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DIGITAL INNOVATION OF PUBLIC SECTOR INSTITUTIONS. CASE STUDY OF THE REGIONAL EDUCATION AUTHORITY IN KRAKOW

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Purpose: The research aims to substantiate the assumption that public sector institutions, such as the Regional Education Authority in Krakow, are digitally innovative units that, due to progressive digitization, adapt their offer to the needs of stakeholders. Implementing this goal required identifying innovative digital solutions implemented by the Regional Education Authority in Krakow in the fields of tasks performed, process improvement, information and communication and work organization.
Design/methodology/approach: The theoretical part of the article describes the results of the literature review within the problem framework and the practical part presents and discusses the results of empirical research. The study was conducted using the survey technique (CAWI), and the study results were developed using descriptive statistics.
Findings: Research conducted at the Regional Education Authority in Krakow showed the average level of digital innovation of this institution. The study identified and analyzed digital solutions used in the areas of task execution, process improvement, information and communication, and work organization.
Research limitations/implications: The limitations of the conducted research mainly relate to their scope, the surveys were conducted only among employees of the Regional Education Authority in Krakow willing to participate in the study. The research should be expanded in the context of expanding the sample, preferably by employees of all Regional Education Authorities in Poland.
Practical implications: Research conducted at the Regional Education Authority in Krakow allows us to conclude that the level of digital innovation of this institution requires support, especially in terms of financial resources and the establishment of teams dedicated to the introduction of innovative digital solutions.
Social implications: The level of digital innovation, both in Polish and foreign public organizations, is an important issue and a long-term process, requiring changes and flexible adaptation to technological challenges and stakeholder expectations.
Originality/value: The presented research results on the implementation of digital innovation solutions in the Regional Education Authority in Krakow are in line with the current trend of research, which emphasizes the need to adapt the offer of services provided by public sector institutions to the expectations of diverse stakeholder groups. An important advantage of the

research is its unique character both in terms of the research area, which is the Regional Education Authority in Krakow, and the subject of research. This institution is often the subject of research in the context of the educational process and pedagogical supervision. However, there is little research using this institution to analyze management processes and the context of digitalization remains poorly recognized.
Keywords: digital innovation, public sector institutions, education, Regional Education Authority in Krakow, digitalization.
Category of the paper: Research paper.

1. Introduction

Recently, public administrations, like private companies, have faced the challenge of digitizing both their service offerings and internal processes. In addition to the clear benefit of increased efficiency and efficiency, digitalization also offers hope for increased citizen participation in public processes. Governments often need to adapt to changes in the social, political and technological environment and innovation is crucial to governments' ability to adapt to changing conditions (Janssen, Van Der Voort, 2016). This is especially true for management in increasingly turbulent times when different organizational agencies interact in highly volatile, inconsistent, unexpected and unpredictable ways (e.g., Ansell, Trondal, Øgård, 2017). The issue of innovation in the public sector is currently of increased interest to both managers of public organizations and policymakers, although it is still not seen as a disruptive phenomenon that radically changes the way public organizations operate. Researchers and practitioners assume that innovations implemented in public sector organizations contribute to the improvement of the quality of public services, the effectiveness and efficiency of operations, as well as solving stakeholder problems and coping with new social challenges (Bloch, 2011, p. 8).

The article aims to justify the assumption that public sector institutions, such as the Regional Education Authority in Krakow, are digitally innovative units that, as a result of progressive digitization, adapt their offer to the needs of stakeholders. Implementing this goal required identifying innovative digital solutions implemented by the Regional Education Authority in Krakow in the fields of tasks performed, process improvement, information and communication, and work organization.

The article in the theoretical part contains a description of the results of the literature review within the framework of the problem undertaken and in the practical part the presentation and discussion of the results of empirical research. The study was conducted using the survey technique (CAWI) and the results of the study results were developed using descriptive statistics.

2. The importance and development of digitalization in the public sector

The digitization of the public sector is one of the key challenges of modern economies and its development has a direct impact on the efficiency and innovation of public institutions. This process, understood as the introduction of modern information and communications technologies (ICT) into administrative activities and public services, includes both the transformation of internal organizational structures and relations with citizens and enterprises. The growing importance of digitization is primarily due to growing social expectations regarding the improvement of the quality of public services, shortening the time of their implementation, and increasing online accessibility. At the same time, progressing globalization and technological development force public institutions to adapt modern digital solutions to meet international competitiveness and build a stable administration based on digital data.

The development of digitization in the public sector is taking place at various levels, from the introduction of electronic document management systems, through the development of e-government portals, to advanced platforms enabling remote handling of official matters. A key element of this process is the integration of databases, which enables a more efficient exchange of information between individual public institutions, as well as improves the monitoring and management of public policies. The introduction of digital technologies in the public sector not only contributes to increasing the efficiency of administration but also strengthens the transparency and openness of government activities, which is an important aspect of building public trust.

It is worth noting that in the European context, the digitization of the public sector is strongly supported by the European Union's policy, which aims to build a digital single market. This strategy includes, among others, the development of e-services (e.g. e-health and digital identities) to enable citizens and businesses to freely access public services throughout the Community (European Commission, 2020).

The development of digitization in the public sector is a dynamic process, requiring not only the modernization of technological infrastructure but also a change in the approach to management and shaping public policies. A significant challenge remains the adaptation of new technologies by public sector employees and their effective implementation, which is associated with the need to systematically improve digital competencies and introduce innovative methods of managing digital projects.

