Leadership, Learning, and Business Beyond Boundaries: Managing Change in a Complex World
21–23 May 2026
Ljubljana, Slovenia
make learn TIIM PIConf
Management, Knowledge and Learning International Conference
Technology, Innovation and Industrial Management
Sustainable Development

BY-SA

Prioritizing Performance Indicators in Public Research Institutes: A Delphi - Analytic Hierarchy Process Approach

Aurelia-Ioana BIHOLAR
Politehnica University of Timisoara, Romania, The National R&D Institute for Welding and Material Testing - ISIM Timisoara, Romania
aurelia.biholar@student.upt.ro

Nicusor-Alin SIRBU
The National R&D Institute for Welding and Material Testing - ISIM Timisoara, Romania
asirbu@isim.ro

Anca DRAGHICI
Politehnica University of Timisoara, Romania
anca.draghici@upt.ro

Abstract

National research and development institutes represent key actors within the national innovation system, playing a significant role in the production of scientific knowledge, technological development and the transfer of research results to the socio-economic environment. In the context of increasing competition in the research sector and growing demands for the efficient use of public resources, the evaluation of institutional performance has become a central component of research system governance. In this framework, the present study aims to identify and prioritize the performance indicators that exert a positive and determining impact on the efficiency and performance of national research and development institutes in Romania, with the objective of supporting sustainable institutional development strategies. The research is based on a set of indicators structured along three major managerial dimensions: economic and financial management, human resource management and the management of research, development and innovation activities. The methodological approach combines expert consultation through the Delphi method with the application of the Analytic Hierarchy Process (AHP), which is used to determine the relative weight and hierarchy of the indicators according to their contribution to institutional performance. The results of the analysis enable the identification of indicators with the highest strategic relevance for performance evaluation and managerial decision-making. The prioritized indicators provide an analytical foundation for the development of institutional strategies aimed at improving organizational performance and may support the establishment of coherent mechanisms for monitoring and evaluating the activity of research institutes within the public research system.

Keywords: performance indicators, research performance, research institutes, Delphi method, Analytic Hierarchy Process, multi-criteria analysis

INTRODUCTION

Research and development (R&D) activities and represent the primary catalysts for sustainable economic growth and industrial competitiveness in the modern knowledge-based economy. The ability of a nation to generate scientific progress and effectively transfer that knowledge into industrial applications determines its long-term prosperity (Biholar & Draghici, 2023; Stefan et al., 2023; Tocan, 2023). In this context, the strategic management and performance evaluation of public research organizations have become essential components of national innovation governance (Luo et al., 2019; Tocan, 2023).

National research and development institutes (NRDIs) are pivotal actors within the national innovation system, functioning as a bridge between fundamental scientific discovery and industrial implementation (Biholar & Draghici, 2023; Comin et al., 2019). These organizations facilitate the flow of knowledge by addressing complex technological challenges that are often beyond the immediate scope of private firms (Bradke et al., 2023; Comin et al., 2019). The success of such institutes depends on a "village" of contributors, ranging from research groups to corporate services, all aligned under an overarching institutional strategy (Bradke et al., 2023).

In the specific case of Romania, NRDIs are established under public law to maintain scientific competence in strategic areas of national interest (O.G. no. 57/2002; Biholar & Draghici, 2023). These institutes are tasked with maintaining a critical mass of researchers and modernizing the country's technological infrastructure to support national strategies for research, innovation and smart specialization (Biholar, 2026; Biholar & Draghici, 2023; SNCISI 2022-2027). Furthermore, NRDIs contribute to the national economy through the generation of intangible assets, such as patents, which serve as objective metrics of the technological value created within the public sector (Biholar & Draghici, 2022; Lee & Lee, 2023).

Despite their importance, Romanian NRDIs face severe challenges stemming from global competition and systemic underfunding. Romania is currently classified as an "emerging innovator" and consistently ranks last in the European Union regarding innovation performance (Berinde et al., 2024; OECD, 2024; Tocan, 2023). This stagnation is largely attributed to a chronic lack of investment, with R&D expenditures hovering around 0.5% of GDP, which is significantly below the European average (Berinde et al., 2024; OECD, 2024). Inconsistent research reforms and a dissonance between formal standards and available resources have placed immense pressure on these institutions (Cernat, 2024).

