

A Method for Evaluating the Strategy of Managing Infrastructure in the BANI World – A Case Study

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Abstract

The BANI paradigm – characterized by brittleness, anxiety, nonlinearity, and incomprehensibility – forces a comprehensive re-evaluation of organizational management strategies, including those related to infrastructure. Infrastructure represents a fundamental asset for all organizations, and its role is especially pronounced within entities focused on production or research. In contemporary practice, effective infrastructure management has emerged as a key criterion for ensuring organizational continuity in the execution of essential processes. This paper presents the outcomes of an analysis conducted to determine the extent to which a research organization's infrastructure management strategy is prepared to adapt to the realities of the BANI environment. Drawing upon a review of scientific literature, the authors propose an original validation tool for assessing organizational resilience in the context of infrastructure management strategies confronted by the challenges inherent to the BANI world. The strategic documents of a selected research organization served as the empirical foundation for this analysis. The study concludes with a set of recommendations aimed at further enhancing strategic practices in the field under consideration.

Keywords

Assessment method, research infrastructure, research institutes, BANI, management strategy.

Introduction

The BANI concept (Brittle, Anxious, Nonlinear, Incomprehensible) succeeds VUCA (Volatility, Uncertainty, Complexity, Ambiguity) as the next step in understanding environmental complexity. Unlike VUCA's focus on volatility and uncertainty, BANI draws attention to system brittleness, nonlinearity, and rising anxiety in management. (Cascio, 2020; Salum & Zaslavskaya, 2024). Growing interest in BANI calls for refinement and clearer methodology.

In a BANI world, where the fragility of management systems manifests unexpectedly and volatility paralyzes decision-making processes, infrastructure must be not only modern, but also adaptive, accessible and shared (Cascio, 2020; Eggleton, 2024; OECD, 2021). Infrastructure management constitutes a critical resource for organizations, exerting a significant influence

on the formation and execution of organizational processes. The importance of infrastructure management is particularly evident in manufacturing enterprises and research-oriented industrial organizations, where operational continuity is contingent upon the condition and scope of available infrastructure (Deming, 2000; OECD, 2021). The literature (Rosarii, 2025; Salum & Zaslavskaya, 2024) indicates that resilience does not rely solely on possessing infrastructure resources, but rather on procedures and the ability to quickly reconfigure existing assets. The infrastructure of research entities constitutes a key resource in achieving the goals and adopted strategy. In this context, the efficient management of research infrastructure (in the sense of facilities, knowledge-based resources or any other elements of a unique nature used for scientific research (Commission Regulation, 2014) requires adaptive, flexible and measurable solutions, tailored both to technological and cultural-organizational challenges. This paper assesses the degree of recognition and readiness for the BANI world in selected research entities in the context of research infrastructure management, particularly about established strategy, based on the use of BANI-OEI (Organizational Evaluation Index), the author's diagnostic tool.

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Literature Research infrastructure management in the context of the BANI world within research organizations

Research infrastructure is of crucial importance for research and development processes in research institutions, as it constitutes the material and organizational foundation for high-quality research, commercialization of its results, and fostering both domestic and international collaboration. However, even the most advanced infrastructure does not bring added value if its utilization, accessibility, maintenance and development are not adequately planned. Effective management of research infrastructure determines the actual utilization of the research institution's scientific and innovative potential, transferring this potential into tangible and intangible outcomes (Jones, 2022).

The combination of the characteristics inherent to research infrastructure, the research potential of the personnel and the socio-economic environment, including technological aspects, gives rise to the challenges of managing research infrastructure (Beck & Charitos, 2021; Cheng et al., 2023; Rosarii, 2025; Zylicz, 2023), such as:

- The technical complexity and costliness of research infrastructure. Research infrastructure tends to be high-tech, expensive to purchase, maintain and upgrade.
- Competition for funds related to external grants for its maintenance and development is accompanied by excessive bureaucracy. Scientific institutions compete for a limited pool of grants – the level of competition is very intense, resulting in a significant share of resources (time, personnel) being engaged in administrative processes rather than actual research.
- Shortages in research infrastructure, high failure rates and outdated laboratory equipment. This often limits the continuity of research and requires investments for its modernization.
- Data management and access to digital resources. Infrastructure must handle increasing volumes of data, including storage, migration, archiving, and data security.
- Multiple stakeholders and software requirements. Infrastructure management systems must address the needs of various stakeholder groups, complicating the process of tool design.
- Personnel shortages in infrastructure maintenance. Project leaders must combine scientific and managerial skills, including team management, negotiation, and communication, which requires broad competencies.

