KMAN PUBLISHING INSTITUTE
Journal Website

Article history:
Received 11 May 2025
Revised 25 August 2025
Accepted 31 August 2025
Published online 01 January 2026

International Journal of Innovation Management and Organizational Behavior

Volume 6, Issue 1, pp 1-14

E-ISSN: 3041-8992

Definition, Classification, and Characteristics of Indicator Systems: A Systematic Review

Sepehr. Rahimian[1], Keyvan. Salehi[2*]

[1] PhD Candidates in Psychology, University of Tehran, Tehran, Iran
[2] Associate Professor, Faculty of Psychology and Educational Sciences, University of Tehran, Tehran, Iran

*** Corresponding author email address**: Keyvansalehi@yahoo.com

A r t i c l e I n f o

Article type:
Original Research

How to cite this article:
Rahimian , S., & Salehi, K. (2026). Definition, Classification, and Characteristics of Indicator Systems: A Systematic Review. *International Journal of Innovation Management and Organizational Behavior, 6*(1), 1-14.
https://doi.org/10.61838/kman.ijimob.4391

A B S T R A C T

Objective: The purpose of this article is to summarize the definitions, classifications, and characteristics of indicator systems and to create a foundation for understanding and developing a common system through a systematic review.

Methodology: Through a review study, using two English keywords, "Indicator System" and "System of Indicators", five databases—Springer, Sage, Elsevier, Taylor & Francis, and Emerald—were systematically searched. After applying exclusion criteria, a total of 68 documents, which based on PRISMA indicators demonstrated acceptable quality for this study, were selected and analyzed. Data analysis in this research was conducted using Altheide's method.

Findings: According to the identified components, the indicator system "refers to a set of characteristics that, through quantitative and qualitative indicators, are influenced by three dimensions—temporal, environmental, and content-related—as well as the target audience, thereby enabling the reflection of changes, the simplification of understanding phenomena, and the measurement and provision of meaningful information about them." Furthermore, the review of existing classifications in the design and development of indicator systems led to the proposal of a new taxonomy, structured into 40 levels and 14 categories, which are consolidated into six overarching themes: the nature of the indicator, the nature of indicator data, the degree of importance and order of operational steps, application and performance (thematic), number of indicators, and level.

Conclusion: In addition, the findings of this study identified the characteristics of indicators as essentially descriptive, prescriptive, and deductive. It also provided explanations regarding the selection of good indicators, which will be further elaborated in the following sections.

Keywords: *Indicators, Indicator Systems, Characteristics, Higher Education Studies, Review*

1 Introduction

In contemporary public sector management and organizational governance, indicators and indicator systems have become indispensable tools for measuring, monitoring, and enhancing performance. They provide decision-makers with quantifiable and qualitative evidence regarding institutional effectiveness, governance quality, service delivery, and socio-economic outcomes. The growing complexity of public sector responsibilities in areas such as health, education, sustainability, financial governance, and digital transformation has intensified the demand for structured frameworks of indicators that enable comprehensive evaluation, transparency, and accountability (Oecd, 2021, 2022).

The historical foundation of indicators lies in their role as "signs" or "pointers" of phenomena, enabling decision-makers to capture essential conditions of systems through measurable variables (Homer, 2022; Unaids, 2020). Over time, indicator systems have evolved beyond single measures to composite and multidimensional frameworks capable of reflecting dynamic processes and outcomes (Alomoto et al., 2021; Facchinetti & Siletti, 2021). For public administration, this evolution has been vital, as governance challenges cannot be addressed adequately without integrated evidence that connects financial, social, environmental, and organizational dimensions (Ali Turk et al., 2024; Barati et al., 2024).

Indicators are defined as quantitative or qualitative variables that provide valid and reliable means for measuring performance, reflecting changes, and guiding managerial decisions (Tool, 2023; Unaids, 2020). In governance contexts, indicators play a dual role: they not only describe the state of organizational systems but also prescribe standards against which progress and compliance can be assessed (Homer, 2022; Na & Han, 2023). Research emphasizes that indicators are valuable not only for data-driven monitoring but also for shaping accountability and trust in institutions (Magrini & Giambona, 2022; Ricciolini et al., 2022).

Organizational and public sector contexts demand indicator systems that can link inputs, outputs, and outcomes in ways that capture efficiency, effectiveness, and equity (Abdullah & Usman, 2022; Berger et al., 2022). This has led to the adoption of multi-criteria and composite indicators that simplify complex realities while retaining enough sensitivity to guide policy and practice (Blancas et al., 2023; Capecchi et al., 2023; Cavicchia et al., 2023).

One of the critical applications of indicator systems is in the evaluation of governance quality and its implications for financial management. Good governance indicators serve as benchmarks for accountability, transparency, participation, and rule of law, all of which directly influence the effectiveness of public sector organizations (Ali Turk et al., 2024; Barati et al., 2024). For example, in the Iranian capital market, macroeconomic instability has been shown to interact with governance indicators to affect profit management (Ali Turk et al., 2024). Similarly, indicators designed for public organizations can diagnose the financial health of institutions, linking governance performance to organizational sustainability (Barati et al., 2024).