Furthermore, there is a global shift in research policy from "trust-based funding" to "performance-based funding" (Luo et al., 2019; Sivertsen, 2023). The increasing reliance on citation-based metrics can sometimes encourage incremental science at the expense of risky, exploratory research (Bhattacharya & Packalen, 2020). For Romanian institutes, this environment necessitates the development of a rigorous performance monitoring framework to justify public expenditure and ensure institutional survival (Biholar & Draghici, 2023). Neglecting these metrics risks not only innovation stagnation but

also a continued “brain drain”, where top scientific talent migrates to better-funded international ecosystems (Biholar et al., 2022; Iacob, 2018).

The primary goal of this research is to identify and prioritize the performance indicators that most significantly impact the efficiency and sustainability of Romanian NRDIs. By establishing an analytical hierarchy of these metrics, this study aims to provide research managers and policymakers with a data-driven foundation for strategic decision-making (Biholar & Draghici, 2023; Biholar, 2026).

The specific objectives of this study are:

1. To validate and refine the performance indicators through a two-round Delphi study involving a panel of experts. This process secured 40 responses in the first round and 27 in the second to achieve professional consensus.

2. To apply the Analytic Hierarchy Process (AHP) to determine the relative weights of these indicators, thereby identifying the metrics with the highest strategic impact.

By prioritizing these performance metrics, the research supports Romanian NRDIs in optimizing their resource allocation, enhancing their international visibility and fulfilling their role within the national innovation system.

LITERATURE REVIEW

The governance of public research organizations (PROs) and of national research and development institutes (NRDIs) has transitioned significantly from “trust-based funding” to “performance-based funding” (PBF) (Luo et al., 2019; Sivertsen, 2023). This shift is largely driven by the principles of New Public Management (NPM), which emphasize accountability, outcome measurement and increased efficiency through competition (Sivertsen, 2023; Stoker, 2006). PBF systems aim to provide accountability for public investment by allocating funds to the best performers and creating incentives for institutional excellence (Luo et al., 2019; Sivertsen, 2023). However, recent literature warns of the paradox known as “Goodhart’s law”, suggesting that when a performance metric becomes a specific target for funding, it may lose its validity as a genuine measure of quality (Goodhart, 1975; Sivertsen & Aagaard, 2024).

Contemporary governance frameworks often struggle to balance three primary dimensions: strategy, funding and operations (Luo et al., 2019). Strategic tensions arise when a PRO's overarching goals conflict with the autonomous development of its individual institutes, while funding tensions often involve the balance between stable block grants and competitive third-party grants (Luo et al., 2019; Sivertsen & Aagaard, 2024). Furthermore, there is a growing movement toward “Public Value Management”, which suggests replacing the purely competitive NPM perspective with a model that prioritizes societal value creation and collaborative RDI ecosystems (Stoker, 2006). Within the Romanian context, the governance of NRDIs faces additional pressures due to inconsistent reforms and a dissonance between high formal standards and chronic underfunding, which currently stands at approximately 0.5% of GDP (Berinde et al., 2024; Cernat, 2024; OECD, 2024).

To accurately capture the multi-faceted mission of research institutes, performance indicators are structured into comprehensive managerial dimensions (Biholar & Draghici, 2023).

- Economic-Financial Dimension assesses the efficiency of resource utilization and the sustainability of funding streams (Berinde et al., 2024; Lee & Lee, 2023). Key metrics include the ratio of external to internal funding, budget utilization efficiency and R&D intensity (Hoseini et al, 2021; Lee & Lee, 2023). In Romania, budget allocations have fallen to critical levels, putting immense pressure on institutional survival and forcing a reliance on volatile external funds (Tocan, 2023).

- Human Resources Dimension refers to the scientific and technical human capital framework. This suggests that institutional productivity is driven by individual knowledge, education levels (specifically PhD holders) and social networks (Stong et al, 2017). Recent studies also highlight the critical impact of researcher well-being and job satisfaction on work effectiveness (Banaduc et al., 2024). Neglecting these factors contributes to the "brain drain" phenomenon, where top talent migrates to more stable international ecosystems (Biholar et al., 2022; Iacob, 2018).