Digital Government Transformation (DGT) plays a key role in the modernization of structures, processes and organizational culture of public institutions. It affects not only the need to introduce new technologies but also the overall reorganization of the activities and tasks of officials. This process includes the reconstruction of existing procedures and the introduction of technological innovations that change the way institutions operate at many levels (Tangi

et al., 2021). Thanks to the implementation of modern digital solutions, the administration can better respond to the needs of citizens and decision-making processes become more transparent, which is important given the growing importance of civil society. Ch. Ofoma and U. Suleiman pay particular attention to the challenges in the digitization of public administration (Ofoma, Suleiman, 2023) pointing out that one of the most important challenges related to the digitization of the public sector is the need to integrate various information systems, which requires not only significant financial outlays, but also appropriate competences on the part of administration employees. Solving the challenges is not possible without extensive training activities among officials, which are aimed at improving the efficiency of the use of modern technologies supporting the digitization process.

The digital transformation of the public sector is not limited to the implementation of technology but also includes building a new organizational culture that promotes innovation and collaboration. Thanks to the use of digital tools, it is possible to improve decision-making and executive processes, which translates into faster and more effective delivery of services to citizens. In addition, digital technologies support the transparency of the administration, which increases public trust in the processes carried out by offices. These examples show that digitalization has a broad impact on the development of values at various levels, including both economic and social (Cui, Aulton, 2023). However, the changes caused by the digital revolution not only affect the organizations themselves but also have a significant impact on all stakeholders involved in creating the organization's value. This is because no technology alone is sufficient to create public value. It is essential to put in place appropriate governance mechanisms and cooperation processes to involve citizens and other stakeholders in the value co-creation process. Digitalization, combined with an appropriate collaborative strategy, should lead to more sustainable and inclusive solutions in the public sector. Similar theses can be found in V. Cluley, S. Parker and Z. Radnor (2023), who note that the co-creation of public value is becoming an increasingly important aspect in the design and delivery of public services, especially in the context of cooperation between public entities and private stakeholders, as well as representatives of the third sector and citizens themselves. The development of digitization must therefore be a key element in building solutions that allow for the integration of modern technologies with public management processes, which not only leads to the improvement of services provided but also enables advanced coordination of cross-sectoral activities (Cluley et al., 2023). The authors also draw attention to the risks of "value destruction" (dis/value) resulting from the fact that in some cases decisions on the implementation of digital services may lead to the marginalization of certain social groups or their exclusion from co-creation processes, which harms the perception of public value. Certainly, digitalization in the public sector requires careful consideration of the needs of all stakeholders to minimize the risk of undesirable effects resulting from the digital exclusion of public organizations' stakeholders. Concerns about excessive and uncontrolled digitization are also expressed by Ch. Ofoma (2024), pointing to the risks resulting from the potential for cyberattacks on public administration organizations.

In conclusion, the development of digitalization in the public sector is an important element of the transformation of public services, enabling more effective, transparent and inclusive management. Digitalization not only streamlines administrative processes but also enables the co-creation of public value by involving citizens and stakeholders in the design and delivery of services. Thanks to the use of modern technologies, public institutions can better respond to the needs of society, while increasing the efficiency of their activities and sustainable development. However, as emphasized in the literature on the subject, digitization also brings challenges, such as the risk of marginalization of social groups that may be excluded from the processes of co-creation of public value and the risk of cyberattacks on public sector institutions. To prevent this, it is necessary to put in place appropriate governance strategies and cooperation mechanisms that enable the full involvement of all stakeholders. As a result, digital transformation in the public sector not only improves service delivery but also becomes a key tool in building a more inclusive and equitable society.

3. The essence of digital innovation in the public sector

According to P.F. Drucker (1992) innovation is a change in the value and satisfaction of consumer needs through the use of specific resources. The basis for the contemporary interpretation of innovation is the OECD methodology, in which innovations are perceived through the prism of product, process, marketing method and organizational solutions. The general definition of innovation in the latest edition Oslo Handbook, which applies to all sectors of the economy, including the public sector, provides that an innovation is a new or improved product or process (or a combination thereof) that differs significantly from a previous product or process that has been made available to potential users (product) or put into use by an entity (process) (OECD, 2020). Product innovation in the public sector refers to the introduction of new or significantly improved goods or services. These services may include, for example, administrative tasks or law enforcement functions; Process innovation, on the other hand, is concerned with the improvement of processes that contribute to the basic functions of public sector organizations. A particular role is given to the implementation of new technologies and frameworks for self-organization to improve the quality of services provided and efficiency (Singler, 2023).

In the public sector, innovation is defined equally broadly (De Vries, Bekkersi Tummers, 2016). It is understood as an idea, practice, or object perceived as new by an individual or organization (Rogers, 2003); as an adaptation of an existing idea for the first time by an organization (Borins, 2000); as new or significant changes in services, operational processes, methods of organization or ways of organizing and communicating with the user (Bloch, 2011). They are also seen as the introduction of a new service a significantly improved service,

or an improvement in service delivery, which is often the result of communication, organizational and process innovation. Innovation in the public sector rarely involves the implementation of a completely new service or delivery method. More often, it is an adaptation to the local context of a service or a method of its provision that has already been used elsewhere (Innovation in the Public Sector…, 2013).

Innovation is seen as a key factor in improving the efficiency and effectiveness of public service delivery and increasing the capacity to solve problems in the face of various societal challenges, such as demographic pressures and climate change (OECD, 2020; Torfing, Ansell, 2017; De Vries et al., 2016; Damanpour, Schneider, 2009). Thus, managers of public sector institutions perceive innovation as an important element of the state and see the need to act to strengthen the innovation potential of public administration (Singler, 2023). A review of the literature on the subject allows us to identify different types of innovations in the public sector (e.g. Windrum, 2008; Halvorsen, 2005; De Vries, Bekkers, Tummers, 2016; OECD, 2020, Singler, 2023).