Financial performance indicators also intersect with sustainability considerations. Measurement systems increasingly integrate financial sustainability with broader socio-economic impacts, highlighting the need for balanced frameworks (De Wolf et al., 2023; Gleißner et al., 2022). In the public sector, adopting sustainability-oriented indicator systems allows organizations to meet short-term operational goals while aligning with long-term policy commitments (Pan et al., 2023; Perchinunno et al., 2023).

Indicators have been applied widely across diverse domains of public sector and organizational management. In education, indicators are used to assess convergence in performance across countries and to evaluate progress in specific institutional reforms (Camanho et al., 2023; Duan et al., 2023). Tools such as the CIPP (Context, Input, Process, Product) model have been particularly influential in guiding higher education performance evaluations (Qian et al., 2022). Similarly, in the governance of education in regions such as Tibet or within marine economies, indicators have provided critical evidence for policy adaptation (Xu & Gao, 2022; Zhou, 2022).

In health governance, indicator systems have been employed to evaluate board-level quality governance and to design frameworks for monitoring environmental impacts on health (Martin et al., 2023). These applications underscore how indicator systems translate complex inputs into actionable evidence for policymakers.

In sustainability and environmental governance, indicators such as carbon footprints, ecological transition measures, and circular economy indices have provided robust foundations for evaluating national and organizational strategies (Abdullah & Usman, 2022; Magrini & Giambona, 2022; Perchinunno et al., 2023). Composite frameworks for agricultural sustainability (Magrini & Giambona, 2022) or water system resilience (Li

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E-ISSN: 3041-8992

et al., 2022) illustrate the adaptability of indicator systems across different policy fields.

In tourism governance, the European Tourism Indicator System (ETIS) has been widely studied and adapted to support destination management and competitiveness (Font et al., 2021; Mihalic & Kuščer, 2021; Owusu-Manu et al., 2020; Punzo et al., 2022). For public institutions overseeing tourism policy, indicators enable balancing economic benefits with social and environmental sustainability.

In digital economy and technology governance, indicators are used to evaluate resilience, innovation capability, and urban-rural integration under conditions of rapid technological change (Tu et al., 2023; Wang et al., 2023; X. Zhao et al., 2023). For example, digital technology policy indicators mediate urbanization and economic development (X. Zhao et al., 2023), while evaluations of patent-based indicators enhance understanding of innovation quality (Hu et al., 2023).

The development of effective indicator systems requires robust methodological foundations. Advances in multi-criteria analysis, clustering, and composite index construction have improved the precision and utility of indicators (Cavicchia et al., 2023; Gallego et al., 2023). Techniques such as the Delphi method have been used to reach consensus in defining core indicators for complex policy areas such as migration and refugee integration (Bajo Marcos et al., 2023). Similarly, cluster-based and regression-based models help address overlaps and redundancies among indicators, ensuring system efficiency (Chai et al., 2023; Y. Zhao et al., 2023).

Indicators have also been categorized as descriptive, prescriptive, and evaluative, with the recognition that effective systems must combine these functions (Huang et al., 2023; Tu et al., 2022). Methodological approaches such as bibliometric reviews (Alomoto et al., 2021) and composite statistical techniques (Sánchez & Jiménez-Fernández, 2022; Scaccabarozzi et al., 2022) provide rigorous bases for refining indicator systems in public governance contexts.

Despite their advantages, indicator systems in public sector management face several challenges. First, the proliferation of indicators across different domains risks fragmentation and lack of comparability (Etis, 2022; Ulitsky et al., 2023). Second, indicators often struggle to capture qualitative dimensions of governance, such as trust, inclusiveness, and equity (Habib et al., 2022; Kraeger et al., 2022). Third, methodological issues such as weighting, redundancy, and temporal comparability continue to pose barriers to effective implementation (Lapatinas & Katsaiti, 2023; Zhang et al., 2023).

Moreover, indicators must adapt to new policy priorities, including resilience to crises such as COVID-19 (Liu et al., 2023; Y. Zhao et al., 2023) and transitions to sustainable digital and financial systems (Hakimi et al., 2024; Mohammadi Yazdi et al., 2024). Without continuous refinement, indicator systems risk becoming obsolete in rapidly changing governance environments (De Wolf et al., 2023; Ulitskaya et al., 2023).

While the literature demonstrates the widespread use and methodological diversification of indicator systems across various public policy domains, a critical gap remains in integrating these systems into coherent frameworks for public sector and organizational performance evaluation. Existing studies often focus on single sectors or fragmented indicators, but comprehensive frameworks that align with good governance, sustainability, and digital transformation are underdeveloped (Ali Turk et al., 2024; Barati et al., 2024; Boumahdi & Zaoujal, 2023).

The objective of this study is to systematically review and synthesize definitions, classifications, and characteristics of indicator systems, with the aim of establishing a common framework for their use in public sector and organizational performance evaluation.

2 Methods and Materials

This research was conducted based on a documentary study and in the form of a systematic review. The general procedure of the study included searching for specified keywords on the Internet, which, after applying filtering in search engines, led to a smaller number of selected articles through the PRISMA method, forming the basis for analyzing the research questions.

