AI as an element of digital transformation in the activities of critical infrastructure regulators in the context of the personality and behavioural conditions of officials

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Abstract

The aim of this article is to identify personality and behavioural conditions as determinants of AI implementation by critical infrastructure (telecommunication and energy) regulators in Poland. To achieve the research objective the results of a survey and experimental research were used. They were conducted between 2022 and 2023 among officials of the Office of Electronic Communications and the Energy Regulatory Office. It was shown that officials are responsible optimists willing to cooperate. They are individuals with relatively low levels of trust in others as well as moderate assertiveness and low risk aversion. Their risk propensity is consistent with prospect theory. They perceive more risk in making decisions under uncertainty than under risk. In contrast officials' succumbing to the *status quo effect* and the *sunk cost effect* is dependent on *framing effect*. Personality and behavioural conditions have implications for the implementation of AI by regulatory authorities.

Keywords: AI, digital transformation, critical infrastructure, public administration, personality and behavioral traits

1. Introduction

Permanent civilization development of the dependence of modern societies on broadly understood infrastructure. Part of this infrastructure is the so-called critical infrastructure (CI) [2]. It plays a particular role in ensuring the continuity of the functioning of the state, its authorities, institutions, services and the exchange of information between them [24]. It is therefore imperative that decision-making processes are undertaken efficiently and optimally by the regulators of these markets. The role of regulators of critical infrastructure markets is to equip employees with the tools to streamline these processes. In recent years, automation, ITC and digital technologies have begun to play a key role in the operation of public administration and the delivery of public services. These form the basis for the development of Digital Era Governance (DEG) and its more advanced version Essentially Digital Model of Governance (EDGE) [38]. The article concerns regulatory authorities in Poland: the Office of Electronic Communications and (OEC) the Office of Energy Regulation (ORE) as an example of central

government administrative authorities [18, 19]. Their selection was based on the crucial importance for the economy and society of these elements of critical infrastructure (information transmission and energy). While pointing out the need to improve decision-making processes in regulatory authorities. Operating in the so-called network sectors they have similar areas of activity, i.e. managing the state's critical resources, creating competition, increasing the availability and quality of services of telecommunications and energy companies with the security of the state while taking into account sustainable development. Any delays in decision-making in these areas affect the efficiency and effectiveness of regulators. Artificial intelligence (AI) offers new opportunities in this regard. It is currently undergoing intensive development and is being applied in many areas of private and public sectors [38], [45]. Of key importance in the use of AI in EU countries is the harmonization of laws in this area. A regulation (AI Act, AIA) was issued in 2024, which introduces a legal framework for the operation of AI-based mechanisms. It not only provides a foundation for innovation through the use of AI, but also guarantees security and respect for human rights in the face of rapidly developing this technology [17]. Recent studies have identified opportunities for using AI in the public sector [6]. These include improving the quality of public services [15], forecasting and implementing policies [34], and creating trust and cooperation between citizens and public authorities [42]. It is also indicated that AI is bringing major changes to the structure of public administration and its management methods [12], which will affect their future operation [36]. Research results confirm the potential of using AI in public administration, but also emphasize the need for constant supervision and development of AI models [29]. An attempt was made to explore the potential for regulators to implement AI in the assessment and decision-making process bearing in mind the personality and behavioural conditions of the officials. They may be among the important determinants by which the use of AI in the public sector has been slower than in the private sector over the past few decades [1]. This is an interdisciplinary approach to the issue of public offices' implementation of AI. Moving away from a literature focused primarily on technological issues and driven by the motive of broadening the debate on AI in public administration it was found that there is a research gap. The article poses the following research question: can personality and behavioural conditions be a barrier to the implementation of AI in decision-making? Thus, the aim of the article became the identification of personality and behavioural conditions as conditions of AI implementation by critical infrastructure (telecommunication and energy) regulators in Poland. It was hypothesised that personality and behavioural conditions constitute a barrier to AI implementation by regulators.

The article first refers to critical infrastructure. This was followed by a detailed literature review of public administration and their use of artificial intelligence. To the authors' knowledge there is no research on the use of AI in regulatory offices and no studies on the personality and behavioral determinants of regulatory officials in the context of AI implementation. This article aims to fill the resulting research gap. This provides an opportunity to better predict officials' reactions to AI introductions in regulatory offices. It should be emphasized that the article does not question the importance of other factors determining the use of new technologies, including AI, such as gender, age, experience, voluntariness, expected effects, social influence (UTAUT model) [37] and organizational dynamics, and cultural and political conditions. These can also play a significant role in explaining the perspectives and attitudes of regulatory officials toward AI.