In recent years, digital innovation has become an important phenomenon in the context of organizational transformation (Mergel et al., 2019; Baptista et al., 2020; Kemal, Shah, 2023).

Digital innovation, although there is no clear conceptualization of this concept and digital technology is a key component of digital innovation research, includes IT tools that are embedded in a socio-technical vision (Nambisan et al., 2017). Nambisan et al. (2017, p. 223) believe that digital innovation is the use of digital technology during the innovation process, which causes the resulting digital innovation to radically change the way services and products are created and structured, enabling new ways of creating and absorbing value. The authors define digital innovation as a sociotechnical phenomenon and conceptualize it "as the creation (and consequent change) of market offerings, business processes, or models that are the result of the use of digital technology. Thus, in digital innovation, digital technologies and related digitization processes are an integral part of a new idea and/or its development, diffusion, or assimilation.

Digital innovation is concerned with the continuous creation and organization of social and technical/physical artifacts for new and improved products, services, and business models, while it is limited to technological artifacts only and affects organizational change only (Kemal, Shah, 2023). Digital innovation extends beyond organizations and industries to include users and consumers, as the use of digital innovation involves actively selecting the resources of an offer and configuring them with other resources, and even thinking about their use and purpose (Henfridsson et al., 2018, p. 91). On the other hand, Hund et al. (2021), understand digital innovation as the creation or adoption and use of novelty that is inherently unlimited and adds value (e.g. product, service, process, or business model) through the inclusion of digital technology. They highlight the socio-technical contribution of digital technology as an essential part of digital innovation; internal or external innovation and novelty that adds value in terms of various possible outcomes in the form of a product, service, process, or business model.

Digital innovation in the public sector is also defined as the use of digital technologies and applications to improve processes and procedures in the delivery of public services (Mergel, Edelmann, Haug, 2019).

To effectively and efficiently pursue digital innovation, organizations need to find ways to engage both external and internal partners. Researchers report that digital innovation is radically changing the nature and structure of new products and services, enabling innovation collectives that engage diverse groups of actors with different goals and more generally, transforming entire industries. The dynamic, collective and limitless nature of digital innovation highlights the creation of innovative inter-organizational networks and open innovation networks, so I emphasize that innovation should be understood as a process of co-creation (Holmström, 2021).

Innovation at the organizational level is determined primarily by professionalism and the availability of free resources. The larger the organization, the more resources are available that can be involved in the adaptation of innovative solutions. In addition, the ability to innovate is also determined by the organizational culture and the presence of talented employees. The issues of empowering employees and transferring decision-making functions to them are important and at the same time, high skills and qualifications as well as entrepreneurial competencies, which are often characteristic of innovative employees, are desirable (Wodecka-Hyjek, 2023).

4. The Regional Education Authority and its role in the education system

The Regional Education Authority is the body that controls public and private educational centers and institutions. As a government unit operating locally in specific provinces, it takes care of maintaining education standards throughout the country. The tasks of the Board of Education and the functions it performs are strictly defined by the Ministry of National Education and relevant legal acts (Dziewulak, 2020; Act of 7 September 1991 on the education system, as amended). The superintendent's office is responsible for implementing the regulations of the Ministry of National Education, while the guidelines of the superintendent's office must be adhered to by the headmasters of both public and non-public educational institutions. On the websites and in the offices of the Regional Education Authority, you can find all the information on the functioning of schools and guidelines on the work of headmasters and teachers. The Regional Education Authority is therefore an intermediary body in cooperation between schools and the Ministry of National Education. The Regional Education Authority is located in each province and supervises educational institutions in their subordinate area, e.g. the Regional Education Authority in Kraków supervises schools and other educational institutions in the Małopolska Region. The main tasks of the Regional Education Authorities

include the implementation of the state education policy, including the implementation of the core curriculum, the distribution of funds for co-financing education, as well as the development of programs to improve the level of education and competencies of teachers in the province. In addition, the Regional Education Authorities organize scientific olympics competitions and reviews in their provinces, supervise the development needs of teachers, and initiate activities to improve teachers' competencies. They are also responsible for the organization of school exams, for the coordination of ways of spending free time with children and young people, and for the organization of additional activities during summer and winter holidays.

In addition to typical organizational tasks, the Regional Education Authorities also perform control functions. An inspection by the Regional Education Authority may be related to the work of the Regional Examination Board or the implementation of the core curriculum in schools in a given province. As the body supervising regional examination boards, the regional education authorities are also responsible for supervising school examinations. The tasks of the Regional Education Authorities also include the control of conditions at school, care for pupils, and counteracting social pathology. The Regional Education Authorities check whether schools comply with the rules for assessment, classification, and promotion of pupils, and whether the regulations related to full-time and part-time compulsory education are properly implemented. The Regional Education Authority may also audit the rights of the child and pupils/students in a given school, as well as the verification of the conditions of learning, education, and care for pupils in terms of safety and hygiene. The education authorities are responsible for selecting the techniques used to carry out all inspections and cooperating with other institutions that may affect school performance. The information collected during the visit is necessary to improve the Polish education system and search for the most effective methods of student development. Reports of the Heads of the REAs are delivered to voivodes and the Ministry of National Education. Conclusions drawn during inspections in given institutions and further plans for school inspections are officially communicated electronically to the general public access. The achievements of proven schools, teachers and students are also made public.