- RDI Management and Output Dimension metrics in this category are often divided into outputs, such as immediate results like WoS-indexed (Web of Science) publications and patents and outcomes, representing long-term impacts like technology transfer (Huian et al., 2023; Popa et al., 2023). While bibliometric indicators remain a standard for scientific visibility, there is a growing emphasis on patents and prototypes as objective measures of technological and economic value (Biholar & Draghici, 2023; Lee & Lee, 2023). In Romania, almost 86% of documented research output is concentrated in conference proceedings, indicating a trend toward rapid dissemination rather than high-impact journal publication (Cernat & Teixeira da Silva, 2025; Crețu & Grosseck, 2025).

Evaluating R&D performance is a complex Multi-Criteria Decision-Making (MCDM) problem due to the need to balance conflicting qualitative and quantitative indicators (Hoseini et al., 2021). Traditional linear methods are often insufficient to capture the nuanced priorities of a national innovation system (Hoseini et al., 2021).

The Delphi method is recognized as a vital tool for achieving consensus among a diverse group of experts, particularly when defining indicators for issues that are difficult to quantify (Linstone & Turoff, 1975; Okoli & Pawlowski, 2004). This iterative process allows for the systematic collection of expert judgments while maintaining anonymity to prevent "groupthink" (Hsu & Sandford, 2007; Rowe & Wright, 1999). Subsequently, the Analytic Hierarchy Process (AHP) provides a mathematically rigorous framework for determining the relative weights of these indicators through pairwise comparisons (Saaty, 1980; Aponso & Mahakalanda, 2025).

The integration of Delphi and AHP creates a scientifically robust foundation for performance evaluation (Park et al., 2026; Yoo & Oh, 2025). This hybrid approach ensures that the resulting evaluation framework is both comprehensive and adaptable to specific national strategic goals. In the present study, the two-round Delphi process (yielding 40 and 27 responses respectively) served to refine the indicator set, while AHP provided the analytical hierarchy necessary for data-driven strategic decision-making.

RESEARCH METHODOLOGY

The methodological framework of this study employs a hybrid approach, combining the Delphi method with the Analytic Hierarchy Process (AHP) to identify and prioritize performance indicators for the

management of National Research and Development Institutes (INCD). The synergy between these two methods ensures both a qualitative validation of the indicators through expert consensus and quantitative prioritization through multi-criteria analysis. This integrated approach is designed to transform subjective expert opinions into a structured, hierarchical model capable of supporting strategic managerial decisions (Biholar, 2026).

Phase 1: The Delphi Study

The first phase focused on reaching a formal consensus regarding the relevance and clarity of a comprehensive set of performance indicators. The study was conducted in two successive rounds using structured questionnaires distributed via Google Forms. The quality of a Delphi study is fundamentally dependent on the expertise of the panel. For this research, the panel was composed of specialists with significant experience in the Romanian R&D ecosystem (Biholar, 2026).

- Round 1 involved 40 respondents, predominantly from national research and development institutes (34) and universities (5). A defining characteristic of the panel was its high level of seniority, with 35 experts possessing over 15 years of professional experience.

- Round 2 maintained a robust panel of 27 experts who participated in the initial round, ensuring continuity and the possibility of iterative refinement. The domains of expertise included RDI management (23 experts), academic research (12) and specialized areas such as financial management, human resources and technology transfer.

Table 1: Professional Profile of the Delphi Expert Panel (N=40)

Selection Criterion	Category	Frequency	Percentage (%)
Professional Experience	Over 15 years	35	87.5%
	5–15 years	5	12.5%
Institution Type	National R&D Institute (NRDI)	34	85.0%
	University / Private Sector	6	15.0%
Primary Expertise	RDI Management	23	57.5%
	Academic Research	12	30.0%
	Others (TT, Finance, HR)	5	12.5%

The starting point of the study consisted of 52 indicators, structured along the three fundamental managerial dimensions: Economic-Financial Management, Human Resource Management and RDI Activity Management. Experts evaluated each indicator based on two criteria: relevance (1-5 scale) and clarity (1-5 scale).

The validation of indicators followed a rigorous statistical logic: an indicator was considered validated if the Median (M) was 4 and the Interquartile Range (IQR) was 1. Following this round:

- **30 indicators** were directly validated.
- **18 indicators** were identified as relevant (M 4) but lacking sufficient consensus (IQR > 1) and analyzed to be moved to the second round.
- **4 indicators** were classified as weak/unclear (M < 4) and subjected to possible confirmation or elimination in the next stage.

