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The Methods of Information Management in the Space of the Current Scientific Discourse: Recommendations for Public Sector Organisations

Abstract

Objectives: The information age constantly poses new challenges for management specialists. Such a circumstance encourages to creative considerations on how to overcome these challenges. The dynamics of changes taking place in the organisational environment and the response to them, which is formulated by the scientific community, is then an interesting subject of research. The author adopts the thesis that it is possible to identify certain common elements of the ongoing discourse, which determine its current character, adequate to the challenges of the present day. The presented analysis includes a study of examples of invoking information management methods in publications from recent years.

Research Design & Methods: The qualitative text analysis – especially one based on the method of binary oppositions – was used in the considerations. The use of this method makes it possible to indicate examples of common denominators connecting the publications that were the subject of the research.

Findings: As the result of the conducted research, the dimension of directing the discourse to the context of using the latest IT technologies to improve internal processes and, on the other hand, to increase the scope of inter-organisational integration was revealed. Another dimension of the discourse turned out to be the reference to information management methods in the context of using IT to change the role and importance of the human factor, but also to autonomise and automate the production system.

Implications / Recommendations: Based on the conducted analyses, recommendations were formulated that will make it easier for public sector organisations to implement their missions within the context of identified dimensions. However, it is necessary to implement changes consistent with the detected trends shaping the inter-organisational information exchange network.

Contribution / Value Added: It was found out that in the face of the changing level of complexity of the environment and the dynamically growing level of inter-organisational integration, the public sector must ensure its ability to engage in ongoing processes. This requires the introduction of appropriate system and organisational solutions as well as the development of analytical competences, taking into account the potential of artificial intelligence and other advanced information technologies.

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Introduction

In the times of the Fourth Industrial Revolution, one of the most important problems is the excessive amount of data and its diversity. The interpretation of such a set requires the detection of non-obvious relationships that connect individual elements. A properly prepared information system helps in the implementation of such a task. However, in order to effectively improve the system itself, information management methods should be used artfully.

The change in the operating conditions of modern organisations is the result of the development of breakthrough technological solutions that primarily affect the sphere of information use. For instance, solutions in the field of the Internet of Things and Services are appearing more and more often. As a result, vast, decentralised ecosystems are created, in which the network of interconnections is very dense (Manu, 2015). Inter-organisational ties become inseparable, eliminating the existing boundaries between cooperating entities (Bukowski, 2016). This affects the way information is managed. Enterprises are taking part in an increasingly faster race for who will be the first to recognise and properly interpret new trends and phenomena.

The ability to effectively collect information must be accompanied by the ability to process it effectively in the procedural and hardware aspect (Becker et al., 2009). At the operational level, the phenomenon of process automation is progressing. As a consequence, cyber-physical manufacturing systems are created (Monostori, 2014). Factors in the form of space and time lose their previous meaning. This creates conditions for innovative integration and optimisation of activities in the field of design, production, sales, and after-sales service (Chen & Li, 2018). Trends in the form of sharing economy cause the resignation from ownership in favour of a fee for use (Strømmen-Bakhtiar & Vinogradov, 2020) and the user themselves becomes a source of valuable feedback for the service provider (Trstenjak & Cosic, 2017).

The outlined above description of selected challenges that currently affect the sphere of information management shows how complex is the reality that organisations operating today face. In some areas, the observed changes are radical and establish new rules of the market game. Therefore, the question arises: what determines the space of topics discussed in the current scientific discourse (over the last two decades) in the context of information management methods – methods whose main task is to improve the functioning of the information system – and what implications does this have for public sector organisations?

Literature review

Information management methods are a very broad category. Its separation is associated with some difficulty. The problem stems from the universal spectrum of applications of many items of the aforementioned collection. The examples listed below include twenty tools of this type. The presented description involves the methods known for many years and mentioned many times in the literature on the subject.

The KSS communication system analysis method is based on the assumption that the quality and flow of information is closely related to the organisational structure and management system. It is postulated here that the information gap be minimised, leading to the optimisation of the course of interrelated information processes. One of the interesting areas of the application of the KSS method concerns the procedure of auditing the intellectual leverage effect. Such leverage is created by using the knowledge available in the environment. This is to lead to the preparation

of innovative products and services as well as to build an advantage based on intangible assets (Winkler, 2018). Another example of the application of the aforementioned method concerns improving the efficiency of the mutual communication system between cooperating enterprises (Schindlbeck, 2015). The method is also referred to in the context of efforts to improve the degree of use of IT within the information system, owing to the introduction of appropriate quality information to its interior (Schindlbeck, 2015).