5. Research Methodology

The research aimed to assess the level of digital innovation as well as to identify and analyze innovative digital solutions implemented in the Regional Education Authority in Krakow. The methodological basis for distinguishing the types of innovation was the classification proposed by De Vries et al. (2016) and the Central Statistical Office (2018).

The study distinguished:

- Digital innovations in the scope of tasks carried out for stakeholders are identified with innovations in the field of digital products and services used to perform the tasks of the Regional Education Authority.
- Digital innovation for process improvement.
- Digital innovations in the organization of work aimed at increasing the level of quality of services and service.
- Digital innovation in the field of information and communication methods with both stakeholders and employees.

The survey was conducted using the survey technique (CAWI) from September 18 to September 25, 2024. The survey involved 101 employees out of 165 people employed at the Regional Education Authority in Krakow, which is 61% of the employees[1]. The questions to which answers were sought were:

1. What types of digital innovations are implemented and used in the Regional Education Authority in Krakow?
2. Which categories of digital innovations are particularly popular/developed in the Regional Education Authority in Krakow.
3. What type of digital innovation solutions are missing at the Regional Education Authority in Krakow?

The above questions became the basis for the adoption of the following research hypotheses:

H1: The Regional Education Authority in Krakow is a public sector institution implementing innovative digital solutions.

H2: At the Regional Education Authority in Krakow, digital innovations are implemented in the following areas: process improvement, task improvement, improvement of information and communication methods, and improvement of work organization.

H3. Some modern digital solutions in the field of process improvement, task improvement, improvement of information and communication methods, and improvement of work organization are rarely or not at all used in the work of the Regional Education Authority in Krakow.

To verify the H1 hypotheses, seven questions were used:

1. Has the Regional Education Authority in Krakow implemented digital innovations in the field of process improvement?
2. Has the Regional Education Authority in Krakow implemented digital innovations in the scope of the tasks performed?

[1] It is worth mentioning that the total number of employees of the Regional Education Authority also includes people who, due to their positions (e.g. drivers or porters), did not receive a questionnaire to fill in.

3. Has digital innovation in information and communication methods been implemented in the Regional Education Authority in Krakow?
4. Has the Regional Education Authority in Krakow implemented digital innovations in the organization of work?
5. Does the Regional Education Authority in Krakow use solutions to encourage employees to submit digital innovations?
6. Does the Regional Education Authority in Krakow have financial resources dedicated to the development and implementation of digital innovations?
7. Are project teams dedicated to the implementation of digital innovations established in the Education Authority in Krakow?

Respondents had the option of answering using a five-point Likert scale, where a score of 1 meant "definitely not" and a score of 5 meant "definitely yes". The answers provided allowed us to examine the opinions of employees on the main areas and conditions for the implementation of digital innovations in the Regional Education Authority in Krakow.

The verification of the H2 hypothesis was possible thanks to the analysis of answers to the seven general questions described above and the following five specific questions:

1. Which of the following digital solutions does the Regional Education Authority in Krakow use in the field of process improvement?
2. Which of the following digital solutions does the Regional Education Authority in Krakow use to improve tasks?
3. Which of the following digital solutions does the Regional Education Authority in Krakow use to communicate with external stakeholders?
4. Which of the following digital solutions does the Regional Education Authority in Krakow use to communicate with employees?
5. Which of the following digital solutions does the Regional Education Authority in Krakow use to improve the organization of work?

The answers to the indicated questions also allowed us to identify solutions in the field of digital innovations, which are missing in the Education Authority in Krakow, which verifies the third hypothesis (H3).

The above five questions were semi-closed, respondents could choose from the versions of the answers below them or add their suggestions. Respondents could select more than one answer.

6. Analysis and discussion of the survey results

Characterizing the implementation of digital innovation solutions in the Regional Education Authority in Krakow is in line with the trend of research in which the need to adapt the offer of services provided by public sector institutions to the expectations of diverse groups of stakeholders is highlighted. The efficiency and quality of public service delivery depend to a large extent on the ability of local authorities to transform administrative structures and processes that respond to rapidly changing conditions and growing needs of citizens, determined by advancing digitalization.

From the answers to the first four questions concerning the areas of implementation of digital innovations (Table 1), it can be concluded that in the opinion of the employees of the Regional Education Authority in Krakow, it is difficult to indicate one area that stands out. The average results of responses to these questions obtained from 101 surveys indicate that in the case of each of the areas, respondents rate the implementation between "moderate" and "rather yes". The highest score was given to digital solutions implemented in the field of process improvement (3.61) and the lowest to improving task performance (3.20). The next three general questions identified how the Regional Education Authority in Krakow supports the development and implementation of digital innovations. The assessment of the degree of support by the Regional Education Authority in Krakow for activities aimed at creating digital innovations indicated certain needs in this area. Support for individual employee initiatives was rated relatively best (3.14). The average rating of the other two ways of support fell below the average rating of 3 on the adopted scale and amounted to 2.98 for the establishment of teams dedicated to the implementation of digital innovations, and 2.86 for the provision of financial resources dedicated to digital innovations. The results indicate that the situation in terms of support for digital innovation in the Regional Education Authority in Krakow is not bad, but requires the attention of managers and further financial support. The answers given to the questions about the areas of implementation of digital innovations and the creation of conditions for their implementation allow us to conclude that the H1 hypothesis is true.