- Lack of institutional mechanisms enabling shared access to infrastructure. Collaboration is often based on informal contacts rather than formal principles.

Additionally, new challenges emerge in research infrastructure management within research institutes due to the BANI world environment (Hasani-Mavriqi, 2020; Rosarii, 2025; Zachosova et al., 2023; Zylicz, 2023):

1. The threat of infrastructure failure and instability (Brittle) – In the BANI world, technical infrastructure has become significantly more vulnerable to failures and disruptions – especially in the absence of resources for redundancy or regular maintenance. It underscores the need for actions designed to stabilize infrastructure through appropriate resource planning and technical support policies within the organization.
2. Emotional pressure and uncertainty (Anxious) – Both managers and staff experience anxiety related to the unknown (e.g., funding instability, regulatory changes), affecting team morale. In the development of research software, discrepancies in expectations arise and intensify tensions – IT researchers expect compatibility, while operational staff focus on usability. Inclusivity and procedural transparency are the foundation for trust within the organization and therefore reduce the anxiety among stakeholders co-creating the institution.
3. Complexity and challenge of prediction (Nonlinear) – Decision-making and management processes have become increasingly nonlinear: changes in one area can trigger a cascade of unintended effects across numerous other processes or domains. The absence of linear logic in evaluation – traditional models for assessing infrastructure investments (the pipeline model) prove ineffective in environments characterized by nonlinear interactions.
4. Difficulty in Understanding Systems (Incomprehensible) – Research infrastructure constitutes a multifaceted, multilateral techno-organizational ecosystem – users often lack insight into its structure or operating principles. Internal and cross-group heterogeneity hampers mutual understanding and the articulation of needs, resulting in situations where even well-designed systems may experience unforeseen consequences.

In a BANI world, traditional models of planning and managing infrastructure, particularly research infrastructure, based on stability and linear development, may prove insufficient.

Review of recent literature (Kolarz, 2020; Wei, et al., 2019; Zachosova et al., 2023) unequivocally indicates the need for implementation of:

- integrated infrastructure management systems,

- digital tools for measuring utilization efficiency,
- procedures to counteract fragility and increase resilience,
- flexible and modular systems for responding to changes.

The authors' of the articles: [Cheng et al. \(2023\)](#), [Deming \(2000\)](#), [Adeola \(2024\)](#), [Eggleton \(2024\)](#), [Hasani-Mavriqi et al. \(2020\)](#), [Kozuch & Sienkiewicz-Małyjurek \(2020\)](#), [OECD \(2021\)](#), [Rosarii \(2025\)](#), [Wei \(2022\)](#), [Zachosova et al. \(2023\)](#) also describe tools and solutions that support research infrastructure management in a BANI context:

- AIOps/Self Healing – strengthening system resilience and minimizing the consequences of failures.
- AI Governance, PDCA – ensuring transparency and accountability in the deployment of AI tools.
- Open Standards (Open Science) – enhancing the comprehensibility and durability of research systems.
- Modelling platforms (DAFNI, ABM) – enabling non-linear scenarios and faster preparation for crisis.
- Psychological support (wellbeing, mindfulness, workplace spirituality) stabilizes teams in the face of uncertainty.

Table 1 compares the traditional model of research infrastructure management with a model rooted in the concepts of the BANI world.

To effectively manage research infrastructure in the unstable environment of the BANI world, it is essential to implement appropriate technical and organizational structures, as well as to introduce a systematic process of learning, adaptation, and corrective actions ([Cascio, 2020](#); [Eggleton, 2024](#); [OECD, 2021](#); [Rosarii, 2025](#)). The PDCA (Plan–Do–Check–Act) model constitutes a philosophy of continuous improvement, assuming that strategy should be a dynamic management tool sub-

ject to cyclical evaluation and modification ([Deming, 2000](#); [Kozuch & Sienkiewicz-Małyjurek, 2020](#)).

As illustrated in Figure 1, in the reality of the BANI world, the ability to respond to discontinuities and unpredictability requires assessment and ongoing evaluation of the established strategy.