More precisely, searches were conducted in online databases—including five databases: *Taylor & Francis, Springer, Sage, Emerald, and ScienceDirect (Elsevier)*—using the keywords *"System of Indicators"* and *"Indicator System"*, enclosed in quotation marks. At this stage, the inclusion criterion for documents was limited to the search for these two terms. Then, to identify more precise results, criteria were applied for excluding some of these documents. These criteria were applied within the databases using the filtering options of the search engines, wherever such options were available, and included the following: limiting the publication year to the past year; selecting documents in the fields of humanities, economics, business, marketing,

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E-ISSN: 3041-8992

mathematics, and research methodology; selecting only English-language documents; including materials where the keywords appeared in the title or abstract; including only open-access and freely available documents; and excluding documents where the keywords occurred fewer than five times. These are referred to as the exclusion criteria of the research documents. Table 1 summarizes the number of articles extracted from each database.

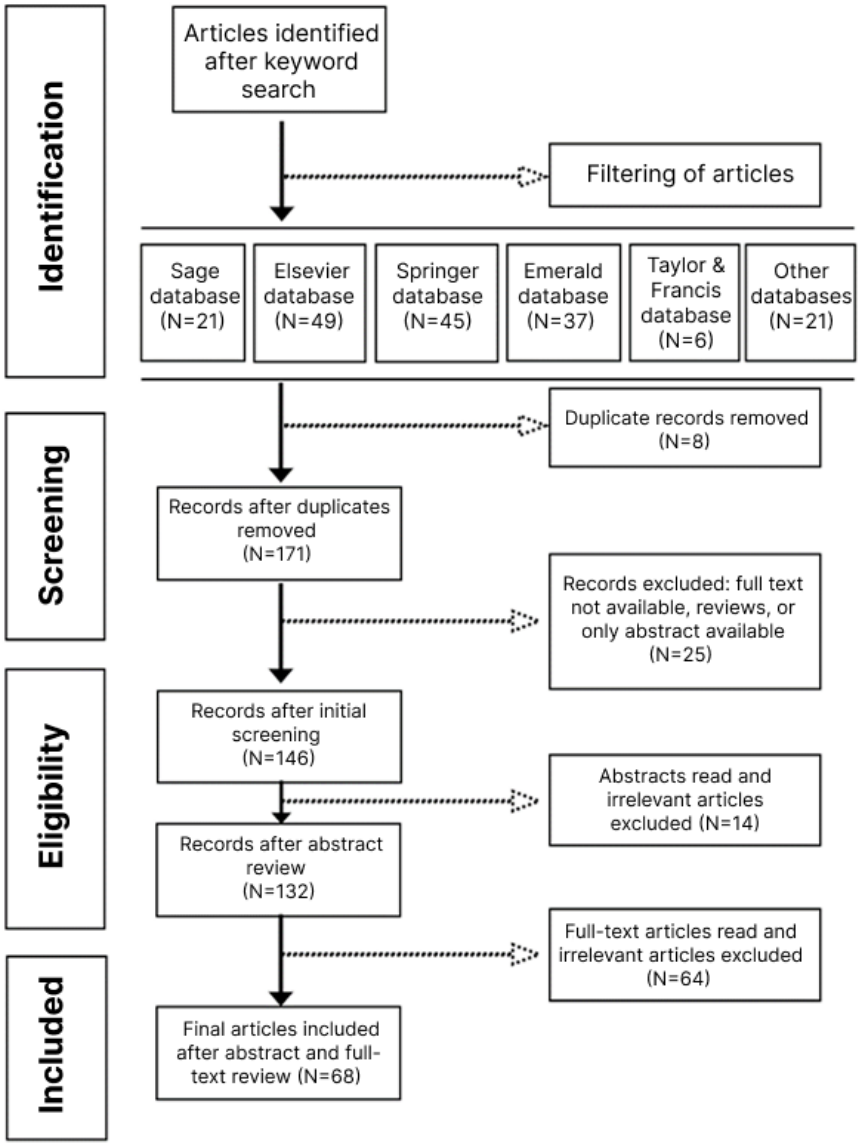
Table 1

Extracted Articles by Database

Database	Science Direct (Elsevier)	Springer	Sage	Taylor & Francis (Online)	Emerald
Keyword "System of indicators"	25	45	6	5	28
Keyword "Indicator system"	24	15	15	1	19
Remaining documents (after removing duplicates and documents with insufficient keywords)	49	45	21	6	37

Figure 1

The Procedure of Article Selection



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E-ISSN: 3041-8992

As shown in Table 1, the total number of remaining documents after the initial removal (search filter application) was 158 articles to initiate the data collection process. Additionally, during the search process, 21 more related articles were identified through a bibliometric method, increasing the total to 179 articles. Then, in the next stage, the articles were evaluated using the PRISMA statement, in order to remove duplicates and to separate those that, based on the title, abstract, and main text, were relevant and suitable for use in this research.

