 p.p.

Analyzing the last variable X5 - the number of people using public administration services via the Internet in the last 12 months to send completed forms, it can be noted that the mazowieckie voivodeship (2014 - 20% and 2018 - 29, 4%, and 2020 - 43.7%), małopolskie (2015 - 19.9%), śląskie (2016 - 23.1% and 2019 - 42.4%), zachodniopomorskie (2017 - 29.6%) and dolnośląskie (2021 - 47.8% and 2022 - 69.6%) occupy the first positions in the analyzed years. Unfortunately, the ppolskie (2014 - 9.8%), świętokrzyskie (2015 - 7.5% and 2016 - 12.2%), lubuskie (2017 - 12.4% and 2018 - 18.3%), lubelskie (2019 - 23.1%), opolskie (2020 - 22.5%) podkarpackie (2021 - 28.2%),

and podlaskie (2022 - 31.7%) provinces took the lowest positions of the analyzed variable. The difference between the mazowieckie voivodeship and the opolskie voivodeship in 2014 was 10.2 p.p., while in 2022 the difference between the dolnoslaskie and podlaskie voivodeships was 37.9 p.p.

Based on the analysis, rankings of voivodeships were made. Table 2 presents the values of the calculated measures of the level of use of e-government services in the voivodeships of Poland in 2014-2022. In the case of the highest value, the voivodeship was assigned a rank of 1. Comparing the ranking based on equal weights in the 2014 and 2022 boundary years, it was noted that the largest recorded differences include 11 ranking places in the wielkopolskie voivodeship, 5 ranking places in the lubelskie and kujawsko-pomorskie voivodeships, and 4 ranking places in the zachodniopomorskie voivodeship. These provinces advanced to higher positions in 2022 compared to 2014, while the opolskie, małopolskie, podlaskie, pomorskie and warmińsko-mazurskie voivodeships experienced a significant drop from a higher position in 2014 to a lower position, which adversely affected the position of these voivodeships in 2022, and the difference was 8 ranking places in the małopolskie voivodeship, 7 ranking places in the opolskie and podlaskie voivodeships, and 4 ranking places in the pomorskie and warmińsko-mazurskie voivodeships.

Such a difference may be due to the low value of the indicator of variable X5 (people using e-government services in the last 12 months to send completed forms) in 2014 and the high value of the indicators of variable X1 (people using the Internet in the last 12 months) in 2022.

Using the TOPSIS method, an overall picture of the spatial differentiation of voivodeships in terms of the use of e-government services in 2014-2022 was obtained. Based on the obtained values of the synthetic measure of the TOPSIS method, a classification of voivodeships was carried out. The basis for obtaining classes is the ranges that the indicator takes

based on the arithmetic mean and standard deviation The classes of the studied objects were obtained using the formula (Makać, 1989):

- Class I - high use of e-government services, marked in dark gray: $q_{it} \geq x^- + s$
- Class II - medium-high use of e-government services, marked in gray: $x^- + s > q_{it} \geq x^-$

- Class III - medium-low use of e-government services, marked in light gray: $x^- > q_{it} \geq x^- - s$
- Class IV - low use of e-government services, marked in white: $q_{it} < x^- - s$

Figure 1 shows the value of the synthetic measure for evaluating the use of e-government services in Poland's voivodeships from 2014 to 2022.

TABLE 2.

RANKING OF VOIVODESHIPS BY LEVEL OF USE OF E-GOVERNMENT SERVICES IN 2014-2022 BASED ON TOPSIS METHOD.