The OiM method consists in examining and rationalising the operation of regulatory units of various institutions. It is about achieving an increase in the efficiency of the organisation of administration owing to the rationalisation of procedures, workflows, methods and systems of communication or control, as well as the organisational structure. Nowadays, it is emphasised that the method is highly useful when it comes to eliminating threats in the form of various attacks on the information system (McCall, 2022). Another important area of the application of this tool is the improvement of systemic support for processes aimed at undertaking research and knowledge management (Brezhneva, 2018).

The SADT method of analysis and design of information systems focuses on the development of an intra-organisational communication system. The functions of the system are gradually broken down into partial and elementary components, while the connections between them are depicted. The area of the application of the method turns out to be solving problems related to organising the operation of entire industrial sectors in accordance with the “smart” idea (Turlakova, 2019). The method also facilitates the implementation of a systemic approach to improve the efficiency of IT project management (Zakharova et al., 2020). Another area of the application of this method is the analysis of complex dependencies in the area of system-dynamic modelling of information influences and cooperation (Yablochnikov et al., 2018).

The BISAD method of analysing and designing the information system helps to build an information system that combines the implementation of the information function with the goals and structure of the organisation. Currently, the method is considered to be the basic tool for modelling information systems. The described method is actually a reference point for other tools in this area (Sungau, 2019). It is emphasised that the BISAD method is an effective tool for implementing Business Intelligence solutions (Kiselnicki & Misiak, 2021).

The ASTEX method is used to restructure the information system under the influence of a change in the division of labour or the structure of personnel qualifications, or the instrumentalisation of information processes. The method is currently appreciated for its effectiveness in restructuring the organisation of the administrative and office sphere of a typical production company (Łęgowik-Małolepsza, 2016). It is also noticed that the method facilitates the elimination or at least reduction of employee fatigue (Potocki, 2013).

The KIWA method of analysing the value of information and communicating is an extension of the popular value analysis. The method assesses the value of information, its carriers, form, flow, origin, timeliness. Owing to this, delays, unnecessary costs, and low quality of information are eliminated. KIWA is currently recognised as a precise tool for recording the course of information processes, which allows for the rationalisation of sources, methods, and forms of information transfer (Czekaj & Ziębicki, 2008). The discussed method is also valued from the perspective of its current applications in the field of information economy (Gola, 2016; Jaki, 2011).

The method of directive analysis is used to improve information processes and rationalise the media that control information processing. The logic of procedure used here requires defining the system outputs and then moving towards the inputs. It also requires thinking in terms of functions

and only then in terms of their carriers. Nowadays, the discussed method is appreciated for the precision of “thinking in terms of functions” (Ćwiklicki, 2011). The method is also useful in the context of current challenges related to the growing amount of data suitable for processing (Hong et al., 2021).

The DZA method of analysing the time of information processes is a tool that allows for the classification of activities carried out as part of the information process and optimisation of its time. For this reason, the DZA method is a valuable tool for diagnosing the information process (Włodarski, 2011). The method can also be used during the implementation of the Agile concept, because owing to it, the structure of administrative and office work can be rationalised in a way that will support the generation of innovative solutions (Łęgowik-Małolepsza, 2019). Generally, contemporary works aimed at mathematical modelling of information processes (in order to optimise them) are the field of the application of the discussed method (Dumas et al., 2021). This is particularly evident in relation to the current challenges of improving entire supply chains (Werner, 2020).

The KSA communication structure analysis method is used to identify internal and external information dependencies in terms of structural, functional, and process diagnosis of the direction of technical and technological changes in the system, organisation, and human resources. The application of the method leads to the detection of errors in the operation of the system and to the indication of the possibility of improving the situation. Nowadays, we can talk about the legitimacy of using the method in the area of analysing relationships in business networks (Barczak, 2015) and also to coordinate a portfolio of projects in network structures (Barczak & Bińczycki, 2018; Barczak, 2018).

M. Klotz’s strategic information system design method is used to define a strategy for an organisation’s information function. The method is a useful tool from the perspective of current challenges in management related to the need to determine the architecture of information processes (Urbanowska-Sojkin, 2009). As part of the Fourth Industrial Revolution, organisations are transforming in accordance with the course of their processes, moving from a vertical to a horizontal system. Currently, it is noticed that the method helps to effectively indicate the paths of data and information flow (Pietsch et al., 2004). Owing to the method, the organisation can fully focus on the effects of its basic activities and what is necessary for this to happen (Jiatong et al., 2022; Tariq & Khan, 2022).