PRISMA stands for *Preferred Reporting Items for Systematic Reviews and Meta-Analyses*. This tool serves as a guideline to increase transparency, precision, and comprehensiveness in systematic review articles, enabling the quantitative and qualitative evaluation of materials on a particular topic in a replicable manner. Figure 1 presents the process of the PRISMA model and the output of selected articles.

As illustrated in this figure, the total number of articles retrieved from all databases was 179, with the count from each database provided. After eliminating duplicates, 171 articles entered the PRISMA model. In the screening stage, 25 articles were removed because the full text was not accessible or only abstracts were available. In the eligibility stage, assessing the suitability of the articles for inclusion in the research by reading abstracts and full texts, 64 more articles were excluded. Ultimately, 57 articles were selected for use in the study.

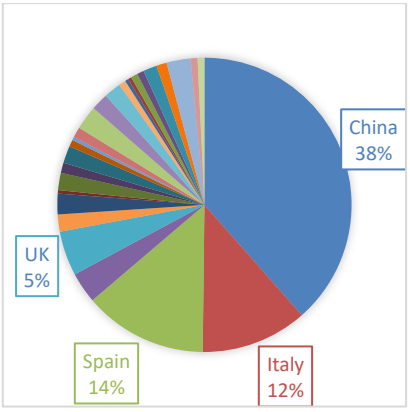
It should be noted that the criterion for excluding unrelated articles was the absence of reference to definitions of indicator systems, classifications of indicator systems, or characteristics of indicator systems, which were among the objectives of this research. The full list of extracted articles, along with the names of the authors, their countries, and the journals in which they were published, is provided at the end of the article (References section). Each article is assigned a number, and from this point onward, these numbers represent the codes of the articles, which are used to reference them in the subsequent sections (see References).

3 Findings and Results

In this section, descriptive statistics of the extracted articles are first presented in order to inform the reader, followed by answers to the main research questions. As shown in Figure 2, the frequency of articles is indicated by the authors' countries. According to the chart, the four countries with the highest number of authors on the subject of this study are, in order: 44% from China, 15% from Spain, 14% from Italy, and 5% from the United Kingdom. The remaining countries each account for less than 5% of the frequency. These figures are based on the individual authors of each article, since in some cases multiple authors from different countries collaborated on a single article, and therefore relying only on the first author would produce inaccurate statistics. The exact number of authors by country, presented in descending order, is as follows: China, 102; Spain, 36; Italy, 31; United Kingdom, 13; Russia, 9; Ireland, 7; Greece, 7; United States, 6; Vietnam, 5; Portugal, 5; Germany, 5; Austria, 5; Morocco, 5; Hungary, 3; Slovenia, 3; Switzerland, 2; Lithuania, 2; Norway, 2; Sweden, 2; South Korea, 2; Malaysia, 1; France, 1; Netherlands, 1; Denmark, 1; Finland, 4; Iceland, 3.

Figure 2

Distribution of Authors' Countries



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E-ISSN: 3041-8992

Figure 3

Percentage of Articles Using Indicators vs. Systems of Indicators

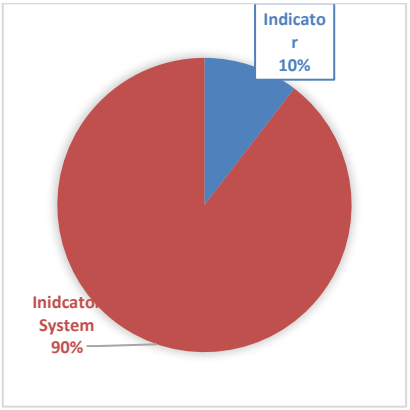
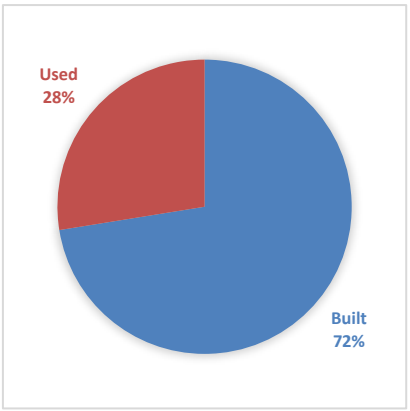


Figure 4

Percentage of Articles that Created New Indicators vs. Used Existing Indicators



As shown in Figure 3, 10% of the articles employed single indicators, while 90% used systems of indicators (either composite or integrated indicators). More precisely, Articles 5, 15, 28, 30, 32, 33, and 45 used single indicators, totaling seven articles. By contrast, Articles 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 29, 31, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, and 67 employed systems of indicators, totaling 60 articles. One article (Article 68) was a review study, which could not be classified into either group.