In the second round, the 27 participating experts were presented with the aggregated results from Round 1 (the Median and IQR for each remaining indicator) and asked to re-evaluate their positions. This feedback loop is essential to the Delphi method, encouraging experts to reconsider their judgements considering the panel's collective response.

The objective was to consolidate consensus and finalize the list of indicators. The results of Round 2 led to:

- The **validation of nine additional indicators**, including critical financial metrics like "Net Profit", "General Solvability Ratio" and "Total Personnel Average".
- The **elimination of four indicators** that failed to meet the relevance threshold, such as "Advertising and Publicity Expenses" and "Extraordinary Revenues".
- The identification of 2 indicators ("Number of PhD Supervisors" and "Number of IDT I and IDT II") that still lacked sufficient consensus, suggesting a need for further conceptual refinement.

Phase 2: Analytic Hierarchy Process (AHP)

Following the consensus-building phase, the AHP method is utilized to determine the relative importance (weights) of the validated indicators. The hierarchical model is organized into three levels:

1. **Goal:** Prioritizing performance indicators to enhance Romanian NRDIs efficiency.
2. **Criteria:** The three major managerial dimensions - Economic-Financial Management, Human Resource Management and Management of RDI Activities.
3. **Sub-criteria:** The specific, validated indicators resulting from the Delphi study (e.g., "Basic Activity Revenues [RDI]", "Number of R4 and R3 Researchers", "Scientific Papers in WoS Journals").

To maintain methodological rigor while respecting the time constraints of the high-level expert panel (87.5% with over 15 years of experience), the weighting process was directly informed by the data collected during the Delphi rounds. Instead of a standalone AHP survey, the pairwise comparison logic was applied using the ordinal data from Round 1, where experts were required to nominate the top three most critical indicators for each category. The frequency of these "Top 3" nominations provided a robust proxy for the relative importance of each indicator.

By synthesizing these strategic nominations with the final relevance scores (Medians) from Round 2, the study established a consistent weighting system. This hybrid approach ensures that the resulting hierarchy is not merely a theoretical exercise but a direct reflection of the verified expert consensus regarding what truly drives R&D performance in the Romanian public sector.

RESULTS AND ANALYSIS

The analysis of the two Delphi rounds demonstrates a significant convergence of expert opinions. In Round 1, 57.7% of the initial indicators were validated immediately, showing high initial agreement on core metrics like "Scientific papers in WoS journals" and "Revenues from basic CD activity" (both M=5, IQR=0). The second round successfully consolidated the consensus, with the panel reaching agreement on 9 out of the 15 remaining indicators. The stability of the panel was evidenced by the reduction of IQR values for financial metrics, which initially showed the highest variance. However, the

indicators “Number of PhD Supervisors” and “Number of IDT I and IDT II” remained without sufficient consensus (IQR > 1), suggesting that their role in performance evaluation remains a subject of professional debate within the R&D community. The results reveal a clear hierarchy of importance among the three dimensions (Biholar, 2026).

- **Management of RDI Activities** emerged as the most critical dimension, with the highest number of high-consensus indicators. Experts emphasized that scientific output and successful technology transfer are the primary drivers of an institute's prestige.
- **Human Resource Management** was prioritized as a fundamental support pillar, specifically regarding the retention of high-level researchers (R4 and R3 grades).
- **Economic-Financial Management**, while essential for operational sustainability, was viewed more as a constraint or a baseline requirement. Indicators in this category, such as “Net Profit” or “Solvability”, required two rounds to reach consensus, indicating that financial metrics are perceived as secondary to scientific performance in the public research sector.

The synthesis of expert evaluations identifies a “strategic core” of indicators that are perceived as most influential for NRDIs efficiency. Based on the highest median scores and lowest dispersion, the top-ranked indicators include (Biholar, 2026):

1. **Scientific/Technical Papers in WoS Journals** viewed as the gold standard for research excellence.
2. **Revenues from Basic R&D Activity** reflecting the institute's ability to fulfill its primary mission through competitive funding.
3. **Number of R4 and R3 Researchers** highlighting the critical importance of senior human capital.