H. Kadłubowski’s managerial information collection model method helps to define the scope of information needed by the management in the decision-making process. The method is currently appreciated for its high usefulness in identifying the real information needs of people managing various types of organisations (Czekaj, 2012). The knowledge of such needs obtained through the use of the method makes it possible to meet the contemporary challenges related to the dynamic growth of information resources (Rascão, 2021; Idoko & Akinsunmi, 2021).

The information flow path analysis method is used to eliminate the mismatch between the organisational structure and the information and decision-making system. Nowadays, the potential of the described method is noticed in the case of defining the ways and forms of providing information to decision-makers (Czekaj, 2012). Currently, it is emphasised that the advantage of the method is the reduction of the risk of making mistakes resulting in a distortion of the message (Nascimento et al., 2021). The challenges related to the analysis of information flow paths are today analysed in the context of implementing innovative solutions that are an expression of the Fourth Industrial Revolution (Molenaar, 2022; Colli, 2023).

The IKSI comprehensive inventory method of the information system is used to consider the system as a set of information, information channels, and technical infrastructure defined in space and time. The area of the application of the IKSI method today includes, among others, the implementation of solutions based on the idea of lean administration (Czekaj, 2010). A precise description of the studied reality allows for the effective implementation of solutions based on artificial intelligence that support managers in the decision-making process (Rtal & Hanoune, 2021; Nourani, 2021). Another area of the application of the method is the optimisation of increasingly complex relationships between public administration and business (Baran, 2010).

The HIPO input-process-output hierarchy method is used to optimise the design of the information system. The system is considered here at three levels: the whole system, the programme, and the programme module. Nowadays, the usefulness of the method is noticed in the sphere of defining the factors determining the success of an information system (Subiyakto et al., 2015) or determining the conceptual framework for this success (Nguyen et al., 2017). In general, the HIPO method is currently mentioned as a useful tool for developing various detailed system solutions that fit into the Fourth Industrial Revolution (Chen et al., 2019; Syed-Mohamad & Md. Akhir, 2019).

The BSP IT management infrastructure planning method is used to analyse and plan the IT management structure. The method facilitates the diagnosis of the structure of the entire information system as well as the recognition of dependencies between functions, cells, data sets, and IT subsystems. Nowadays, it is emphasised that it is a useful tool for designing the architecture of an information system (Vasconcelos & Sousa, 2022; Kotusev, 2021). The method is also mentioned by authors who consider the problem of information sharing. This is information saved in the system by various business functions that use it (Huom et al., 2022).

The method of the para-algorithmisation of information sets for a fixed part of the problem is used to analyse the information resources necessary to solve recurring problems (a situation of repetitive content, form, time, etc.) The challenges for which the method is applied are today the subject of a thorough analysis of the scientific community, because the implementation of solutions based on artificial intelligence translates into the need to standardise the scope of data and information (Adel, 2022). At the same time, such a need exists for entire complex supply chains (Khan & Abonyi, 2022). The use of the method can lead to an increase in the level of synergy between the human-worker and the surrounding technology (Pai et al., 2022).

The ISAC method of analysis and design of the information system is used to increase the level of the computerisation of the enterprise in a way that effectively meets its information needs. The perspective of the user's needs and system and IT procedures is adopted here. The ISAC method is nowadays particularly appreciated for its purposeful aspect, which allows the organisation to effectively respond to the challenges of the Fourth Industrial Revolution (Kavvadia, 2021). The implementation of the method is conducive to the flexible modernisation of the system operation and its adaptation to the requirements of cyber-physical organisational units (Cachada et al., 2018). The method is conducive to improving modern business processes with a complex course (Lundeberg, 2017).

The FAOR information system functional analysis method is used to analyse and design an integrated information system. The method focuses on modelling the organisation in the context of the latest achievements in IT knowledge. Nowadays, the FAOR method is used in the case of improving the scope of the cooperation and coordination of the organisation's activities with the support of information technology implemented as part of the information system (Schmidt, 2011). Currently, the FAOR method is used in relation to a wide range of problems in the area

of adapting information systems to the challenges of the present day (Pernici & Rolland, 2012). The literature also raises the issue of the usefulness of the method due to the way in which it takes into account the interactions resulting from the human factor in the created system solution (Fernandes, 2012).