| voivodeship | 2014 | | 2015 | | 2016 | | 2017 | | 2018 | | 2019 | | 2020 | | 2021 | | 2022 | |
|-----------------------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|
| | X_{ik} | ranga | X_{ik} | ranga | X_{ik} | ranga | X_{ik} | ranga | X_{ik} | ranga | X_{ik} | ranga | X_{ik} | ranga | X_{ik} | ranga | X_{ik} | ranga |
| dolnośląskie | 0,35 | 3 | 0,306 | 4 | 0,3135 | 6 | 0,3626 | 8 | 0,4613 | 5 | 0,6131 | 4 | 0,6859 | 2 | 0,7901 | 2 | 0,8643 | 2 |
| kujawsko - pomorskie | 0,207 | 10 | 0,1021 | 15 | 0,2468 | 14 | 0,3811 | 6 | 0,4169 | 10 | 0,5089 | 6 | 0,5391 | 5 | 0,6946 | 5 | 0,7711 | 5 |
| lubelskie | 0,1818 | 13 | 0,2037 | 13 | 0,3032 | 8 | 0,2447 | 16 | 0,3464 | 13 | 0,3622 | 14 | 0,4323 | 14 | 0,4405 | 16 | 0,7051 | 8 |
| lubuskie | 0,1865 | 12 | 0,2551 | 8 | 0,2502 | 13 | 0,2935 | 14 | 0,3364 | 14 | 0,4266 | 12 | 0,4859 | 12 | 0,5575 | 11 | 0,6265 | 11 |
| łódzkie | 0,2077 | 9 | 0,1763 | 14 | 0,2788 | 12 | 0,3193 | 11 | 0,3926 | 11 | 0,489 | 7 | 0,5059 | 9 | 0,5686 | 9 | 0,6883 | 9 |
| małopolskie | 0,3128 | 4 | 0,3288 | 2 | 0,4515 | 2 | 0,3576 | 10 | 0,4783 | 4 | 0,4247 | 13 | 0,4939 | 11 | 0,6275 | 6 | 0,6146 | 12 |
| mazowieckie | 0,4231 | 1 | 0,3929 | 1 | 0,484 | 1 | 0,4669 | 3 | 0,5791 | 1 | 0,6632 | 2 | 0,7697 | 1 | 0,8302 | 1 | 0,8739 | 1 |
| opolskie | 0,226 | 7 | 0,2238 | 10 | 0,3111 | 7 | 0,3835 | 5 | 0,3358 | 15 | 0,4296 | 11 | 0,3769 | 16 | 0,5113 | 13 | 0,5607 | 14 |
| podkarpackie | 0,1774 | 14 | 0,2588 | 7 | 0,2857 | 11 | 0,2721 | 15 | 0,2598 | 16 | 0,3476 | 15 | 0,5048 | 10 | 0,5095 | 14 | 0,5722 | 13 |
| podlaskie | 0,213 | 8 | 0,3175 | 3 | 0,2998 | 9 | 0,2964 | 13 | 0,4531 | 6 | 0,4783 | 8 | 0,4555 | 13 | 0,5678 | 10 | 0,5539 | 15 |
| pomorskie | 0,3903 | 2 | 0,243 | 9 | 0,4325 | 4 | 0,4838 | 2 | 0,5179 | 2 | 0,6648 | 1 | 0,5194 | 8 | 0,7461 | 3 | 0,7265 | 6 |
| śląskie | 0,2429 | 5 | 0,2757 | 6 | 0,4469 | 3 | 0,4143 | 4 | 0,4992 | 3 | 0,6436 | 3 | 0,6149 | 3 | 0,6201 | 7 | 0,8206 | 3 |
| świętokrzyskie | 0,1318 | 16 | 0,0524 | 16 | 0,1875 | 16 | 0,3133 | 12 | 0,354 | 12 | 0,4324 | 10 | 0,4046 | 15 | 0,4763 | 15 | 0,5515 | 16 |
| warmińsko - mazurskie | 0,2311 | 6 | 0,2229 | 11 | 0,2354 | 15 | 0,3583 | 9 | 0,4471 | 7 | 0,3414 | 16 | 0,5361 | 6 | 0,5388 | 12 | 0,6761 | 10 |
| wielkopolskie | 0,1624 | 15 | 0,2121 | 12 | 0,2942 | 10 | 0,3808 | 7 | 0,4419 | 8 | 0,4522 | 9 | 0,5218 | 7 | 0,6949 | 4 | 0,8201 | 4 |
| zachodniopomorskie | 0,2069 | 11 | 0,2995 | 5 | 0,4011 | 5 | 0,4885 | 1 | 0,4251 | 9 | 0,5443 | 5 | 0,5727 | 4 | 0,6105 | 8 | 0,7194 | 7 |