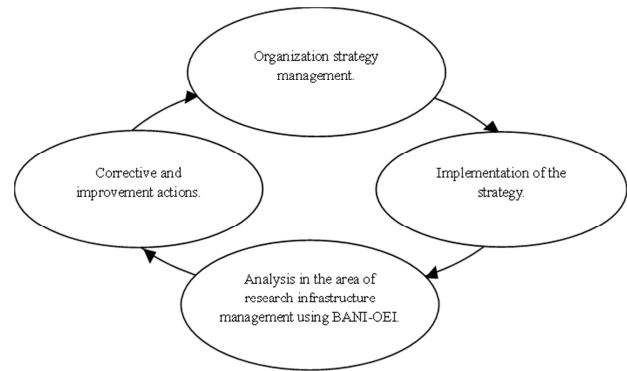


Fig. 1. The PDCA cycle in research infrastructure management in the BANI world (Source: own study)

In the context of the BANI environment, which presents new challenges to the management of research infrastructure, it becomes essential to possess tools that enable systematic evaluation of organizational resilience and adaptive capacity both at the level of strategy and operational practices ([Cheng et al., 2023](#); [Hasani-Mavriqi et al., 2020](#); [Kolarz et al., 2020](#); [Wei et al., 2019](#); [Zachosova et al., 2023](#)). In this regard, as illustrated in Figure 1, the “Analysis in the management of research infrastructure using the proprietary BANI–OEI tool” constitutes an integrated mechanism within the PDCA cycle. The proprietary BANI–OEI tool has been developed to diagnose the alignment of an organization’s strategy with the challenges of the BANI world in terms of its existing infrastructure.

Table 1
Differences in approaches to infrastructure management in research units

Aspect	Traditional model	Model in the BANI world Table Head
Failure	Reactive repairs, external service.	Required redundancy, proactive automation, and use of AIOps.
Decision	Stable process, predictable evaluation.	Use of AI Governance with PDCA cycle.
Data	Locally managed repositories.	Open standards, full transparency.
Team	Technical operational support of the system.	Mindfulness, mental and spiritual support.
Planning	Linear development scenarios.	Infrastructure modelling (DAFNI), stress tests.

Source: own study based on the literature review ([Cascio, 2020](#); [Cheng, 2023](#); [Deming, 2000](#); [Adeola et al., 2024](#); [Eggleton, 2024](#); [Hasani-Mavriqi et al., 2020](#); [Kozuch & Sienkiewicz-Małyjurek, 2020](#); [OECD, 2021](#); [Rosarii, 2025](#); [Wei, 2022](#); [Zachosova, 2023](#)).

The purpose and objective of the diagnostic tool

The purpose of employing the BANI-OEI tool is to enable a critical self-assessment of the organization's strategy within four key areas corresponding to the components of the BANI acronym. The tool facilitates the identification of areas requiring intervention at both the strategic and operational levels. It supports the planning of improvement actions within the PDCA cycle, given the fragility and volatility of the environment.

Structure and logic of the diagnostic tool

Table 2 presents the characteristics of the proposed BANI-OEI tool, which is based on four assessment dimensions, each accompanied by a set of key diagnostic questions as well as sample evaluation criteria. Each letter in the BANI acronym (B-A-N-I) constitutes a separate dimension evaluated using a five-point qualitative scale shown in Table 3. The aggregate of partial scores allows for the calculation of the overall BANI-OEI index, which enables the assessment of

Table 2
Characteristic of the BANI-OEI diagnostic tool

BANI dimension (CODE)	Area of assessment	Key diagnostic questions	Sample criteria
Brittle (B)	Resilience and redundancy.	Does the strategy include provisions for counteracting equipment failures, a single source of infrastructure resources and single supplier dependency?	Risk mapping, backup systems, crisis response scenarios, life cycle assessment (purchase, utilization, de-commissioning)
Anxious (A)	Organisational and psychological stability.	Do infrastructure users have clarity, predictability, and adequate support regarding infrastructure usage?	Helpdesk, onboarding procedures, and user instructions.
Non-linear (N)	Flexibility and agility.	Does the strategy allow for a quick adjustment of infrastructure resources to a dynamically changing technological environment and research needs?	Budget reserves flexible schedules, modularity of resources, PDCA.
Incomprehensible (I)	Transparency and access to information.	Is the infrastructure management system data-driven, transparent, understandable, and digitally supported?	Dashboards, KPIs, decision support systems.