Table 1.
Assessment of digital innovations and conditions for their support

Question	Mean	Median	Minimum	Maximum	Standard deviation
Has the Regional Education Authority implemented digital innovations in the field of process improvement?	3,61	4,00	1,00	5,00	0,91
Has digital innovation been implemented in the Regional Education Authority in the field of task improvement?	3,20	3,00	1,00	5,00	1,05
Has the Regional Education Authority implemented digital innovations in the field of information and communication methods?	3,41	3,00	1,00	5,00	1,03

Cont. table 1.

Has the Regional Education Authority implemented digital innovations in the organization of work?	3,59	4,00	2,00	5,00	0,91
Does the Regional Education Authority use solutions to encourage employees to submit digital innovations?	3,13	3,00	1,00	5,00	1,27
Does the Regional Education Authority have financial resources dedicated to the development and implementation of digital innovations?	2,86	3,00	1,00	5,00	1,01
Are project teams dedicated to the implementation of digital innovations established in the Education Authority?	2,98	3,00	1,00	5,00	1,14

Source: own study.

The first of the detailed questions included in the survey concerned the digital solutions used by the Regional Education Authority to support process improvement. The respondents indicated three main solutions in this area (Table 2). More than half of the respondents indicated the fact that integrated information resources are used to improve digital processes, and slightly less paid attention to the procedures and instructions used for this purpose to manage electronic process data resources. Only one in three respondents used electronic systems such as ERP for this purpose.

Table 2.
Digital innovation for process improvement

Type of solution	Number of responses	Number of positive responses	Positive response rate
Digital, integrated information resources necessary for the execution of processes	101	54	53,46
Procedures and instructions for managing electronic data assets supporting the implementation of processes	101	50	49,5
IT system supporting the implementation of processes (e.g. ERP)	101	30	29,7

Source: own study.

In the next in-depth question, respondents were asked about digital solutions for improving stakeholder tasks. The results of the answer to this question are presented in Table 3. The largest number of respondents indicated the use of the Regional Education Authority's in Krakow website (87.13%) and ex-quo electronic system for submitting forms or submitting applications (73,27%) and various types of online platforms (73.27%). It is worth noting that there are only a few indications of solutions such as online appointment systems (3.96%), electronic voting systems (1.98%), or artificial intelligence (0%). The latter solution did not receive a single indication in the study.

Table 3.
Digital innovation for tasks delivery improvements

Type of solution	Number of responses	Number of positive responses	Positive response rate
Websites	101	88	87,13
Online platforms	101	74	73,27
Electronic system for submitting forms or submitting applications	101	74	73,27
Electronic systems for issuing consents and certificates	101	24	23,76
Big data	101	22	21,78
Electronic application systems	101	22	21,78
Online appointment systems	101	4	3,96
Electronic voting systems	101	2	1,98
Artificial Intelligence (AI)	101	0	0

Source: own study.

The next question concerned the digital innovations used by the Regional Education Authority in Krakow in the process of informing and communicating with external stakeholders. The answers to this question (Table 4) indicate that the website (88.12%) and the BIP website (86.14%) were used for this purpose. Another frequently indicated form of digital contact with external stakeholders is mailing (64,36%). On the other hand, solutions such as chat with an employee or a mobile application are indicated extremely rarely (0.99% and 2.97%, respectively), and a chatbot (AI) was not indicated at all.

Table 4.
Digital solutions for stakeholder information and communication

Type of solution	Number of responses	Number of positive responses	Positive response rate
Websites	101	89	88,12
BIP website	101	87	86,14
Mailing	101	65	64,36
Social media	101	30	29,7
Electronic Stakeholder Request Systems	101	28	27,72
Information campaigns on the Internet	101	19	18,81
Electronic contact form	101	18	17,82
Online tutorials and training for stakeholders	101	18	17,82
The Mobile Application	101	3	2,97
Chat with an employee	101	1	0,99
Chatbot (AI)	101	0	0

Source: own study.

The next question also referred to the use of digital innovations in processes related to information and communication, but this time between the employees of the Regional Education Authority in Krakow. As the answer to this question (Table 5) shows, the most frequently used digital solutions in this area include electronic documentation management system (98.02% of responses) and mailing (84.16%). The next places were taken by online instructions and training for employees (66,34%) as well as contact using the website (59,41%). On the other hand, social media (4.95%) and electronic systems for submitting employee requests (7.92%) are used the least frequently.

Table 5.
Digital solutions for employee information and communication

Type of solution	Number of responses	Number of positive responses	Positive response rate
Electronic Documentations Management System (EDMS)	101	99	98,02
Mailing	101	85	84,16
Online instructions and training for employees	101	67	66,34
Websites	101	60	59,41
Intranet	101	23	22,77
Electronic systems for submitting employee requests	101	8	7,92
Social media	101	5	4,95

Source: own study.

The last of the analysed questions concerns the use of digital innovations in improving the organization of work (Table 6). The most frequently indicated solutions in this area include electronic documentation management systems (98.02%), electronic time and attendance (34,64%), and the use of online platforms for online work (35.64%) and remote work (30.69%). On the other hand, the hybrid work (10.89%) and integrated data archiving systems (13.86%) are used the least often.

Table 6.
Digital solutions for organization of work

Type of solution	Number of responses	Number of positive responses	Positive response rate
Electronic Documentation Management System (EDMS)	101	99	98,02
Electronic time and attendance	101	36	35,64
The use of online platforms for online work (MS Teams, Zoom)	101	36	35,64
Remote work	101	31	30,69
Integrated data archiving systems	101	14	13,86
Hybrid work	101	11	10,89

Source: own study.

The answers to general questions concerning the areas of implementation of digital innovations, along with answers to specific questions about specific forms of solutions implemented in this area, allow us to confirm the H2 hypothesis.