This is followed by the results of surveys at OEC and ORE between 2022 and 2023 on personality traits and behavioral aspects of officials' decision-making. The inclusion of officials from the two regulatory authorities strengthens the power of the conclusions. In addition, the article presents recommendations that contribute to the practice of regulatory offices in the context of using AI.

2. Literature review

The authors conducted a narrative review of publications indexed by Scopus to map existing conceptual approaches and propose a conceptual framework. The paper uses a grounded theory approach, and the articles are thematically analyzed to identify concepts related to artificial intelligence and public administration. The grounded theory approach uses an open, axial and selective coding process. They identified more than 526,000 articles indexed with the keyword

"artificial intelligence" and more than 47,000 articles with the keyword "public administration" (data as of March 20, 2025).

By choosing 'artificial intelligence' (AI) and 'public administration' as keywords to search for articles (302), the authors aimed to capture different perspectives on the field. By choosing these terms, they ensured that the review would cover different aspects of the application of artificial intelligence in the context of public administration. This enabled the authors to provide a comprehensive overview of the current state of research and emerging trends. It was decided to limit the research to open access articles related to the topic of current, practical applications of AI in decision-making in public administration. Based on the aforementioned criteria, the authors made a selection by reviewing the abstracts of 125 articles and, as a result, 14 articles were left for the next stage. These articles were reviewed in full-text and described in this article. In the next step, the documents were reviewed in terms of the area of application of AI in decision-making processes in public administration. The results are presented in Table 1.

Table 1. Areas of application of AI in decision-making processes in public administration - results of The literature survey

Area of application	Description	Article
Supporting decisions to shape sustainable development	Participation in decision-making, transformation processes of modern local government public administration towards sustainable development, support in environmental management	[25] [31]
Support for public service planning decisions	Improving the quality of public e-services better management in this area, opportunities for citizens to participate in the design and implementation of services delivered by artificial intelligence	[15] [41]
Crisis management	Public safety management and crisis management optimisation integrating AI technology	[23] [40]
Support of decision-makers	Digitisation supporting managers in their decision-making and at the same time changing their competence and training needs of managers ,application of expert systems, supporting the knowledge management process	[22] [28]
Improving documentation management	Document management system	[3]
Automated decision-making systems	Algorithmic decision-making in public administration mainly in relation to enforcement of legislation, drawing attention to the problem of staff responsibility for automating decisions in the system, constraints on the design of decision-making systems and how they are implemented in organisations, the need to best design explanations of automated algorithmic decisions from a social and human perspective in different decision-making contexts, the need to consider socio-technical and legal perspectives of transparency in relation to algorithmic decision-making in public administration	[1]
Data management and data protection **Ensuring the security of data needed for decision-making processes**	Data management and data protection, data management in algorithmic Big Data systems based on AI, highlight the enormous potential of data generation, useful for prediction, forecasting and decision-making through AI techniques, to highlight the need to transform huge amounts of data into information, pointing to machine learning as a technology capable of dealing with the classification of large data sets for statistical purposes and more complex tasks such as decision-making, using artificial intelligence to enhance document security in the public sector, need to create appropriate regulations	[7, 8] [26] [30]

Source: autors' own work.

The research focuses mainly on the issue of implementing AI-based solutions in public administration. It should be pointed out here that in the initial phase of increasing automation and implementation of ICT in the creation and distribution of public services were the main issues for New Public Management. The consequence of further technological changes is the Digital Era Governance and Essentially Digital Model of Governance [39]. Digitalization is to enable the development of effective, efficient and inclusive solutions supporting the creation of public policy and the provision of public services. This research, these concepts were supplemented with personality and cognitive determinants of the implementation of AI in public administration.