Finally, as indicated in Figure 4, 72% of the articles created a new system or indicator, while 28% used existing indicators or systems of indicators. Specifically, Articles 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 17, 18, 19, 20, 21, 23, 24, 27, 29, 31, 34, 36, 37, 38, 39, 40, 41, 44, 46, 47, 48, 49, 51, 52, 54, 55, 56, 58, 59, 60, 61, 62, 63, 64, 66, and 67 developed new indicators, totaling 50 articles. In contrast, Articles 4, 14, 15, 22, 25, 26, 28, 30, 32, 33, 35, 42, 43, 45, 50, 53, 57, and 65 used existing indicators, totaling 19 articles. One article (Article 68) was a review paper, which does not fall into either group. Before addressing the results of the research questions, the following provides an overview of which studies responded to each of the research questions:

1. Articles that provided definitions of indicators or indicator systems: 10, 20, 25, 57.
2. Articles that presented classifications of indicators or indicator systems: 1–68 (except those not listed).
3. Articles that described characteristics of indicators or indicator systems: 1, 4, 7, 9, 10, 11, 13, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 40, 43, 44, 45, 48, 49, 50, 51, 52, 53, 55, 57, 59.

As is evident, only a small number of articles provided explicit definitions of indicators. However, many of the articles offered classifications of indicators. The following

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E-ISSN: 3041-8992

section presents the findings in response to each of the research questions.

Research Question 1: What are the definitions of indicators (or systems of indicators)?

The findings of this study revealed that, surprisingly, only a handful of the articles in the systematic review provided explicit definitions of indicators. Specifically, only four studies offered definitions of indicators prior to using them in their studies. Nevertheless, researchers did not limit themselves to these definitions. To complement their understanding, they searched for other definitions of indicators in order to arrive at a more comprehensive conceptualization.

Table 2

Summary of Definitions of Indicators

No.	Organization or Author	Definition of Indicator
1	Homer (2022)	Defines indicators as signs, variables, or pointers of phenomena that are commonly used in environmental, managerial, and research reports.
2	Yin, Cao, et al. (2022)	Considered the "twin brothers of data." Indicators are transmitters of information and the foundation of research work, sometimes used as evidence and sometimes as early warnings to prevent economic, social, and environmental problems.
3	Font, Torres-Delgado, et al. (2021)	Measures of the existence of issues or phenomena of interest, used to describe an aspect of society, a social or macro activity, or a geographical region, or to show changes in these areas.
4	Abdoullah & Osman (2022)	Related variables that can be measured over time or across space, providing information about a larger phenomenon of interest, enabling comparisons.
5	Chambers Dictionary, World Health Organization (2002)	Something that is a sign, a pointer, or anything that displays conditions at a specific time.
6	Glossary of Key Terms in Evaluation	Quantitative or qualitative factors that provide simple and reliable means to measure achievements, reflect changes related to interventions, or help assess the performance of a developing subject.
7	OECD	A parameter, or a value derived from parameters, which provides information about the state of a phenomenon/environment/area, where the relationship with the parameter value is meaningful.
8	USAID	A variable used to measure changes in a phenomenon or process.
9	European Commission	A description of project objectives in numerical or qualitative terms, including target group, time, and place.

As shown in Table 2, similarities can be identified across these definitions. Based on Altheide's qualitative content analysis approach, the researchers found that these definitions emphasize two key aspects of indicators: functions and attributes/characteristics. More specifically, the attributes include "quantitative and qualitative nature, spatial and temporal dimensions, and the target group," while four functional properties include "reflection of changes, simplification of phenomena, measurement of changes, and provision of meaningful information." Consequently, a combined definition may be proposed from these shared elements: "Indicators refer to a set of characteristics that, through quantitative and qualitative markers influenced by temporal, environmental, and content-related dimensions and the target audience, enable the reflection of changes, the simplification of understanding phenomena, and the measurement and provision of meaningful information about them."

Research Question 2: What are the types (classifications) of indicators or indicator systems?

The types of indicators were previously discussed. At this stage, the question arises whether a comprehensive classification of indicators exists. The review of articles helped collect several classifications, providing a framework for their selection from the outset of use. In summary, 14 categories of indicators were extracted from the reviewed studies. The total levels across these 14 categories amounted to 40, which, after consolidation and summarization, were grouped into six overarching categories.