To verify the H3 hypothesis, modern digital solutions were identified in process improvement, task implementation, information and communication methods, and work organization, which the Regional Education Authority in Krakow used sporadically or not at all. In terms of process improvement, the respondents least often indicated the use of ERP systems, which were mentioned by less than 30% of the respondents. In the area of improving task performance, a particularly low number of indications was noted for solutions such as online appointment scheduling systems (3.96%), electronic voting systems (1.98%) or artificial intelligence, which was not indicated even once. Concerning information and communication methods, the study distinguished two levels: solutions related to informing and communicating with stakeholders and internal communication addressed to employees. In the first case,

solutions such as chat with an employee (0,99%) and mobile applications (2,97%) were indicated the least, while chatbots were not indicated at all. In the second area, the least popular solutions turned out to be electronic systems for submitting employee requests (7.92%) and social media (4.95%). The last area analyzed concerned the use of digital tools in work organization. In this respect, the respondents indicated the hybrid work model (10.89%) and integrated data archiving systems (13.86%) the least often. The results of the research presented above allow us to confirm the H3 hypothesis.

An analysis of the literature on the subject allows us to notice that the context of digital innovations and their implementation at the level of public administration institutions has been taken up by various researchers. Hong et al. (2022) in their research focused on the analysis of the use of digital technologies such as big data, artificial intelligence, the Internet of Things, and augmented reality by Korean local governments in the transformation of their services. They noted that the implication of digital innovations in the public sector is mainly determined by the expectations of users and it can be directly said that there is demand-pull innovation, which is a response to citizens' demands for innovation. These researchers suggest the existence of isomorphic pressure as a driver of innovation in the public sector, state that public organizations imitate other organizations or companies in adopting innovative practices and found justification for the statement that the motivation of local governments to innovate digitally depends on local politicians and their election promises, and suggested that younger decision-makers are more active innovators. A specific adaptation of public sector organizations to the expectations of the social environment can be seen in the processes of their transformation. The processes of making public organizations similar to the organization of the business sector are an expression of a rational strategy resulting from the assumptions of modern concepts of public management. A kind of imitation and its key determinants are visible in the implementation of management methods in public organizations, often taken directly from the practice of enterprises. It also seems that institutional isomorphism, undoubtedly dominant among public organizations in recent decades, is the result of a kind of pressure to increase the rationality, effectiveness and efficiency of the functioning of the public sector (Wodecka-Hyjek, 2023). In turn, Kafel et al. (2021) characterize the use of digital technologies in public organizations in Poland. The authors indicate that the most frequently implemented tools in public administration in Poland are electronic record boxes, electronic document workflow, electronic handling of HR matters, online meetings, online courses, internal virtual network drives, electronic time recorders, and social media in contact with stakeholders. Kuhlmann and Heuberger (2023), on the other hand, characterize the state of digitization in German public offices on the example of the functioning of local citizen service points. The authors, based on the conducted research, stated that although local citizen service points are crucial for the digitization of local administration, the digital transformation in the surveyed service points is currently mainly limited to the information function of e-government, online communication between local authorities and citizens is much less developed,

and the transactional function is practically non-existent. Employees of the surveyed authorities do not see significant benefits of digitalization, on the contrary, they often reported increased stress, higher workload, additional time needed to process each case, more demanding procedures, and increased workload due to constant availability to superiors via email as a result of digitalization approaches. On the other hand, citizens, users of the digital office, mostly expected an increase in the package of e-services and the same level of digital interaction with public authorities as takes place in contacts with commercial suppliers. Equally interesting research is described by Kwon et al. (2024), who investigated the use of various digital technologies such as artificial intelligence (AI), blockchain, big data, 3D printing, augmented reality (AR), QR codes, drones, and the Internet of things (IoT) to improve public services and meet the needs of citizens. They noted that many local governments have embraced digital innovation and advanced technologies, including artificial intelligence, the Internet of Things, and big data, to solve often complex, often unprecedented problems, improve processes and procedures, and increase citizen engagement, despite the existence of significant differences in the adoption of digital innovations among local communities. At the same time, these authors provided evidence that community wealth/education levels and independent IT departments significantly affect the level of involvement of California governments in innovation and digital technologies.

The cited cases allow us to conclude that the level of digital innovation, both in Polish and foreign public organizations, is an important issue and a long-term process, requiring changes and flexible adaptation to technological challenges and stakeholder expectations. Research conducted at the Regional Education Authority in Krakow allows us to conclude that the level of digital innovation of this institution requires support, especially in terms of financial resources and the establishment of teams dedicated to the introduction of innovative digital solutions. The highest score was given to digital solutions implemented in the field of process improvement, while the lowest score was given to those related to the improvement of task performance. The most used innovative digital solutions in the area of process improvement are integrated information resources, procedures and instructions for managing electronic process data resources, and electronic systems such as ERP. In another area, improving tasks for stakeholders, the most frequently indicated were the websites of the Regional Education Authority and ex-equo the electronic system for sending forms or submitting applications, and various types of online platforms. The most used digital solutions in the field of employee information and communication are the electronic documentation management system and mailing, while the digital solutions used in informing and communicating with external stakeholders are primarily websites and BIP websites, as well as an electronic contact form. On the other hand, the most common digital innovations in improving work organization include electronic documentation management systems, electronic time and attendance the use of online work platforms, and remote work.