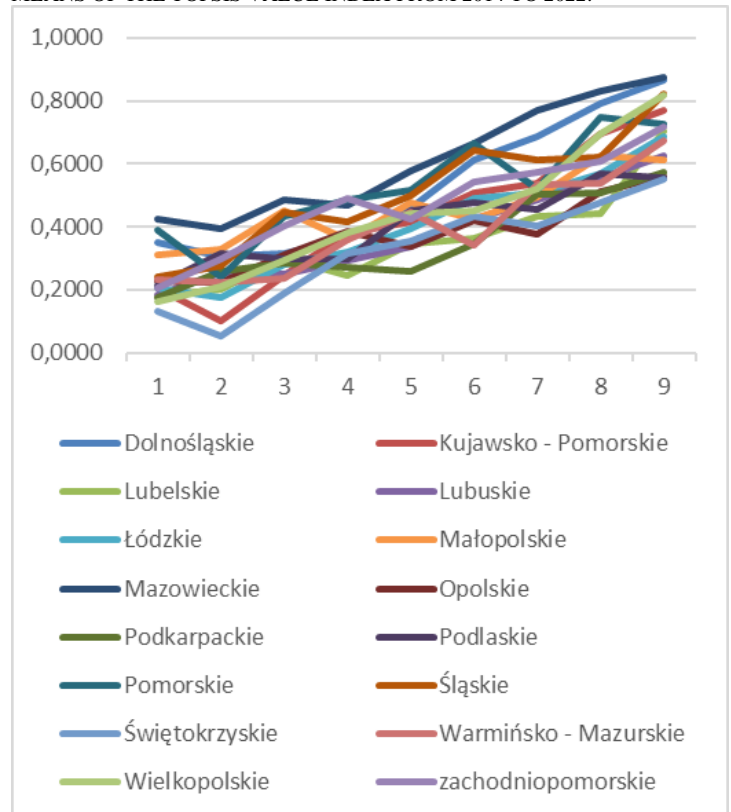
Source: own study.

In 2014, the highest value of this measure is characterized by the mazowieckie (0.93), pomorskie (0.80) and dolnośląskie (0.74) voivodeships. The last places in this ranking are occupied by the provinces of świętokrzyskie (0.13), wielkopolskie (0.21), lubelskie, lubuskie (0.23) and podkarpackie (0.24). Analyzing the year 2022, the highest values were maintained by the dolnośląskie (0.83) and mazowieckie (0.82) voivodeships. opolskie (0.19), świętokrzyskie (0.20) and podlaskie (0.20) and podkarpackie (0.22) voivodeships achieved the lowest value, while it is worth noting that this indicator was lower than in 2014 and significantly deviated from the value of this measure in the other voivodeships.

The survey made it possible to classify voivodeships in terms of the achieved level of use of e-government services. The ranking of voivodeships obtained using the TOPSIS method indicates that the clear leader in the use of e-government services in the period studied is the mazowieckie voivodeship. Among the provinces with high use of e-government services is also the Pomeranian voivodeship, which only in 2015 and 2022 ranked in the category of moderately low use. The category of voivodeships with medium-high utilization of e-government services includes śląskie, małopolskie, zachodniopomorskie and dolnośląskie voivodeships. The category of low utilization of e-government services included świętokrzyskie, opolskie and podkarpackie voivodeships, while the remaining voivodeships can be assigned to the category of medium-low utilization of e-government services.

The TOPSIS survey showed large disparities in the use of e-government services between voivodeships in Poland, as shown in Chart 1.

CHART 1. DIRECTIONS OF CHANGE IN THE LEVEL OF USE OF E-GOVERNMENT SERVICES IN THE PROVINCES OF POLAND BY MEANS OF THE TOPSIS VALUE INDEX FROM 2014 TO 2022.