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Table 3

Types of Indicator Classifications with Their Definitions

Category	Classifications	Levels	Definition / Explanation	Source
Nature of Indicators	Descriptive / Functional / General Improvement / Efficiency / Effectiveness	1 Descriptive	Description of what happens to the environment and human health. What is the situation? Efficiency indicators: Are we improving?	(Berger et al., 2022; Oecd, 2022)
		2 Functional	Does it matter? Are we achieving the goals?	(Blancas et al., 2023; Na & Han, 2023)
		3 General Improvement	Is our overall situation better?	(Perchinunno et al., 2023)
		4 Efficiency	Are we progressing and improving?	(Magrini & Giambona, 2022)
		5 Effectiveness	Are the scales and measurements working well?	(Ricciolini et al., 2022)
Functional / Systemic	Functional / Systemic	6 Systemic	Single measurements summarizing system features—e.g., social or educational systems—conveying the most relevant information to decision-makers	(Chatziioannou et al., 2023)
		7 Functional	Functional indicators, besides descriptive role, are prescriptive; they include normative or policy criteria, enabling comparison with regional, national, or global goals	(Blancas et al., 2023; Na & Han, 2023)
General / Specific / Reference	General / Specific / Reference	8 General	–	(Yin et al., 2022)
		9 Specific	–	(Yin et al., 2022)
		10 Reference	–	(Yin et al., 2022)
Nature of Indicator Data	Quantitative / Qualitative	11 Quantitative	Results derived from numeric data	(Tu et al., 2023; Y. Zhao et al., 2023)
		12 Qualitative	Results derived from non-numeric data	(Gallego et al., 2023; Huang et al., 2023)
Positive / Negative	Positive / Negative	13 Positive	Indicators where larger values are better	(Li et al., 2022; Shi et al., 2022)
		14 Negative	Indicators where smaller values are better	(Huang et al., 2023; Liu et al., 2022)
Subjective / Objective	Subjective / Objective	15 Subjective	Subjective indicators such as job satisfaction or preferences and attitudes	(Boumahdi & Zaoujal, 2023; Habib et al., 2022)
		16 Objective	Objective indicators such as demographic change, aging-related health decline, or household income	(De Wolf et al., 2023; Magrini & Giambona, 2022; Ulitskaya et al., 2023)
Direct / Indirect	Direct / Indirect	17 Direct	Directly related to measurable outputs or outcomes	(Punzo et al., 2022; Y. Zhao et al., 2023)
		18 Indirect	Indirectly related, used when data collection is impossible or too costly	(Liu et al., 2022)
Importance & Sequencing	Primary / Secondary	19 Primary	Expresses priority of indicators	(Tu et al., 2023)
		20 Secondary	–	(Scaccabarozzi et al., 2022)
Core / Supplementary	Core / Supplementary	21 Core	Collect essential and key information necessary for stakeholders	(Font et al., 2021; Punzo et al., 2022)
		22 Supplementary	Optional, additional information for stakeholder-specific goals	(Chatziioannou et al., 2023)
Input / Output / Results	Input / Output / Results	23 Input	Information about project resources and performance efficiency	(Tool, 2023)
		24 Output	Preliminary information that supports higher-level outcomes	(Tool, 2023)
		25 Results	Indicators showing whether project results have been achieved	(Tool, 2023)
Planning / Intervention	Planning / Intervention	26 Planning	Indicators used to explain and define requirements in planning stage	(Tool, 2023)
		27 Intervention / Implementation	Indicators as tools for monitoring progress and management	(Tool, 2023)

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Application & Function (Thematic)	Educational / Evaluative / Social / Health	28 Educational	Used to monitor and assess education of migrant and refugee children	(Bajo Marcos et al., 2023)
		29 Evaluative	Provides information on system performance and sustainability	(Owusu-Manu et al., 2020)
		30 Social	Indicators to track community direction and progress	(Chatziioannou et al., 2023)
		31 Health	Indicators to demonstrate environmental effects on public health and support evidence-based policy	(Martin et al., 2023)
Number	Single / Systemic / Composite / Mixed Systems	32 Single	Based on single facts representing observed condition	(Zhou, 2022)
		33 Systemic	Combination of two or more indicators into a defined model	(Blancas et al., 2023)
		34 Composite	Latent variables resulting from merging main indicators into multi-dimensional models	(Gallego et al., 2023)
		35 Mixed Systems	Composite systems summarizing complexity of a phenomenon	(Cavicchia et al., 2023)
Level	Global / National / Regional / Organizational / Project	36 Global	Aggregated global-level indicators across countries	(Perchinunno et al., 2023)
		37 National	Aggregates project or regional indicators into national perspective	(Magrini & Giambona, 2022)
		38 Regional / Urban	–	(Gallego et al., 2023; Punzo et al., 2022)
		39 Organizational	Indicators as evidence within organizations for transparency and accountability	(Bajo Marcos et al., 2023; De Wolf et al., 2023)
		40 Project	Indicators focused on specific project objectives and outcomes	(Chen et al., 2023)

As can be seen, the 40 levels extracted across 14 categories can be consolidated into six broader groups: nature of indicators, nature of indicator data, importance and sequencing of operational steps, application and performance (thematic), number of indicators, and level. More precisely, when selecting indicators, they can be examined from these six perspectives.

In the first group, which concerns the nature of indicators, categories include descriptive, functional, systemic, general, or reference indicators. The second group, concerning the nature of indicator data, includes quantitative, qualitative, subjective, objective, direct, indirect, positive, or negative indicators. The third group, regarding importance and order of operational steps, divides indicators into core or complementary, primary or secondary, planning or intervention and implementation, and input, output, or results. The fourth group, based on application and performance, categorizes indicators as educational, evaluative, health-related, social, etc.—this group is sometimes referred to as thematic, since the labels depend on the research subject. The fifth group considers the number of indicators, distinguishing between single indicators and indicator systems, which themselves can be composite or integrated. Finally, in the sixth group, indicators are classified by levels of measurement, including global, national, urban/regional, organizational, and project-level indicators.

Research Question 3: What are the characteristics of indicators (or indicator systems), and what are the key considerations in selecting them?

By reviewing the studies included in this research, it was found that indicator systems are inherently characterized as prescriptive, descriptive, and deductive. Furthermore, based on the reviewed literature, good indicators themselves possess trait-like characteristics such as being systematic, feasible, and operational. These intrinsic characteristics of indicators are addressed in the first part of this question. At the same time, the aspects of indicator selection and weighting have their own specific features.