7. Conclusions

E-administration has become a response to the challenges commonly faced by public administration, i.e. debureaucratization, transparency, efficiency, friendliness, and compatibility. Modern technologies make it easier to meet these challenges. Universal access to online services contributes to reducing the specificity of resources necessary to carry out a given activity, which was analyzed in the context of the theory of transaction costs. Operations carried out electronically leave a trace, making their verification easier. This improves the transparency of operations, which is key to effectively reducing corruption. In addition, services that are not dependent on the official's decision, but are allocated 'automatically', are characterized by greater objectivity (Cichocki, Nagańska, 2021). Alvarenga et al. (2020) believe that digital local government is more likely to boost citizen engagement in local affairs and stimulate them by including innovative digital solutions. The innovativeness of institutions in the public sector is determined by many factors, among which the following deserve special attention: limited budget, responsibility of managers of public organizations for the decisions made and the risk of disposing of public funds, the possibility of significant political influence on the decisions made, the inability to overcome rigid rules and procedures, the inability to see long-term benefits, low level of adaptation of new technologies, changing social needs and expectations, organizational culture that is not conducive to innovation, ineffective cooperation with the private sector and society, poor leadership, employee resistance, and excessive demands of citizens (Wodecka-Hyjek, 2023). While research conducted a decade ago drew attention to barriers to innovation, contemporary research is focused on highlighting the premises and factors conducive to the implementation of innovation in public sector organizations (e.g. De Vries, Bekkers, Tummers, 2016, Moussa, McMurray, Muenjohn, 2018).

Summing up the research conducted by the authors, it can be stated that all three hypotheses have been positively verified, which means that the Regional Education Authority in Krakow is a public sector institution implementing innovative digital solutions. In the analyzed institution, digital innovations are implemented in four areas related to improvement: processes, tasks performed, methods of information and communication, and organization of work. At the same time, it should be emphasized that some modern digital solutions are rarely used or are not used at all in the work of the Regional Education Authority in Krakow. In conclusion, it should be noted that innovative digital solutions are used in the surveyed office, but there is a need for further development of their practical application.

Undoubtedly, the conducted research has certain limitations, resulting primarily from its limited scope (the surveys were conducted only among employees of the Regional Education Authority in Krakow willing to participate in the survey). Therefore, these results cannot be generalized and their analysis should be critical. Next, it would be necessary to expand the

research in the context of expanding the sample, preferably by employees of all Regional Education Authorities in Poland. It would be interesting to diversify the survey depending on the faculties or delegations and to confront the results obtained by extending the survey to other public sector institutions.

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References

1. Alvarenga, A., Matos, F., Godina, R., Matias, J.C.O. (2020). Digital transformation and knowledge management in the public sector. *Sustainability, 12(14),* 5824. DOI:10.3390/su12145824.
2. Baptista, J., Stein, M.K., Klein, S., Watson-Manheim, Lee, J. (2020). Digital work and organizational transformation: emergent Digital/Human work configurations in modern organizations. *The Journal of Strategic Information Systems, Vol. 29, No. 2,* 101618.
3. Bloch, C. (2011). *Measuring Public Innovation in the Nordic Countries (MEPIN)*. Aarhus: Danish Center for Studies in Research and Research Policy.
4. Borins, S. (2000). Loose Cannons and Rule Breakers, or Enterprising Leaders? Some Evidence about Innovative Public Managers. *Public Administration Review, 60(6),* 498-507. http://www.jstor.org/stable/977433
5. Cichocki, S., Nagańska, A. (2021). Przeciwdziałanie korupcji za pomocą nowoczesnych technologii – analiza skuteczności rozwiązań e-government, Gospodarka Narodowa. *The Polish Journal of Economics, iss. 3.* Warsaw School of Economics, pp. 97-124.
6. Cluley, V., Parker, S., Radnor, Z. (2023). Editorial: Public value for all? Considering the parameters of public value co-creation. *Public Money and Management, 43(1),* 1-3. https://doi.org/10.1080/09540962.2022.2140900
7. Cui, T., Aulton, K. (2023). Conceptualizing the elements of value in public services: insights from practitioners. *Public Management Review,* 1-23. https://doi.org/10.1080/14719037.2023.2226676
8. Damanpour, F., Schneider, M. (2009). Characteristics of innovation and innovation adoption in public organizations: Assessing the role of managers. *Journal of Public Administration Research and Theory, 19(3),* 495-522.