Source: own study based on the literature review (Cheng et al., 2023; Deming, 2000; Adeola et al., 2024; Eggleton, 2024; Hasani-Mavriqi et al., 2020; Kolarz et al., 2020; OECD, 2021; Rosarii, 2025; Wei, 2022; Zachosova et al., 2023).

Table 3
BANI dimension assessment descriptions

Value	Characteristics
0	None, criterion omitted in the strategy.
1	Low recognition, key mentioned approach in the organization's strategy.
2	General inclusion in the strategy, no implementations, no plans.
3	Addressing the issues in the strategy, partial implementation of the strategy provision, and actions in the pilot phase.
4	Addressing the issues in the strategy, full implementation of the strategic provisions, documented actions, and confirmed effectiveness of operation.

Source: own study.

the maturity of the organization's adopted strategy in terms of the BANI framework.

A five-point scale assessment was adopted for each dimension as detailed in Table 3.

Calculation formula for the evaluation of the BANI-OEI index

The adopted methodology enables both the summation of the four partial indicators corresponding to each BANI dimension and the direct calculation of the index without separating partial values.

The partial BANI-OEI_x indicator for a given dimension is calculated by formula (1) as the quotient of the sum of scores obtained in all diagnostic questions within that dimension and the maximum possible number of points (i.e., the number of questions in the given dimension multiplied by 4), then multiplied by 100%. The resulting value reflects the percentage level of strategy maturity concerning the considered dimension (B, A, N, or I), according to the interpretation presented in Table 4. The formal notation is presented in the following formula (1):

$$\text{BANI-OEI}_x = \frac{\sum_{i=1}^n x_j}{4 \cdot n_x} \cdot 100\% \quad (1)$$

where: n_x – number of analytical diagnostic questions in a given dimension, x_j – assessment of the diagnostic questions in dimension x on a scale 0–4.

Condition: $\text{BANI-OEI}_x \in \langle 0\%; 100\% \rangle$

The BANI-OEI indicator constitutes a weighted sum of the four partial indicators for the individual BANI dimensions, as defined by formula (2):

$$\text{BANI-OEI} = \sum_{x \in \{B, A, N, I\}} w_x \cdot \text{BANI-OEI}_x \quad (2)$$

where: w_x – the weight of a given dimension, BANI-OEI_x – maturity of the strategy in relation to dimension X (B, A, N, I),

Conditions: $\sum w_x = 1, \text{BANI-OEI} \in \langle 0\%; 100\% \rangle$

Alternatively, it may be calculated directly from formula (3), as the product of the weight assigned to a given dimension and the quotient of the sum of scores obtained for all diagnostic questions in that dimension and the maximum possible number of points (i.e., the number of questions in the given dimension multiplied by 4), then multiplied by 100%.

$$\text{BANI-OEI} = \sum_{x \in \{B, A, N, I\}} \left(w_x \cdot \frac{\sum_{i=1}^{n_x} x_j}{4 \cdot n_x} \right) \cdot 100\% \quad (3)$$

w_x – the weight of a given dimension, n_x – number of analytical diagnostic questions in a given dimension, x_j – assessment of the diagnostic questions in dimension x on a scale 0–4.

Conditions: $\sum w_x = 1, \text{BANI-OEI} \in \langle 0\%; 100\% \rangle$

The sum of the weights for all dimensions should equal 1, and the final indicator value falls within the range of 0 to 100, where a higher value indicates a higher level of recognition and readiness of the organization in the respective BANI dimensions.

Table 4
Assessment of the level of BANI recognition and readiness

BANI-OEI (%)	Qualitative assessment
80–100	High level of recognition and readiness in the area of infrastructure management, further supervision required. All BANI components are taken into account. Presentation of response mechanisms, risk management procedures, digital tools, KPI indicators, and embedding in the PDCA cycle. Demonstration of the ability to rapidly reconfigure resources, communicate with stakeholders, and manage research infrastructure transparently.
50–79	Medium level of recognition and readiness in infrastructure management. The strategy contains elements responding to BANI challenges, but in a dispersed and unstructured form.
< 50	Low level of recognition and readiness in infrastructure management. The strategy lacks a systemic approach to brittleness, anxiety, nonlinearity, and incomprehensibility. There are no adaptive mechanisms. Improvement measures in infrastructure management strategy are required.