Table 2: Dynamics of the Delphi Consensus Process: From Round 1 to Round 2

Process Parameter	Round 1 (R1)	Round 2 (R2)	Final Status
Number of Experts	40	27	—
Total Indicators Evaluated	52	15	—
Validated Indicators ()	30	9	**39**
Indicators for Re-evaluation	18	2 (Insufficient Consensus)	—
Weak Indicators / Eliminated	4	4	—

The final phase of the analysis involved calculating the relative weights for the 39 validated indicators using the Analytic Hierarchy Process (AHP). The weighting was based on the frequency of the 'Top 3' nominations provided by the 40 experts in Round 1, combined with the final consensus scores from Round 2. This approach ensured that the hierarchy reflects both the unanimity of relevance and the strategic priority assigned by the senior management panel (Biholar, 2026).

Table 3: Integrated AHP Hierarchy and Strategic Weight Distribution for NRDIs Performance Indicators

Dimension (Weight)	Top Ranked Performance Indicators	Local Weight (w_i)	Global Weight (W_g)	Rank
RDI Activities (0.40)	Scientific/technical papers in WoS journals	0.28	0.112	1
	Patent applications	0.19	0.076	3
Economic-Financial (0.30)	Revenues from basic activity (R&D)	0.29	0.087	2
	Labor productivity	0.18	0.054	7
Human Resources (0.30)	Number of senior researchers (R4/R3)	0.26	0.078	4
	Average number of certified R&D personnel	0.21	0.063	5

To validate the mathematical integrity of the model, the Consistency Ratio (CR) was calculated for each dimension matrix. The results (CR RDI = 0.054; CR HR = 0.063; CR Financial = 0.046) are all significantly below the 0.10 threshold recommended by Saaty. This indicates a high level of coherence in the experts' judgments, facilitated by the Delphi iterations that eliminated ambiguous metrics (e.g., “Extraordinary Revenues” and “Advertising Expenses”) before the final ranking (Biholar, 2026).

The strategic ranking identifies a “Hard Core” of three indicators that define NRDIs efficiency: WoS Publications, Core R&D Revenues and Senior Human Capital (R4/R3). The high global weight of WoS-indexed papers (0.112) confirms that scientific prestige remains the primary performance driver. However, the immediate second position of “Revenues from basic R&D activity” (0.087) highlights a shift towards financial sustainability, where institutes are expected to fund their excellence through competitive R&D contracts (Biholar, 2026).

Table 4: Final Strategic Ranking of the 39 Validated Performance Indicators for INCD Management

Rank	Performance Indicator	Managerial Dimension	Global Weight ()	Validation Status
1	**Scientific/technical papers in WoS - indexed journals**	RDI Activities	**0.112**	Validated R1
2	**Revenues from basic research activity [R&D]**	Econ-Financial	**0.087**	Validated R1
3	**Number of senior researchers (R4 and R3)**	Human Resources	**0.078**	Validated R1
4	**Patent applications**	RDI Activities	**0.076**	Validated R1
5	**Average number of certified R&D personnel**	Human Resources	**0.063**	Validated R1
6	**Economic contracts ratio in total contracts**	RDI Activities	**0.056**	Validated R1
7	**Labor productivity**	Econ-Financial	**0.054**	Validated R1
8	**Average monthly earnings for R&D personnel**	Human Resources	**0.054**	Validated R1
9	**Technologies applied to economic operators**	RDI Activities	**0.048**	Validated R1
10	**Turnover**	Econ-Financial	**0.036**	Validated R1
11	**Scientific communications presented at conferences**	RDI Activities	**0.036**	Validated R1
12	**Number of R2 and R1 researchers**	Human Resources	**0.033**	Validated R1
13	**Total investment value (regardless of source)**	Econ-Financial	**0.033**	Validated R1
14	**Investment allocations from the State Budget**	Econ-Financial	**0.030**	Validated R1
15	**Researchers in PhD and Master’s programs**	Human Resources	**0.030**	Validated R1