The ARIS integrated information system design method is a tool that is based on the analysis of the organisation's activity, taking into account the perspective of its components and their functional properties. The use of the ARIS method makes it easier to build a modern information system that will be able to meet modern challenges (Dotsenko & Kamenskyi, 2019). The method is a response to trends that shape the use of the latest, innovative solutions emerging in the field of information technology (de Kinderen et al., 2021). Among these trends, the development of network organisations and progress in the use of artificial intelligence should be mentioned above all (de Kinderen et al., 2022).

The OOA/OOD method is a collection of tools known as object-oriented methods. They allow for effective modelling of system dynamics. Currently, methods from the OOA/OOD group are mentioned in the context of challenges related to improving the sphere of adjusting the system to the needs and expectations of its users or potential external partners (Ngowi & Mvungi, 2018). The method is treated as the foundation for the current paradigm of analysis and design of comprehensive solutions in the form of information systems (Tamai, 2019; Short, 2019). The literature also mentions that the OOA/OOD method is the optimal starting point for the complementary use of other specialised tools (Yadav et al., 2021).

Methodology

In the context of the conducted literature review, there arises a question about the possibilities of identifying dimensions shaping the space of scientific discourse devoted to methods of information management. The Qualitative Data Analyses (QDA) methods are the tools that can be successfully used in a case such as the search for a common denominator of contemporary scientific discourse. The specificity of the data here is that it is qualitative in nature, which excludes the possibility of making simple quantitative comparisons (Creswell & Creswell, 2018). The aim of the analysis is to find the key content elements and relationships that create the context. In the modern world, the exploration of this type of cognitive space often brings new and very valuable insights, expanding the available knowledge and opening new research fields. The requirement of representativeness in the case of this type of qualitative research does not apply. The point here is only to observe the characteristic symptoms of previously unnoticed phenomena and relationships that confirm the existence of these circumstances. Therefore, in this case, there is no need to comment on the frequency of the recorded observation; what counts is the fact of even a single statement of the occurrence of the identified phenomenon (Krippendorff, 2013). This approach also allows us to reach for incomplete, selective, diverse datasets, the composition of which seemingly raises objections related to the subjectivism of the selection. In this case, however, it is about inspiration and noticing prospective new perspectives of analysis. There is an analogy here to the procedure known from such methods as “brainstorming” or “focus group research”. The main subject of interest is the structure of the semantic context that occurs in the material studied. When analysing the title issue, the following rules of conduct were applied:

- the titles and abstracts of the publications identified and described in the previous section of the considerations were adopted as the units of analysis. The selection of these publications was intentional and was to guarantee the diversity of the set of considered cases;
- all included publications had to focus directly on the analysed title issue;
- in each of the included publications, the terms that constitute the basic context of the presented scientific discourse have been distinguished;
- the next step was to develop a concept map showing the network of connections between the identified concepts that create the context;
- finally, a strategy of analysing binary oppositions by nomothetic explanatory induction was applied (Gibbs, 2008; Kuckartz, 2014).

Research results

The analysis of the scientific publications described in the previous sections – which were devoted to twenty methods of information management – indicates their significant diversity in terms of the context of the considerations. For the purpose of the analysis, the concepts that can be distinguished are presented in the form of nouns. The resulting initial set includes the following elements: network organisations, public sector, information system, information technology, business processes, the Fourth Industrial Revolution, information flow, information relations, IT development, IT management, technological maturity, the implementation of IT technology, process automation, artificial intelligence, digital transformation, information process, smart production, the integration of information resources, the coordination of information resources, socio-technical system, cyber-physical system, information needs, information audit, system innovations, technological innovations, process innovations, system modelling, information efficiency, the Internet of Things, information value, strategic information, information engineering, information architecture, value chain, integrated system, sharing economy, information sharing, information security, decision-making process. The next step was to reduce the above set due to the occurrence of synonymous terms.