Source: own study.

The results obtained through the evaluation, expressed as the BANI-OEI indicator value, make it possible to assess the level of recognition and readiness of the adopted organizational strategy in the BANI context, according to the interpretation presented in Table 4.

Despite its usefulness and simplicity, the BANI-OEI tool also possesses several limitations that should be considered when applying it in managerial practice:

- the subjective nature of the assessment. In a data-driven situation or with a diverse organisational culture, ambiguous or divergent assessments may occur.
- lack of predefined weights for individual dimensions. In some instances (e.g., for critical infrastructure), resilience may be of greater significance, while in others, flexibility may be prioritised.
- dependence on timeliness and quality of data. Complete diagnosis requires access to reliable data, and informational gaps may lead to inaccurate results.
- lack of integration with quantitative metrics. As a qualitative tool, it should be used in conjunction with other tools based on quantitative assessments, rather than as the sole evaluation instrument.

The BANI-OEI tool can be modified and tailored to meet the needs of the organisation being evaluated.

Application of an analytical worksheet to assess the level of the strategy resilience and adaptability to the BANI environment – a case study

Below is an example of how the developed validation tool can be applied to assess a research organization's strategy (Lukasiewicz Research Network, 2025) in the area of research infrastructure management within the BANI world context. In particular, using the analytical worksheet (Table 5), the evaluation was conducted based on a total of twelve diagnostic questions (three for each BANI dimension). The assessment was carried out using Table 3, on a 0–4 scale. Individual BANI dimensions summarized the results obtained. The sum of the partial scores for each BANI dimension provided the final BANI-OEI index, which enables the evaluation of the resilience and adaptive capacity of the chosen strategy about the BANI framework. Due to the number of diagnostic questions and the adopted rating scale, the possible score ranged from 0 to 48. Such a diagnosis enabled the formulation of recommendations for the adopted strategy and the definition of corrective actions and solutions.

Example of analysis of the evaluation of the research organization's strategy under BANI conditions

A model research organization, comprising several dozen research institutes, constitutes an excellent environment for analyzing adaptive strategies regarding infrastructure in the face of the new reality of the BANI world. In light of the changing circumstances, adapting the research infrastructure strategy – which represents one of the fundamental resources of this network – is crucial for the adaptability and flexibility of the organization. Table 5 presents the analytical worksheet for assessing a research organization's strategy in the field of research infrastructure management. The expert team answered twelve diagnostic questions (three per BANI dimension) using interpretative guidelines and strategic document analysis. Assessment involved brainstorming and consensus procedures for discrepancies. Inter-rater agreement was qualitative, and results are based on unweighted averages as dimension weights remain undefined.

The summary results of the assessment for individual BANI dimensions are presented in Table 6. The results were calculated based on partial evaluations shown in Table 5, using the BANI-OEI indicator formula, and the maturity level was determined according to the criteria adopted in Table 4.

The assessment of the research organization's strategy, conducted with the use of the BANI-OEI tool, revealed a marked differentiation in the degree of alignment with the four BANI dimensions. The strongest dimension was "I – Incomprehensibility," which achieved an index value of 58.3% – indicating that the direction of digitization and data management has been identified within the strategy. The weakest result was recorded in "N – Nonlinearity" (16.7%), which shows that the strategy does not address the realities of rapid, abrupt changes and lacks mechanisms enhancing flexibility (no contingency planning, no scenario analysis, no dynamic response processes).

CHECK – assessment and measurement (BANI-OEI analysis) – The evaluation of the research organization's strategy across the four BANI-OEI dimensions demonstrated that the following maturity levels were achieved:

B – Brittleness: 50.0% – Medium level of recognition and readiness in infrastructure management; further supplementation of infrastructure strategy is necessary.

A – Anxiety: 33.3% – Low level of recognition and readiness in infrastructure management.

N – Nonlinearity: 16.7% – Low level of recognition and readiness in infrastructure management.

I – Incomprehensibility: 58.3% – Medium level of recognition and readiness in infrastructure management; requires further refinement of strategy.