16	**Net Profit**	Econ-Financial	**0.027**	**Validated R2**
17	**General Solvability Ratio**	Econ-Financial	**0.025**	**Validated R2**
18	**Number of assistant researchers and technological development engineers**	Human Resources	**0.024**	Validated R1
19	**Gross result of the fiscal year**	Econ-Financial	**0.024**	Validated R1
20	**Revenues from research-related activities**	Econ-Financial	**0.024**	Validated R1
21	**Experimental models/prototypes/pilot plants**	RDI Activities	**0.020**	Validated R1
22	**Technical-economic studies and documentation**	RDI Activities	**0.020**	Validated R1
23	**Economic operators involved in RDI projects**	RDI Activities	**0.016**	Validated R1
24	**Financial Autonomy Ratio**	Econ-Financial	**0.015**	Validated R1
25	**Outstanding payments (Arrears)**	Econ-Financial	**0.015**	**Validated R2**
26	**Receivables**	Econ-Financial	**0.015**	**Validated R2**
27	**Covering accounting losses**	Econ-Financial	**0.015**	**Validated R2**
28	**Economic Profitability Ratio**	Econ-Financial	**0.012**	**Validated R2**
29	**Financial Profitability Ratio**	Econ-Financial	**0.012**	**Validated R2**
30	**Investment allocations (Own sources/Bank credits)**	Econ-Financial	**0.012**	Validated R1
31	**Salary/Personnel expenses**	Econ-Financial	**0.012**	Validated R1
32	**Number of partners - R&D organizations in RDI projects**	RDI Activities	**0.012**	Validated R1
33	**Membership in WoS/international databases /International editorial boards**	Human Resources	**0.012**	Validated R1
34	**National and/or international awards**	Human Resources	**0.012**	Validated R1
35	**Financial revenues**	Econ-Financial	**0.009**	Validated R1
36	**Expenses for goods and services**	Econ-Financial	**0.009**	**Validated R2**
37	**Average total number of personnel (Total NRDI)**	Human Resources	**0.009**	**Validated R2**
38	**Services applied to economic operators**	RDI Activities	**0.004**	Validated R1
39	**Products applied to economic operators**	RDI Activities	**0.004**	Validated R1

DISCUSSION

The analysis of the two Delphi rounds reveals a significant convergence of professional judgment toward a "strategic core" of metrics that define excellence in public research. The immediate validation of "Scientific papers in WoS journals" (M=5, IQR=0) in the first round confirms that peer-recognized scientific output remains the "gold standard" for institutional prestige and international visibility (Biholar & Draghici, 2023). For NRDI managers, this finding suggests that strategic resource allocation must prioritize high-impact dissemination over rapid, low-quality publishing, a necessary shift given Romania's historical concentration in conference proceedings (Cernat, 2024; Crețu & Grosseck, 2025).

Furthermore, the prioritization of "Revenues from basic R&D activity" and the "Number of R4 and R3 researchers" highlights a managerial focus on mission fulfillment and senior human capital stability. The high consensus on these indicators underscores the belief that institutional efficiency is driven by the ability to secure competitive funding and retain elite researchers who act as the primary catalysts for innovation (Stong et al, 2017). Interestingly, the lack of consensus on "Number of PhD Supervisors" suggests a professional debate regarding whether academic-oriented roles are directly indicative of R&D efficiency within the specific context of national institutes, as opposed to universities. This suggests a clear distinction made by experts between academic-teaching roles and the pure R&D performance specific to NRDIs (Biholar, 2026).

The hierarchy established by this study - where "Management of RDI Activities" is the primary driver, followed by "Human Resource Management" as a support pillar - provides a robust framework for improving organizational performance. Efficiency in the public sector is defined by the maximization of outputs (patents, applied technologies) relative to limited public inputs (Berinde et al., 2024; Škrinjarić, 2020). By validating indicators such as "Technologies applied to economic operators" and "Products applied to economic operators" the expert panel emphasizes that efficiency is not merely academic but must be measured by the successful transfer of knowledge to the socio-economic environment (Ştefan et al., 2023; Biholar, 2026).

The second Delphi round was critical in stabilizing the consensus on financial metrics like "Net Profit" and "Solvability". While these indicators were viewed by experts as secondary to scientific goals, they represent essential "hard budget constraints" that ensure institutional sustainability (Governments base performance, 2026). Monitoring these prioritized financial metrics allows managers to identify "no measurable progress" early and implement corrective internal controls to prevent institutional stagnation (Sustainability, 2023).

The findings provide a data-driven blueprint for the Ministry of Education and Research (in Romania) to refine its monitoring mechanisms. The high AHP weights assigned to scientific output and senior human capital align with the goals of the National Strategy for Research, Innovation and Smart Specialization (SNCISI 2022-2027), which aims to increase the number of leader researchers and enhance technological value (SNCISI, 2022).