3. Methodology

The survey was conducted between 2022 and 2023 among officials of two regulatory

authorities in Poland: The Office of Electronic Communications (n=107, W: 50.5%, M: 49.5%) and the Energy Regulatory Office (n=157, W: 60.5%, M: 39.5%). In the first stage of the research, questionnaire experiments were prepared. These presented scenarios of decision-making situations through which behavioural effects were identified. The assumption was made that individuals know how they would behave in certain situations in reality [20]. Due to the purpose of the article research results are presented on succumbing to behavioural effects under conditions of risk and uncertainty [4], [35], succumbing to the *status quo effect* [13], [35], *framing effect* [5], [35], [44] *sunk cost effect* [14]. Their characteristics allow us to conclude that they are relevant in the situation of assimilation and implementation of new solutions by individuals. The empirical data are presented on a dichotomous scale: 0 - no effect, 1 - effect). Five levels of behavioural effects have been defined: a) <20.0%, never occurring or very rare effect, b) <20.0-40.0%), rare effect, c) <40.0-70.0%), medium often effect, d) <70.0-90.0%), very often effect, e) ≥90.0, almost always or always effect. In the second stage of the study, the officials assessed [20] their own personality traits with reference to the Big Five Model of Costa and McCrea [10, 11]. In this case, personality is categorised into neuroticism, agreeableness, conscientiousness, extraversion and openness. The classification of personality traits proposed in this model is the most reliable, recognisable and most widely used in personality trait research [24], [32, 33]. A scaling of the importance of each personality trait was performed using a 5-point Likert scale. The following response coding was used: definitely no (-2), rather no (-1), no opinion (0), rather yes (1), definitely yes (2). The responses obtained were subjected to appropriate statistical analysis using Excel.

4. Research results

The use of AI in the activities of regulators, both at the stage of regulatory programming, implementation and control to a large extent may depend on the personality of officials and their susceptibility to succumb to behavioural effects. Undoubtedly, it is fully justified to identify these conditions. Figure 1 presents the results of the study on the personality of officials.

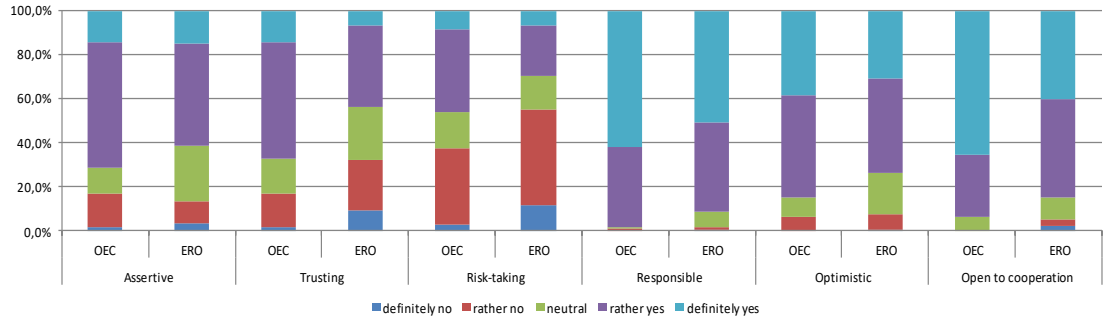

Figure 1. Personality traits of officials in regulatory agencies
Source: authors' own work.

The first of the personality dimensions identified in Costa and McCrea's Big Five Model is extraversion. Among other things, it relates to social self-confidence - assertiveness. Regulatory officials overwhelmingly rated themselves as assertive individuals. 71.1% of OEC officials and 61.1% of ERO officials rated their personality in this way ('rather yes' and 'definitely yes' responses). In the second dimension of the Big Five Model relating to agreeableness, trust and cooperativeness were assessed. The results indicate that officials of both regulators are individuals who trust others. 67.3% of OEC and 43.9% of ERO respondents rated their personality in this way ('rather yes' and 'definitely yes' responses). It should be noted that in the case of ERO officials, about one third of the respondents were of the opposite opinion. In the agreeableness dimension, officials strongly indicated that they were open to cooperation. 93.5% of OEC and 84.7% of ERO respondents rated their personality in this way ('rather yes' and 'definitely yes' answers). The third dimension of the personality model relates to openness, which is related to, among other things, a willingness to take risks. In the case of OEC respondents, the results are not clear-cut. Group OEC and ERO are dominated by those who are willing to take risks (response 'rather yes' and 'definitely yes' 45.8% and 55.4% of

respondents). On the other hand about a third officials in OEC and ERO the rated themselves as risk averse ('rather no' and 'definitely no' answers).