In summary, the intrinsic characteristics of indicators include their descriptive, prescriptive, and deductive nature. In addition, a good indicator is one that is concise, feasible and attainable, meaningful, measurable, and accessible in terms of time, financial resources, and data collection capability. It should also be representative and relevant, non-duplicative, adaptive, scientific, systematic, practical, scalable, flexible, operational, dynamic, comparable, transparent, and sufficient.

Current methods of indicator selection are mainly focused on the relative importance of indicators and the overlap of indicator information. Methods that demonstrate the

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E-ISSN: 3041-8992

importance of indicators include the coefficient of variance and change, the optimal variance method, and the elliptical length method. However, relative importance alone can only reveal that an indicator is more significant for evaluation outcomes; it cannot determine whether there is information overlap among indicators. Selection methods for addressing information overlap among indicators often include correlation coefficients, cluster analysis, and support vector regression.

4 Discussion and Conclusion

The results of this systematic review highlight three major dimensions of indicator systems in the context of public sector and organizational performance evaluation: (1) the definitional clarity and conceptualization of indicators, (2) the typologies and classifications that guide their use, and (3) the inherent characteristics that determine the quality of indicators and the principles of selection. Together, these findings provide a structured lens through which indicator systems can be understood, evaluated, and applied in governance and organizational management contexts. By integrating these insights, this study contributes to bridging the gap between the conceptual diversity of indicators and the operational requirements of public sector organizations.

One of the most striking results of this study was the relative scarcity of explicit definitions of indicators, despite their widespread use across multiple domains. Only a handful of studies provided comprehensive definitions, framing indicators as variables, measures, or signs that capture aspects of complex phenomena (Abdullah & Usman, 2022; Font et al., 2021; Homer, 2022; Unaids, 2020). This observation aligns with findings in the literature that emphasize the operational rather than conceptual reliance on indicators in applied governance and management research (Blancas et al., 2023; Ricciolini et al., 2022). The absence of definitional consensus, however, suggests a weakness in theoretical underpinnings that may compromise coherence across studies. In line with earlier reviews of sustainability and well-being indicators (Alomoto et al., 2021; Facchinetti & Siletti, 2021), this study demonstrates the need for common definitional frameworks to enhance comparability across public sector contexts.

The second major set of results concerns the classification of indicators. This study extracted 14 categories with 40 levels that, when aggregated, condensed into six overarching categories: nature of indicators, nature of data, importance and sequencing of operational steps, application and thematic domains, number of indicators, and levels of measurement. These classifications provide an organizational logic that parallels and extends earlier frameworks developed for sustainability (Magrini & Giambona, 2022; Perchinunno et al., 2023), education (Camanho et al., 2023; Duan et al., 2023), and tourism (Font et al., 2021; Punzo et al., 2022). For example, the grouping of indicators into descriptive, functional, and systemic resonates with existing models of performance indicators in governance (Berger et al., 2022; Gallego et al., 2023). Similarly, distinctions between subjective and objective, quantitative and qualitative, and direct and indirect indicators mirror practices in organizational evaluation and social policy assessment (Habib et al., 2022; Ulitskaya et al., 2023). These taxonomies reinforce the idea that indicators are multi-layered constructs requiring contextual adaptation to organizational and sectoral needs.

The third finding relates to the intrinsic characteristics of indicators and the criteria for selecting them. This study identified that indicators must not only be descriptive, prescriptive, and deductive but also exhibit qualities such as measurability, transparency, comparability, feasibility, and adaptability. These align closely with criteria outlined by major institutions such as the OECD (Oecd, 2021, 2022) and UNAIDS (Unaids, 2020), as well as with the methodological emphasis of recent research on indicator design (Yin et al., 2022; Y. Zhao et al., 2023). Importantly, the findings of this review underline the importance of methodological rigor in the selection of indicators, recommending the use of both variance-based and correlation-based methods to ensure balance between significance and informational uniqueness. This echoes earlier work in educational assessment (Baniasadi et al., 2022), sustainability monitoring (Blancas et al., 2023; Scaccabarozzi et al., 2022), and urban development (Chatziioannou et al., 2023).

Taken together, these results point to the growing maturity of the indicator system field while also revealing gaps. The synthesis of definitions, typologies, and characteristics demonstrates how fragmented understandings can be consolidated into coherent frameworks. However, the scarcity of standardized definitions and methodological inconsistencies across domains highlight ongoing challenges that require attention from both scholars and practitioners.

The findings of this study resonate with existing research across multiple applied domains. In public sector finance, for instance, indicators of good governance have been shown to directly influence the effectiveness of financial management

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and profit strategies (Ali Turk et al., 2024; Barati et al., 2024; Gleißner et al., 2022). The importance of integrated financial and sustainability indicators in organizational settings has been widely emphasized (De Wolf et al., 2023; Pan et al., 2023), consistent with this study's observation of multi-dimensional requirements for effective indicator systems. In education and training, the role of indicators in evaluating convergence and performance across institutions has been documented (Camanho et al., 2023; Qian et al., 2022), reinforcing this review's finding that sectoral adaptation is a key determinant of indicator relevance.