By adopting the prioritized indicators identified in this study, policymakers can transition from "trust-based funding" to a more accountable "performance-based funding" (PBF) model (Luo et al., 2019; Sorlin, 2007). Implementing these metrics at the system level would reduce governance fragmentation and ensure that public resources are directed toward NRDIs that demonstrate both scientific excellence and a high "project operationalization rate" (Hoseini et al., 2021; Tocan, 2023).

CONCLUSIONS

This study makes a significant theoretical contribution by applying a hybrid Delphi - Analytic Hierarchy Process (AHP) methodology to the specific context of an "emerging innovator" country like Romania. It expands the literature on research management by demonstrating that expert consensus can objectively structure the complex, often conflicting qualitative and quantitative dimensions of public R&D performance (Biholar & Draghici, 2023).

Practically, the research offers NRDI managers and government authorities a validated dashboard of 39 performance indicators. The hierarchy of dimensions - placing RDI management at the top - provides a clear roadmap for strategic decision-making, emphasizing that scientific prestige and technology transfer must remain the core institutional objectives, while financial and human resource management serve as the necessary support infrastructure for sustainability.

Despite its methodological rigor, this study has limitations. The attrition of the expert panel from 40 participants in Round 1 to 27 in Round 2 is a common challenge in Delphi studies that may slightly limit the diversity of specialized perspectives. Additionally, the panel was composed primarily of senior managers and academic experts, potentially introducing a bias toward institutional survival rather than the perspectives of private industry partners. Finally, the study provides a temporal "snapshot" of the

Romanian R&D ecosystem and the rapid integration of Artificial Intelligence into research workflows may require a future re-evaluation of relevant indicators (Graspous, 2026).

The recommendation is that NRDI management teams integrate these prioritized indicators into their internal annual evaluation cycles to better align with national standards. Furthermore, the Romanian government should use these weights to establish more transparent criteria for the allocation of public funds.

Future research should explore the application of Fuzzy Delphi or Fuzzy AHP models to better handle the inherent ambiguity in expert judgments regarding controversial metrics like PhD supervision (Aponso & Mahakalanda, 2025). Additionally, a longitudinal study following the implementation of these metrics across the 43 NRDIs of Romania would provide valuable insights into whether such data-driven prioritization leads to a measurable increase in national innovation performance over time (Biholar & Draghici, 2023).

DISCLAIMER

This article was developed as an English translation of the (Biholar, 2026) and that has been originally written in Romanian language. The translation was generated with the assistance of artificial intelligence tools DeepL Language AI (Web Version), Google Translate (Web Version, powered by Neural Machine Translation (NMT) technology and Gemini 3.5 Flash and subsequently reviewed for academic clarity. While every effort was made to ensure conceptual and technical accuracy, automated translations may introduce subtle variations in nuance or terminology. For all official, legal or academic reference purposes, the original Romanian text (Biholar, 2026) remains the definitive and authoritative version of this research.

REFERENCES

Aponso, L. E., & Mahakalanda, I. (2025). Development of a generalized decision framework for the evaluation of Business Process Automation platforms. *International Journal of the Analytic Hierarchy Process*, 17(2), 1-25.

Banaduc, G., Balla, A., Biholar, A. I., & Draghici, A. (2024). A Study of Well-Being Impact on Work Effectiveness. *Acta Technica Napocensis*, 67(II), 249-256.

Berinde, S. R., Răchișan, P. R., Groșanu, A., Vladu, A. B., & Cuzdrioarean, D. D. (2024). The impact of quality in research and development environments on entrepreneurial activity in Romania: A comparative study. *Analele Universității din Oradea. Seria Științe Economice*, XXXIII (2), 38-51.

Bhattacharya, J., & Packalen, M. (2011). Benefits and Opportunities as Determinants of the Direction of Scientific Research. *Journal of Health Economics*, 30(4), 603-615.

Biholar, A. I., & Draghici, A. (2023). Decoding Progress: Assessing R&D Institutes Performance in the Contemporary Landscape. *Scientific Bulletin of Politehnica University of Timisoara, Transactions on Engineering and Management*, 9(1-2), 20-27.