9. De Vries, H., Bekkers, V., Tummers, L. (2016). Innovation in the Public Sector: A Systematic Review and Future Research Agenda. *Public Administration, vol. 94(1),* pp. 146-166.
10. Drucker, P.F. (1992). *Innowacja i przedsiębiorczość. Praktyka i zasady.* Warszawa: PWE.
11. Dziewulak, D. (2020). *Polityka oświatowa. Przegląd ekspertyz z wybranych obszarów oświatowych (lata 2008-2018).* Warszawa: Wydawnictwo Sejmowe.
12. European Commission (2020). *eGovernment Benchmark 2020: eGovernment that works for the people.* Publications Office. https://data.europa.eu/doi/10.2759/24753
13. GUS (2018). *Badanie innowacji w wybranych jednostkach administracji publicznej w Polsce,* https://stat.gov.pl/statystyki-eksperymentalne/badania-i-rozwoj-innowacyjnosc-spoleczenstwoinformacyjne/badanie-innowacji-w-wybranych-jednostkach-administracji publicznej,3,1.html?pdf=1, 20.09.2024.
14. Halvorsen, T. (2005). On Innovation in the Public Sector. In: T. Halvorsen, J. Hauknes, I. Miles, R. Roste (eds.), *On the Differences between Public and Private Sector Innovation, Public Report No. D9*, NIFU STEP. Oslo, pp. 5-6.
15. Henfridsson, O., Nandhakumar, J., Scarbrough, H., Panourgias, N. (2018). Recombination in the Open-ended Value Landscape of Digital Innovation. *Inf. Organ., 28(2),* 89-100.
16. Holmstrom, J., Magnusson, J., Mahring, M. (2021). Orchestrating Digital Innovation: The Case of the Swedish Center for Digital Innovation. *Commun. Assoc. Informat. Syst., 48(31),* 248-264.
17. Hong, S., Kim, S.H., Kwon, M. (2022). Determinants of digital innovation in the public sector. *Government Information Quarterly, 39(4), Article 101723*. https://doi.org/10.1016/j.giq.2022.101723
18. Hund, A., Wagner, H.-T., Beimborn, D., Weitzel, T. (2021). Digital Innovation: Review and Novel Perspective. *The Journal of Strategic Information Systems, 30(4).* ISSN 1873-1198 (online).
19. Kafel, T., Wodecka-Hyjek, A., Kusa, R. (2021). The Application of Digital Solutions in Public Administration: the Evidence from Poland. In: Soliman (ed.), *Innovation Management and Information Technology Impact on Global Economy in the Era of Pandemic* (pp. 9124-9133). Proceedings of the 37th International Business Information Management Association Conference (IBIMA), 30-31 May 2021 Cordoba, Spain. King of Prussia, PA: International Business Information Management Association.
20. Kemal, A., Shah, M.H. (2023). Digital Innovation in Social Cash Organizations – the Effects of the Institutional Interactions for Transforming Organizational Practices. *Information Technology and People, 37(5),* pp. 2092-2126. DOI https://doi.org/10.1108/ITP-02-2023-0176
21. Kuhlmann, S., Heuberger, M. (2021). Digital transformation going local: implementation, impacts and constraints from a German perspective. *Public Money & Management, 43(2),* 147-155. https://doi.org/10.1080/09540962.2021.1939584

22. Kwon, M., Lee, E., Hong, S., Chun, S.A. (2024). Understanding the Determinants of Digital Innovation in California Local Governments: Digital Inequality and Agency Assignment Perspectives. *Digital Government: Research and Practice, 5, 3, Article 25* (September 2024), https://doi.org/10.1145/3689369
23. Mergel, I., Edelmann, N., Haug, N. (2019). Defining Digital Transformation: Results from Expert Interviews. *Government Information Quarterly, vol. 36(4),* https://doi.org/10.1016/j.giq.2019.06.002.
24. Mergel, I., Edelmann, N., Haug, A. (2019). Defining digital transformation: results from expert interviews. *Government Information Quarterly, Vol. 36 No. 4,* doi: 10.1016/j.giq.2019.06.002.
25. Moussa, M., McMurray, A., Muenjohn, N. (2018), A Conceptual Framework of the Factors Influencing Innovation in Public Sector Organizations. *The Journal of Developing Areas, vol. 52(3),* pp. 231-240.
26. Nambisan, S., Lyytinen, K., Majchrzak, A., Song, M. (2017). Digital Innovation Management: Reinventing Innovation Management Research in a Digital World. *MIS Quarterly, 41(1),* 223-238.
27. OECD (2020). *Podręcznik Oslo 2018. Zalecenia dotyczące pozyskiwania, prezentowania i wykorzystywania danych z zakresu innowacji. Pomiar działalności naukowo-technicznej i innowacyjnej.* Warszawa/Szczecin.
28. Ofoma, C. (2024). Digitalization and Public Value Co-Creation in Public Sector Organizations: The Citizens as Co-Creators. *Institutiones Administrationis – Journal of Administrative Sciences.* https://doi.org/10.54201/iajas.98
29. Ofoma, C.V., Suleiman, U.A. (2023). Workforce diversity and public. *Public Administration & Regional Studies, 16(2),* 43-61.
30. Rogers, E.M. (2003). *Diffusion of Innovations*. New York: NY, Free Press.
31. Rust, R.T, Kannan, P.K. (2003). E-Service: A New Paradigm for Business in the Electronic Environment. *Communication of the ACM, 46(6),* pp. 37-42.
32. Singler, S. (2023). A Measurement Framework For Public Sector Innovation: Advancing The Oslo Manual For Public Sector. *International Journal of Innovation Management, World Scientific Publishing Co. Pte. Ltd., vol. 27(01n02),* pp. 1-47, February, DOI: 10.1142/S1363919623500056.
33. Tangi, L., Janssen, M., Benedetti, M., Noci, G. (2021). Digital government transformation: A structural equation modelling analysis of driving and impeding factors. *International Journal of Information Management, 60(April),* 102356. https://doi.org/10.1016/j.ijinfomgt.2021.102356
34. Torfing, J., Ansell, C. (2017). Strengthening political leadership and policy innovation through the expansion of collaborative forms of governance. *Public Management Review, 19(1),* 37-54.

35. Ustawa z dnia 7września 1991 r. o systemie oświaty Dz.U. 1991, nr 95, poz. 425 (1991). https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU19910950425/U/D19910425Lj.pdf
36. Windrum, P. (2008). Innovation and Entrepreneurship in Public Service. In: P. Windrum, P. Koch (eds.), *Innovation in Public Sector Services: Entrepreneurship, Creativity and Management,* Cheltenham: Edward Elgar, pp. 3-20.
37. Wodecka-Hyjek, A. (2023). *Koncepcja oceny przedsiębiorczości publicznej w urzędach administracji samorządowej*. Kraków: Wydawnictwo Uniwersytetu Ekonomicznego w Krakowie.