In sustainability contexts, previous studies demonstrate how composite and systemic indicators provide robust evaluation frameworks for ecological and agricultural transitions (Boumahdi & Zaoujal, 2023; Magrini & Giambona, 2022; Perchinunno et al., 2023). This aligns with the observed trend in this review that indicators are increasingly designed as composite or systemic rather than single measures. Similarly, in digital governance and technology-driven management, indicators have been shown to capture the transformative effects of innovation, urban-rural integration, and digital policy (Hu et al., 2023; Tu et al., 2023; Wang et al., 2023; X. Zhao et al., 2023). These examples substantiate the finding that indicator systems must remain dynamic and adaptable to new policy and technological environments.

Furthermore, in tourism and urban policy, indicator frameworks such as ETIS have been applied to assess sustainability and competitiveness (Font et al., 2021; Mihalic & Kuščer, 2021; Owusu-Manu et al., 2020; Punzo et al., 2022). The classifications identified in this study, particularly thematic groupings of educational, health, and social indicators, mirror these applications, reinforcing their cross-sectoral validity.

At the methodological level, the use of advanced techniques such as the Delphi method (Bajo Marcos et al., 2023), MICMAC analysis (Chatziioannou et al., 2023), and cluster-based modeling (Chai et al., 2023; Y. Zhao et al., 2023) demonstrates the field's progression toward more rigorous and participatory approaches in indicator system design. These align with this study's emphasis on ensuring validity and reducing redundancy in indicator selection. At the same time, the growing literature on composite indices (Capecchi et al., 2023; Cavicchia et al., 2023; Gallego et al., 2023) underscores the demand for indicators that balance simplicity with multi-dimensional depth.

The results of this review therefore not only consolidate current knowledge but also provide evidence of a paradigm shift: indicators are no longer merely reporting tools but instruments of governance, accountability, and organizational transformation. They have moved from being descriptive markers to becoming prescriptive levers, influencing how policies are designed, evaluated, and adapted (Martin et al., 2023; Na & Han, 2023). In this respect, indicator systems contribute to both the measurement of outcomes and the shaping of organizational behavior and public expectations.

Despite the progress, several challenges remain. A key issue is the fragmentation of definitions and classifications, which complicates cross-sectoral comparison. Another challenge is the limited integration of qualitative dimensions, such as inclusiveness, resilience, and well-being, which are increasingly central to governance debates (Bajo Marcos et al., 2022; Bajo Marcos et al., 2023). Moreover, indicators often lag behind in adapting to emerging trends such as blockchain-based financial flows (Hakimi et al., 2024) and the development of human resource management in e-commerce environments (Mohammadi Yazdi et al., 2024). These gaps reveal the importance of continuous refinement and theoretical grounding of indicator systems.

In conclusion, this study confirms that indicator systems are essential tools for organizational performance evaluation in the public sector, but their effectiveness depends on definitional clarity, systematic classification, and adherence to rigorous selection criteria. The results support earlier findings that indicators are multi-functional and context-dependent, while also extending the literature by providing a consolidated framework for their conceptualization and application.

The first limitation of this study is that it is based exclusively on a systematic review of secondary literature. While this provides breadth and inclusiveness, it does not capture real-time changes in indicator design or contextual adaptation in specific organizational settings. A second limitation lies in the reliance on published academic sources, which may exclude practitioner-based frameworks and grey literature that often inform policy practice. A third limitation is that the review, while comprehensive, may have language and database constraints that limited access to certain regional or non-English studies.

Suggestions for future research include the need for empirical validation of the consolidated framework proposed in this study. Future studies could apply the six-category typology in diverse governance contexts to test its applicability and adaptability. Longitudinal research is also

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needed to assess how indicators evolve over time and how they respond to crises such as pandemics, financial instability, or environmental shocks. Methodological research could further refine approaches for weighting and reducing redundancy among indicators, particularly by applying machine learning and AI-driven analytics. Finally, comparative cross-country studies could strengthen understanding of how cultural, institutional, and political contexts shape the construction and application of indicator systems.

In practice, the results of this study suggest that policymakers and organizational leaders should prioritize the design and implementation of indicator systems that are both comprehensive and adaptable. Indicators should not be treated as static reporting measures but as dynamic tools of governance that guide strategic planning, accountability, and stakeholder engagement. For organizations, adopting multi-dimensional, composite indicators can enhance transparency and build public trust. Training public managers in indicator design and interpretation will also improve the effective use of these tools. Ultimately, embedding indicator systems into governance processes will strengthen decision-making and contribute to sustainable and accountable organizational performance.

Authors' Contributions

All authors have contributed significantly to the research process and the development of the manuscript.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

Acknowledgments

We would like to express our gratitude to all individuals helped us to do the project.

Declaration of Interest

The authors report no conflict of interest.

Funding

According to the authors, this article has no financial support.

Ethical Considerations

In this research, ethical standards including obtaining informed consent, ensuring privacy and confidentiality were observed.

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