The fourth dimension of the Big Five Model relates to emotional stability, related to, among other things, emotional resilience. The study assessed the question of optimism. OEC and ERO officials are individuals with high levels of optimism. As many as 85.0% of OEC respondents and as many as 73.9% of ERO respondents rated their personality in this way ('rather yes' and 'definitely yes' answers). The last dimension of the personality model concerns conscientiousness, which manifests itself, among other things, in responsibility for one's actions. Respondents from both OEC and ERO are people who are responsible. As many as 98.1% of OEC respondents and as many as 91.1% of ERO respondents rate their personality in this way ("rather yes" and "definitely yes" answers).

Indulging in behavioural effects may be important in the implementation of AI solutions by regulatory staff. The results of research in this area are presented in Table 2.

Table 2. Susceptibility of OEC and ERO officials to behavioural effects

	Never occurring or very rare effect		**Rare effect**		**Medium often effect**		**Very often effect**		**Almost always or always effect**	
	OEC	**ERO**	**OEC**	**ERO**	**OEC**	**ERO**	**OEC**	**ERO**	**OEC**	**ERO**
Certainty effect – an aversion to risk in the context of benefits (prospect theory)							X	X		
Loss avoidance effect – risk seeking in context of losses (prospect theory)							X	X		
Reflection effect (prospect theory)					X	X				
Uncertainty aversion effect vs risk propensity							X	X		
Status quo effect and framing effect (positive context of information)					X	X				
Status quo effect and framing effect (negative context of information)							X	X		
Status quo effect and framing effect (positive context of information and isomorphism)	X	X								
Sunk cost effects and framing effect (ambiguous assessment of the situation by others)					X	X				
Sunk cost effects and framing effect (unambiguous negative assessment of the situation by others)			X	X						

Source: authors' own work.

The results of the study indicate that regulatory officials made decisions according to prospect theory. Under conditions of benefit, 78.5% of OEC respondents and 84.7% of ERO respondents succumbed to the *cetrainty effect*, i.e. they exhibited aversion to risk. In contrast, under conditions of loss, 74.8% of OEC officers and 75.2% of ERO officers expressed risk seeking, i.e. succumbed to the *loss avoidance effect*. It is also significant that 57.9% of OEC respondents and 63.7% of ERO respondents succumbed to the *reflection effect*. Thus, the officials did not show constancy of preference towards risk. Furthermore, when officials were given a choice between making a decision under uncertainty and risk, 87.9% of OEC respondents and 88.6% of ERO respondents succumbed to the *uncertainty aversion effec*t. The study also found that the use of the *framing effect* through positive messaging contributed to

51.1% of OEC respondents and 56.5% of ERO respondents succumbing to the *status quo effect*. In contrast, the use of the *framing effect* through negative messaging resulted in a change in the proportion of officials who succumbed to the *status quo effect* (OEC: 72.6% of respondents; ERO: 72.2% of respondents). Only 8.1% of OEC respondents and 15.3% of ERO respondents succumbed to the *status quo effect* when the *framing effect* was used through positive messaging emphasising the aspect of isomorphism (becoming similar to other offices). The research study also showed that 42.1% of OEC respondents and 41.2% of ERO respondents succumbed to the *sunk cost effect* when they received ambiguous information about the effects of a certain action. However, when they received a clear negative assessment of the effects of a particular action, the proportion who succumbed to the *sunk cost effect* was already 22.8% and 30.6% of the respondents, respectively.