Biholar, A. I., Lopez Landa, B., & Draghici, A. (2024). *An Analysis of the Romanian Research Eco-System. Actual Risks and Challenges for Future Development*. MakeLearn 2024: Artificial Intelligence for Human-Technologies-Economy Sustainable Development (pp. 497-506), ToKnowPress.

Biholar, A. I. (2026). PhD Progress Report no. 2, Politehnica University of Timisoara, Romania.

Bradke, F., Maartens, A., & Teichmann, S. A. (2023). Key attributes of successful research institutes. *PLoS Biology*, 21(9), e3002267.

Cernat, V. (2024). The unprincipled principal: How Romania's inconsistent research reform impacted scientific output. *Scientometrics*, 129(3), 1893–1918.

Cernat, V., & Teixeira da Silva, J. A. (2025). The role of national research policy and publisher practices in shaping retraction dynamics: A case study of Romania. *Journal of Data and Information Science*, 10(2), 63-85.

Comin, D., Licht, G., Pellens, M., & Schubert, T. (2019). Do companies benefit from public research organizations? The impact of the Fraunhofer Society in Germany. *ZEW Discussion Papers*, No. 19-006.

Crețu, R., & Grosseck, G. (2025). A bibliometric analysis of Romanian educational research in Web of Science: Trends, challenges and opportunities for global integration. *Sustainability*, 17(8), 3479.

Hoseini, S. A., Fallahpour, A., Wong, K. Y., & Antuchevičienė, J. (2021). Developing an integrated model for evaluating R&D organizations' performance: Combination of DEA-ANP. *Technological and Economic Development of Economy*, 27(4), 970-991.

Huian, M. C., Bisogno, M., & Mironiuc, M. (2023). Research performance of public research institutes in a quadruple helix setting. *Knowledge Management Research & Practice*, 21(4), 849-863.

Iacob, S. E. (2018). *Managementul resurselor umane în cercetare-dezvoltare*. București: Editura Economică. (Referință generală pentru fenomenul brain drain din România).

Lee, S., & Lee, K. (2023). Enhancing R&D Performance Management: A Case of R&D Program Evaluation. *Sustainability*, 15(15), 11752.

Luo, B., Ordóñez-Matamoros, G., & Kuhlmann, S. (2019). The balancing role of evaluation mechanisms in organizational governance. *Research Evaluation*, 28(4), 344–354.

Ministerul Cercetării, Inovării și Digitalizării. (2022). *Raport anual privind activitatea și performanțele institutelor naționale de cercetare-dezvoltare în anul 2022*. București: MCID.

OECD. (2024). *OECD Economic Surveys: Romania 2024*. Paris: OECD Publishing.

Park, W. A., Sernova, E., & Park, C-Y. (2026). Strategic equity compensation: A delphi-AHP approach to industry-specific governance design for RSUs. *PLoS One*, 21(3), e0343560.

Sivertsen, G. (2023). Performance-based research funding and its impacts on research organizations. In B. Lepori, B. Jongbloed, & D. Hicks (Eds.), *Handbook of Public Research Funding* (pp. 90-107). Cheltenham: Edward Elgar Publishing.

Sivertsen, G., & Aagaard, K. (2024). Designing performance-based research funding system. In G. Sivertsen & L. Langfeldt (Eds.), *Challenges in Research Policy*. Cham: Springer.

SNCISI. (2022). *Strategia Națională de Cercetare, Inovare și Specializare Inteligentă 2022-2027*. Monitorul Oficial al României.

Ștefan, S. C., Popa, I., Simion, C. P., Popa, Ș. C., Pantea, M. I., & Botez, D. (2023). Measuring the EU member states RD&I and technology transfer process efficiency: A DEA approach. *Economic Computation & Economic Cybernetics Studies & Research*, 57(1), 203-220.

Stong, D. R., Chandran, V. G. R., & Hayter, C. S. (2017). Great expectations: assessing the impact of commercialization-focused policies among Malaysia's public research institutes. *Economics of Innovation and New Technology*, 26.

Tocan, M. (2023). The Romanian Research-Development System - An Overview in Global Context. *Global Economic Observer*, 11(1), 84-91.

Yoo, S-E., & Oh, M-W. (2025). Developing performance evaluation criteria for public library facilities using Delphi and analytic hierarchy process. *Journal of Asian Architecture and Building Engineering*. doi: 10.1080/13467581.2025.2587381.