The overall BANI-OEI result for the assessed

Table 5
Assessment of the level of BANI recognition and readiness

BANI dimension	Analytical diagnostic question	Score (0–4)	Evidence (description – examples)
B	Does the strategy include mechanisms for identifying and mitigating risks associated with the loss of operational capacity of research infrastructure – does it envisage the development of an infrastructure risk map, e.g., for infrastructure failures or cyber threats?	2	Certain dependencies have been identified, but there are no safeguarding mechanisms. The strategy mentions "risk monitoring at all organizational levels," but lacks concrete tools or risk maps.
B	Does the strategy provide for actions to strengthen organizational resilience to potential disruptions – does it envisage the implementation of redundancy and resource-sharing principles (e.g., backup power sources)?	3	Diversification of funding sources and strategic partnerships with businesses are indicated as mitigating actions. The strategy includes references to infrastructure development and resource sharing within the Network, but lacks details concerning redundancy. The issue of its maintenance is not elaborated upon.
B	Does the strategy assume the development of emergency scenarios / stress tests for research infrastructure? (e.g., AI-OPS sensors)?	1	No extensive section on emergency scenarios is provided.
A	Does the strategy take into account transparent principles of access and use of the infrastructure?	2	There is a declaration of openness and shared use without operational regulations.
A	Does the strategy indicate methods of communicating uncertainty and changes within the organization and external stakeholder?	1	The strategy assumes management reports and quarterly reviews but does not specify channels for ongoing communication.
A	Does the strategy include tools to support users in real-time research infrastructure management (dashboards, status updates)?	1	Digitization and ERP/CRM systems are mentioned, but there are no specific user support tools.
N	Does the strategy incorporate flexible models for interdisciplinary collaboration in research infrastructure management – does it account for nonlinear relationships between investments and R&D outcomes?	1	No systematic approach to outcomes evaluation, although master plans are mentioned.
N	Does the strategy assume testing new methods of using infrastructure? (e.g. timesharing, remote access)	1	It does not refer to the contemporary resource management model.
N	Does the strategy consider the risk of side effects of long-term decisions on research infrastructure management?	0	No systematic analysis of strategic consequences.
I	Does the strategy include a data management system for infrastructure?	2	Database and system integration (PIMCOR, BIB, Cockpit) is mentioned. Objectives are described, but a transparent system for classification, prioritization, and selection of infrastructure is lacking.
I	Are indicators for monitoring the use of research infrastructure defined in the strategy?	3	KPIs were identified at a general level (e.g., number of projects), but without specific methods.
I	Does the strategy address decision-making in research infrastructure management based on data?	2	A certain degree of transparency exists, but mechanisms for automation or predictive analytics are lacking.

Source: own study.

Table 6
Summary results of evaluation

BANI Dimension	BANI-OEI (%)	Qualitative assessment	Reasoning – summary
Brittle	50.0	Medium level of recognition and readiness in infrastructure management.	The strategy partially addresses the need for infrastructure resilience through the development and consolidation of resources, yet lacks systemic mechanisms for risk identification and contingency planning. It assumes shared use and consolidation of resources but does not identify infrastructure risks. There is an absence of a life cycle-based approach to infrastructure management, as well as tools such as AIOps or stress tests.
Anxious	33.3	Low level of recognition and readiness in infrastructure management.	The strategy proclaims openness and joint use of infrastructure, but does not define operational access rules or user support mechanisms. Users may experience uncertainty, particularly regarding predictability and service. The absence of helpdesk, mentoring, or reservation interfaces may deepen uncertainty among stakeholders. In a BANI world, dominated by emotional pressure and unpredictability, the lack of communication and stabilization systems for users limits the organization's ability to foster trust and predictability.
Nonlinear	16.7	Low level of recognition and readiness in infrastructure management..	The strategy does not anticipate flexibility in resource reallocation, lacks rapid response systems or dynamic infrastructure budgets. References to pilots, timesharing, remote access, or dynamic budgets are missing. In the context of the BANI world, characterized by discontinuity and cascading changes, the strategy exhibits no capacity for rapid adaptation or reconfiguration of infrastructure.
Incomprehensible	58.3	Medium level of recognition and readiness in infrastructure management.	The strategy signals a move towards digitalization and data management, but lacks details – metrics, classification mechanisms, prioritization, and decision-support tools. In the BANI world, where complexity and system heterogeneity hinder understanding, the strategy requires the implementation of dashboards, scoring systems, and transparent access principles to ensure information clarity and availability for stakeholders.