5. Discussion

The survey results indicate that regulatory officials perceived themselves as responsible and willing to cooperate with others. A relatively lower level of trust in others and a moderately high level of assertiveness were indicated. A high level of optimism did not translate into an equally high declared willingness to take risky decisions. Risk-taking and trust in others received the lowest ratings among personal characteristics. The characteristics indicated are close to the bureaucratic model of management in public administration, which is associated with administration dependent on formal administrative procedures. It is doubtful whether such human resources are a barrier or an opportunity for the implementation of AI solutions and the development of the organisation in accordance with DEG and EDGE. In the category of barriers, one should consider the *low risk aversion* of officials, the low level of trust, which to a greater extent concerns the ORE, or also, albeit indirectly, moderately high assertiveness (especially among OEC officials). This may limit openness to AI and reinforce concerns, or even undermine the rationale for regulators to implement AI-based solutions. This is important when officials act routinely and are overly confident in their knowledge and competence [27], [43]. Reliance on trained ‘human thought processes’ supported by regulatory frameworks, along with responsibility for decision-making and fear of the imperfections of artificial intelligence, can effectively limit officials' readiness for change. The use of AI solutions, even in conditions of uncertainty, does not necessarily mean a worse alternative to those already in use. In the case of assertiveness, it should be noted that, on the one hand, it may result in reduced trust in AI. On the other hand, assertive officials are more likely to engage in critical thinking and constructive discussion. In the long term, this may contribute to a better understanding of AI and greater willingness to implement it. A high level of responsibility, optimism and openness to cooperation among officials can be identified as an opportunity for the introduction of AI solutions in regulatory agencies, especially in OECs. Officials with a high level of responsibility may be more aware of the limitations of AI, which reinforces their caution and reduces the risk of errors. In addition, such an attitude may strengthen the regulatory authorities' pursuit of greater integrity, transparency and security of artificial intelligence while maintaining ethical standards. It should be emphasised that a high level of optimism and openness to cooperation among officials may strengthen their readiness for changes related to the implementation of AI. A high level of optimism can lead to an underestimation of the risks associated with AI. The results of the study indicate that officials from both regulators show inconsistency in their risk preferences depending on the context (prospect theory: *certainty effect, loss aversion effect, reflection effect*). Very often, officials perceive greater risk in decision-making under risk than under uncertainty displaying the *uncertainty aversion affect*. Succumbing to these effects has specific consequences for the implementation of AI in regulatory agencies. Officials may not assess the benefits or costs of using AI in absolute terms, but, as perspective theory emphasises, only in relation to a reference point, such as the scope of their current professional duties. It should also be noted that potential losses will be more noticeable to officials than the potential benefits of AI implementation, and they will also be more inclined to take risky actions in the face of losses associated with the use of AI. Risk aversion will be reinforced if the importance of one's work is devalued due to the implementation of artificial intelligence by regulatory authorities. Fear of change may also grow and the desire to maintain the status quo may strengthen. The results of research on civil

servants' susceptibility to the status quo effect point to the importance of the form of communication (*framing effect*). The positive aspect of the same information weakened the status quo effect. This effect was significantly weaker when confirmation of positive changes resulting from the changes being introduced came from other agencies. This is due to the tendency for organisations to become similar (isomorphism). The key to implementing AI by regulators and weakening the *status quo effect* is to maintain positive forms of communication about its implications, by pointing out opportunities for self-development and development throughout the organisation and supporting data on the use of AI by other public entities. In the case of research on the *sunk cost effect*, it should be noted that the extent to which it occurred depended on the context. Clearly presenting the negative consequences of AI implementation can be demotivating for officials. It is therefore necessary to clearly communicate the consequences of AI use for the functioning of regulatory authorities.

6. Conclusions

Making regulatory decisions in the field of critical infrastructure is a very difficult and demanding process, which burdens regulators' officials. This is due to the fact that the effects of these decisions determine the actions of many entities operating in the electronic communications or energy market. The introduction of solutions using AI is undoubtedly a challenge and an opportunity to improve this process. However, it is important to emphasise that the role of AI is not to replace, but to facilitate officials' decision-making by providing them with a robust, fast, comprehensive and rigorous framework for developing, designing, formulating, implementing and executing decisions [9], [16], [41]. This is important from a programming and regulatory implementation perspective. The article draws attention to the issue of civil servants' personality traits and susceptibility to behavioural effects as determinants of AI use in regulatory authorities. This is an expression of an interdisciplinary view of the AI issue. It cannot replace human regulators of critical infrastructure markets, but it can streamline the decision-making process. As literature and empirical research show, artificial intelligence can be successfully used in critical infrastructure regulatory authorities in areas that do not involve too much responsibility. These include, for example, document management systems, data management and data protection. The openness and trust of regulatory officials towards artificial intelligence and their cognitive tendencies indicating their openness to change, including in the area of AI, are of key importance. At the same time, it is necessary to maintain professional ethics.

Further research and the replication of the article’s findings are necessary, primarily due to the limitations of the research results. These stem from the subject scope (officials of the selected regulators) and the subject matter (selected personality traits and behavioural conditions). It is entirely justified and interesting to conduct international research to further demonstrate the importance of cultural differences in the use of AI in regulatory authorities. These limitations also arise from the fact that the study concerns AI. This is a matter that is developing extremely rapidly thus providing a wide range of research opportunities.

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