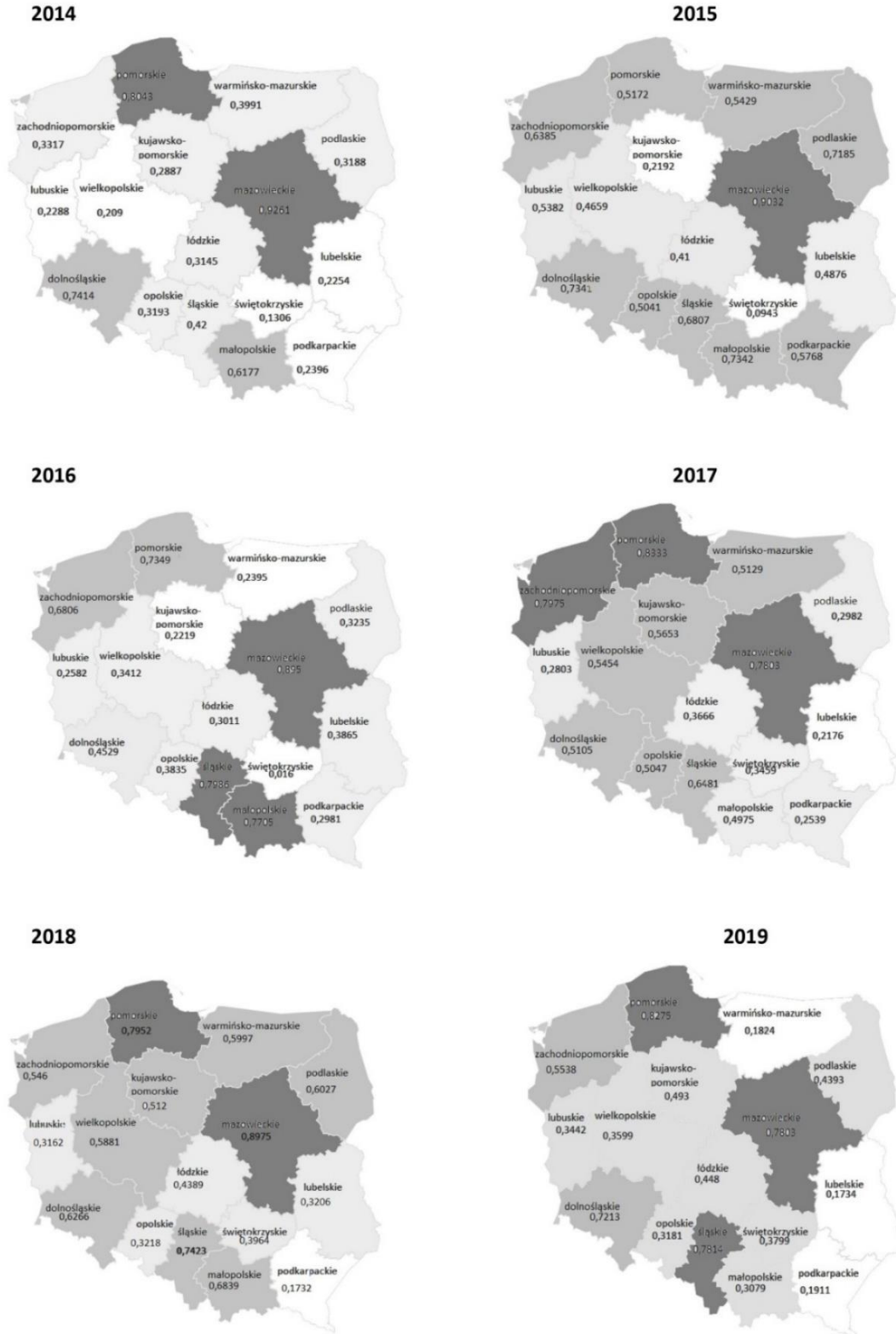


Source: own study

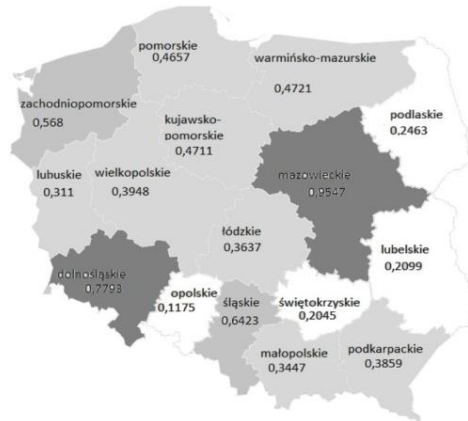
In 2014 - 2022, the best results were achieved by the mazowieckie voivodeship achieving a value of 0.87 followed by the dolnoslaskie voivodeship (0.86) and the śląskie and wielkopolskie voivodeships (0.82). Thus, the voivodeships characterized by the highest use of e-government services can

include the above-mentioned provinces, while the świętokrzyskie, podlaskie, opolskie and podkarpackie voivodeships were assigned to the lowest class in terms of the use of e-government services