Source: own study.

strategy amounted to 39.6%, which, according to the adopted classification methodology, indicates a low level of adaptation of research infrastructure management strategy to BANI world challenges. In particular, the strategy demonstrates limited capacity for systematic response to infrastructure fragility (Brittle), does not provide sufficient communicative and organizational support for users (Anxious), does not account for the nonlinearity of decision-making processes (Nonlinear), and does not fully implement tools ensuring transparency and comprehensibility of data (Incomprehensible). This outcome points to the need

for a strategic revision toward resilience, flexibility, and digital transparency, in line with recommendations from the relevant body of literature (Cascio, 2020; Cheng et al., 2023; Kozuch & Sienkiewicz-Małyjurek, 2020; OECD, 2021). In this context, the following improvement actions are proposed:

Brittle:

- Develop risk maps and business continuity plans for existing infrastructure;
- Prepare risk scenarios and conduct stress tests for the current infrastructure.

Anxiety:

- Design user access and support systems (e.g., helpdesk, mentoring, reservation interfaces);
- Implement knowledge management programs, mentoring, and psychological support for R&D teams;
- Create an interoperable platform for real-time infrastructure management.

Nonlinearity:

- Introduce flexible budgets and mechanisms for rapid thematic or crisis response;
- Implement a risk management system for infrastructure;
- Diversify and test new methods for managing material resources.

Incomprehensibility:

- Implement digital dashboards for monitoring infrastructure utilization;
- Establish KPIs for laboratory efficiency (e.g., % of apparatus utilization, equipment usage time per project, number of commercial/non-commercial projects);
- Set transparent access rules for infrastructure (scoring system, user registration).

Summary

In the context of dynamic changes, as well as the growing uncertainty and complexity of the organizational environment, the accurate identification and adjustment of an institution's functioning to the realities of the BANI world emerge as key task for management staff. Resources, including the existing infrastructure, become particularly significant for organizations. For entities such as research units, infrastructure constitutes the foundation for the implementation of their adopted strategies. The adaptation of research infrastructure management strategies to the realities of the BANI world should not be incidental; it must be conceived as a continuous, iterative process, grounded in empirical data, involving infrastructure users, and reflecting the evolving needs of stakeholders.

To assess the degree of alignment of organizational strategy with the BANI dimensions, the BANI-OEI analytical tool has been developed, providing a structured diagnostic framework. This tool can be used both in internal processes of strategic self-evaluation and in inter-institutional benchmarking analyses. BANI-OEI supports the assessment of strategic maturity in conditions of high volatility; however, its full functionality requires further development – particularly in refining assessment criteria, standardizing diagnostic questions, and integrating quantitative components.

To increase the accuracy and usefulness of the BANI-OEI tool in the research institute environment, the following are recommended:

- develop standardized assessment sheets and methodological guides,
- expand the tool to include quantitative indicators related to infrastructure utilization,
- introduce the option to differentiate the weight of BANI dimensions depending on the specifics of the institution,
- build a sectoral benchmark base,
- integrate with artificial intelligence tools supporting infrastructure data analysis and risk prediction.

The assessment of research infrastructure management strategy conducted using the BANI-OEI tool revealed a varied level of maturity across the four BANI world dimensions. The highest score was achieved in the “I – Incomprehensible” area (58.3%), indicating a partial recognition of the need for digitization and data management. The lowest score was recorded in the “N – Nonlinear” dimension (16.7%), suggesting a lack of flexibility and inability to adapt infrastructure resources swiftly. The “B – Brittle” dimension scored 50.0%, and “A – Anxious” 33.3%, indicating the need to supplement resilience mechanisms and provide communication support for users.

The overall BANI-OEI result for the evaluated strategy was 39.6%, which, according to the adopted classification, corresponds to a low level of maturity in adapting the strategy to the challenges of the BANI world.

It should be emphasized that the presented analysis was exemplary and served to illustrate the application potential of the BANI-OEI method in strategic assessment practice. The results do not constitute a comprehensive evaluation of all aspects of the strategy, but rather highlight areas requiring further improvement.

In light of these findings, it should be acknowledged that research infrastructure management strategy in the BANI world should undergo systematic evaluation, be embedded within the PDCA cycle, and incorporate resilience mechanisms, flexible management models, and digital transparency. Only then will it be possible for a research organization to operate effectively amid constant variability and unpredictability.

The assessment methodology for research infrastructure strategy presented in this study is applicable to any organization that regards its infrastructure as a critical asset.

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