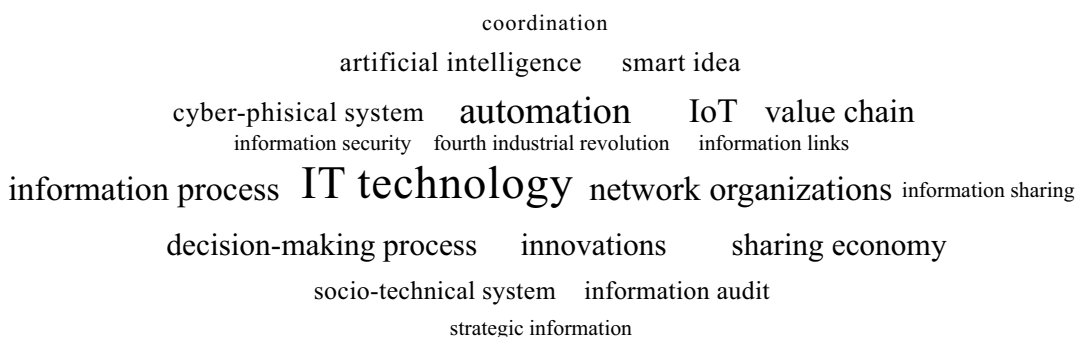


Figure 1. A map of key concepts defining the context of recalling information management methods in contemporary scientific publications

Source: Own research.

Based on the set of selected key phrases forming the context of the researched discourse, a concept map was created (Figure 1). Concepts of the greatest importance for recognising

the general context in which the analysed publications fit in have been marked on it. Concepts that are closer to the centre of the map have a denser network of connections with other concepts, while the size of the font indicates the frequency of their occurrence in the set of publications – usually both parameters changed in a similar way.

Discussion

The Fourth Industrial Revolution, even when it was not directly mentioned, left its mark on the scientific discourse conducted in recent years. This manifests itself in various ways. This is particularly visible in the area of references to information management methods. We are dealing here with the management of a resource that is of key importance from the perspective of the current changes. Almost every sphere of organised human activity is influenced by this dynamic process. However, the nature of the successively emerging challenges and the knowledge accumulated so far make it seem that certain phenomena attract the attention of a wider group of researchers. Therefore, the thesis was adopted in the considerations that it is possible to identify certain common elements of the ongoing discourse, determining its current character, adequate to the challenges of the present day. In accordance with the procedure provided for, in the presented analysis it was decided to attempt to indicate the criteria for the division identified in the context research, in accordance with the logic of determining binary oppositions by means of nomothetic explanatory induction.

The image that emerges from the analysis of the map of key concepts that determine the context of referring to information management methods in contemporary scientific publications leads to the formulation of at least two criteria. The first of these criteria concerns directing the discourse to the issue of using the latest IT technologies to improve internal processes on the one hand and to increase the scope of inter-organisational integration on the other. The common denominator here is the issue of references to the formal boundaries of the organisation in the conditions of the growing importance of information resources and their flow. This is evidenced, on the one hand, by concepts strongly emphasising the perspective of improving the internal organisation, such as “information security” or “decision-making process”, and, on the other, by concepts indicating the increasing importance of supra-organisational structures: “value chain”, “sharing economy”, or “network organisations”. A good example of a discourse conducted in accordance with the observations made is the invoking of the KSS communication system analysis method as part of considerations on the possibility of improving the communication process between independent organisations (Schindlbeck, 2015); the DZA method of analysing the time of information processes to describe the issue of coordinating the operation of the entire, complex supply chain (Werner, 2020); or KSA communication structure analysis methods to consider complex relationships in business networks (Barczak, 2015).

The second criterion differentiating the ongoing discourse may be the issue of recalling information management methods in the context of using IT to change the role and importance of the human factor and, on the other hand, to give autonomy to technical solutions and automate the production system as a whole. The common denominator here is the issue of references to the scope of human interference in the functioning of the system. This is evidenced, on the one hand, by concepts such as innovation, strategic information (requiring creative interpretation by a human), decision-making process, and, on the other, by concepts such as automation, the Internet of Things, and artificial intelligence. A good example of a discourse conducted in accordance with the observations made above is the reference to the FAOR information system functional analysis

method as part of considerations on the importance of interactions resulting from the impact of the human factor (Fernandes, 2012); the ARIS integrated information system design method to describe the issue of using artificial intelligence within the information system (de Kinderen et al., 2022); or the HIPO input-process-output hierarchy method to consider creating innovative system solutions that fit into the idea of the Fourth Industrial Revolution (Chen et al., 2019; Syed-Mohamad & Md. Akhir, 2019).