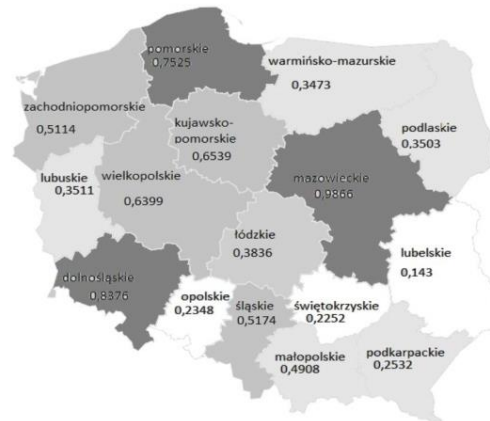
FIGURE 1. DISTRIBUTION OF VOIVODESHIPS DETERMINED BY THE TOPSIS METHOD - DETERMINATION OF THE VALUE OF THE SYNTHETIC MEASURE BASED ON THE BENCHMARK AND ANTI-BENCHMARK FOR THE YEARS 2014-2022



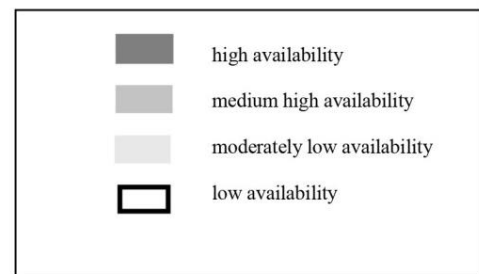
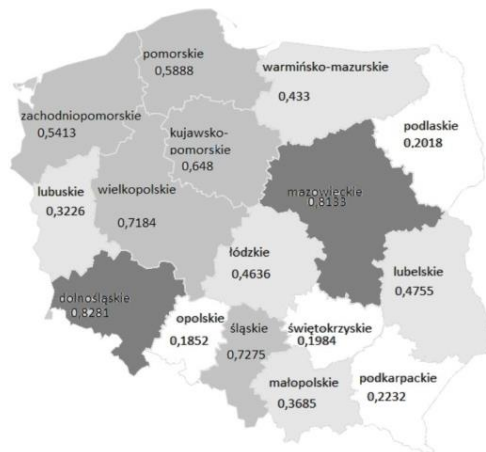
2020



2021



2022



Source: own study

IV. SUMMARY AND CONCLUSIONS

In conclusion, it should be said that class membership is variable, while a positive trend is that the number of voivodeships included in the lowest utilization class is decreasing. The results of the survey indicate that the mazowieckie and Pomerianian voivodeships are characterized by the highest use of public services, while the świętokrzyskie, podkarpackie and opolskie voivodeships are characterized by low use of e-government services. The use of e-government services in the other provinces varies.

Analyzing the results of the TOPSIS survey, one can notice significant changes in the use of e-government services in the podlaskie voivodeship, which in 2014 occupied the 8th position in the country, and in 2015 was in the 3rd position. The Pomerianian voivodeship occupied the 2nd position in 2014, while in 2015 it was already in the 9th position. Another significant change can be observed in the kujawsko-pomorskie voivodeship, which in 2015 occupied the 15th position in the ranking, and in 2017 was in the 6th position. Such a situation

may be due to the fact that the whole e-government is a long-term process, while all the voivodeships benefited from the funds obtained from EU programs at different times, which made it possible to obtain a position in the ranking for a given year.

Based on the analysis, there is considerable variation in each variable across provinces. What is unsatisfactory, however, is the insufficient interest in downloading and sending completed forms. The best position in this regard was occupied by the mazowieckie voivodeship, although the rate did not exceed 35%. This situation may be due to the fact that the public does not have a lot of confidence in sending documents electronically, since some procedures mandate personal appearance in offices. From observation, it can be concluded that these indicators will gradually increase in the coming years, as more and more offices accept applications only electronically (e.g. Agency for Development and Modernization of Agriculture - ARandMR - applications for area payments, Tax Office - PIT declarations).

Surveys conducted have shown that the use of e-government services is growing. Thus, the level of e-government development in Poland is increasing, which is not surprising in

the context of the chosen EU priorities. In turn, an analysis of domestic and foreign literature and EU documents shows that the variation in the development of e-government services is a complex issue. Conclusions are not always unequivocal, but the factors influencing the large disparities in the voivodeships should be carefully looked at, and certainly appropriate measures should be taken to level them out. In view of the major challenges facing Poland, related to the implementation of EU goals until 2030, it is reasonable to activate local governments, increase awareness of the availability of services and digital competence of citizens and businesses, and targeted investments in solutions for digitalization of administration services in provinces with a low level of digitalization of public services in the current financial perspective.

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