The identified dimensions of the space of recalling information management methods (within the current scientific discourse) are not the only possibilities in this regard. Potentially, further common denominators can be sought within the researched discourse. However, it is not the number of dimensions that is important here, but the observation and description of the trend that proves the phenomena taking place. In the analysed case, we are dealing with the process of using traditional methods of information management to improve the space in which, as a result of technological changes, the role of a human being is changing. What we are observing proves a general redefinition of the scope of tasks facing humans. This is the result of a dynamic increase in the amount of information that needs to be processed, with a simultaneous increase in their diversity and the scope of reality that this information represents (and it is for this reason that the formal boundaries of the organisation cease to matter). At the same time, it turns out that everything should be treated as if it were in constant motion due to the number of interactions connecting increasingly complex networks of related entities. All these conditions change the optics of looking at information management methods, which is expressed in the current scientific discourse devoted to this subject.

Turning to issues related to the functioning of public sector organisations, in the context of the observations made so far, it is possible to formulate recommendations that will facilitate the implementation of the mission of this type of entities in the modern world. Organisations whose main goal is not profit but solving problems important to a given community, in the face of the growing level of the complexity of the environment, must take care to deepen their integration with it. Access to more and more complete information is the foundation for building the organisation's influence on the entire system. Therefore, in order to effectively influence the reality, it is crucial to deepen the level of the understanding of phenomena occurring in a specific network of integrating entities (Geodecki & Zawicki, 2021). Since changes in the functioning of the public sector must keep up with changes in the environment, it is necessary to dynamically develop competences that allow public sector organisations to more precisely identify rapidly growing (both quantitative and qualitative) information resources generated within the network of cooperating entities (van der Meer & Dijkstra, 2022). Owing to information management methods such as those discussed above, it is possible to consciously create specialised interfaces that allow public sector organisations to "plug in" to the optimal place in the stream of inter-organisational information flows. This also means that such organisations need to intensively develop advanced analytical competences based not only on organisational solutions, but also on the use of the latest information technologies, especially artificial intelligence.

Of course, from the perspective of key technologies – the dynamic development of which takes place as part of the Fourth Industrial Revolution – public sector organisations should pay special attention not only to solutions based on artificial intelligence but also to blockchain technology (due to the credibility of data sources of various origins) and quantum computers (due to the rapidly increased computing power enabling the processing of a gigantically growing amount of data). The breakthrough associated with the use of artificial intelligence involves relieving humans

from the mental work of detecting patterns in large datasets and identifying any deviations from the standards set by the relevant public authorities. It is obvious that in the public sphere, activities are conducted primarily on the basis of a system of standards, regulations, and procedures. This situation is particularly suitable for the use of the previously mentioned technologies, because it is an area of highly determined activities and, in addition, everything takes place within a clearly defined context of references. This distinguishes this type of activity from commercial ventures, which require much more individual creative input that only the human mind can provide.

Like all research procedures, the analysis presented above is subject to various limitations. Due to the qualitative nature of the methods used, the unresolved issue at the current stage of work is determining the statistical characteristics of the observations made. Qualitative research does not guarantee that the explored area covers the most important issues from the perspective of the challenges faced by the examined public sector entities. It may even turn out that subsequent similar studies will lead to slightly different conclusions. However, this will not be a denial of the results already described, but only their extension and supplementation with an additional point of view. The qualitative research results presented here are, therefore, only exploratory in nature and should be treated as such. This means that any conclusions drawn refer only to a certain aspect of the examined reality. In this case, additional limitations also result from the scope of the examined source material (but the qualitative nature of the analysis makes it possible to focus on data that is merely an exemplification of a broader group of phenomena). The purpose of carrying out the procedure described above was to identify and understand the nature of exemplary relationships that can be observed in the studied area without judging the scale of their occurrence.

Conclusions

The carried out analysis shows a complex picture of the space of the current scientific discourse, which is devoted to information management issues – especially when it comes to taking into account the perspective resulting from the specific activities of public sector organisations. However, it can certainly be said that in the face of the changing level of the complexity of the environment and the dynamically growing level of inter-organisational integration, the public sector must also ensure its ability to join the ongoing processes. This requires the introduction of appropriate system and organisational solutions as well as the development of analytical competences, taking into account the potential of artificial intelligence and other advanced information technologies. Future research – based on the conclusions presented above – should more precisely determine the scale and scope of necessary adaptation activities that public sector organisations can carry out in order to effectively implement the tasks entrusted to them in a world changed by the Fourth Industrial Revolution.

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Conflicts of Interest

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Data Availability Statement

All data will be available and shared upon request.
