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Systematic Review

The Preference Selection Index (PSI) in Multi-Criteria Decision-Making: A Systematic and Critical Review of Applications, Integrations, and Future Directions

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Abstract

This paper presents a systematic review of the performance of the Preference Selection Index (PSI) application in multi-criteria decision-making (MCDM) problems based on PRISMA. This work extensively reviewed more than 100 studies to investigate the methodological bases of the PSI and its synergistic combination with other decision-making methodologies. Interestingly, the PSI is highly commended as one of the most straightforward applications with low computational effort, which implies that the PSI in this context is receiving wide attention for complex decisions and sensitive judgments, where assigning criteria weights is challenging. However, in some circumstances, the PSI mechanism in assigning weights becomes a drawback when the accuracy of the decision is crucial. However, despite the increased use of the PSI, there is still a lack of systematic evaluation of its methodological sensitivity of weighting assumptions, consistency, and comparative performance in the hybrid MCDM problems. Addressing these gaps will help make the PSI more accurate in the evolving landscape of decision-making techniques. This review underscores the wide use of the PSI, encouraging further research in terms of its applications and methodology enhancement, ensuring that the PSI remains a relevant option that evolves the complexity and sensitivity of decision-making in various areas.

Keywords: MCDM; PSI; decision making; sustainability; material selection; renewable energy; manufacturing system; healthcare and safety; PRISMA

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1. Introduction

Multi-criteria Decision-making (MCDM) methods are used in evaluating conflicting factors in a particular application, helping select an appropriate option [1]. Determining the MCDM approach and using it in a particular problem needs the determination of the strengths and limitations of each one, especially when deciding on a complex system such as the industrial and technology sectors [2,3]. In general, MCDM approaches provide a framework for integrating and evaluating multiple criteria, thus enhancing the accuracy of the decision-making process by making a trade-off between conflicting objectives [4].

Among the different MCDM tools, the Preference Selection Index (PSI) was developed by Maniya and Bhatt [5]. The PSI can select the best alternative without determining the relative importance between attributes. The PSI simplifies the complex decision-making

problems where assigning the relative importance is conflicting or difficult. Based on this main advantage, the PSI's application expanded widely, ranging from material selection to energy management [6].

This review explores the different PSI applications among several industries, discussing its impact on decision-making and addressing method limitations to provide researchers with a comprehensive view and opportunities for future developments and enhancements. Despite the increasing implementation of the PSI method over diverse decision-making problems, the available literature lacks a comprehensive synthesis of its methodological applications, limitations, and development. Previous studies have primarily focused on specific applications or compared PSI with other MCDM approaches, without presenting an integrated examination of its evolution and performance in multiple contexts. Therefore, this study aims to bridge this gap by performing a systematic review of the PSI's different applications according to the PRISMA procedure. The novelty of this study lies in the comprehensive mapping of PSI use over many sectors, the critical assessment of its methodological weaknesses, strengths, and the identification of key trends in integrated and hybrid PSI models, including but not limited to PSI–AHP, PSI–TOPSIS, and PSI–Fuzzy. Additionally, the study proposes a conceptual framework that highlights future directions and emerging research gaps to improve the adaptability and robustness of PSI-based decision-making.

The structure of this review is divided systematically to analyze the PSI within the MCDM framework. It starts with Section 2, which describes the research methodology that has been followed during the research process, including the objectives and both the inclusion and exclusion criteria. Section 3 shows the concept map of research focus areas of the PSI method in this review alongside the PSI implementation steps. Afterward, Section 4 highlights the PSI limitations. Section 5 emphasizes the integration of PSI with other MCDM approaches and how this integration can be enhanced. Section 6 compares the PSI approach with the different MCDM approaches. Finally, Section 7 provides a conclusion of the review.

2. Research Methodology

2.1. Background and Objectives

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement was introduced a decade ago to improve the clarity and transparency of reporting systematic reviews and meta-analysis through evidence-based guidelines. These guidelines offer a set of recommendations developed to help researchers organize research processes [7,8].

Although many MCDM methodologies exist, the PSI has obtained wide attention because it is simple, requires minimal computations, and ability to handle situations where assigning weights of criteria is complex. Unlike many other MCDM techniques that require defining weights or pairwise comparisons, PSI allows objective decision-making without subjective input, which makes it especially valuable in uncertain or conflicting decision environments. However, despite its increasing use, there is a limited systematic assessment of its methodological consistency, integration with other tools, and domain-specific performance. Therefore, this study focuses on PSI to fill this gap and provide a clear synthesis of its advantages, limitations, and applications within the wider MCDM framework. This review was registered at Open Science Framework (OSF) and publicly available at https://osf.io/5w7yf (accessed on 9 November 2025).

The main objectives of this review are as follows:

- **Defining the PSI applications:** This is performed by mapping all areas where PSI has been utilized to help in evaluating different scenarios in various fields. Additionally, highlighting unique adaptations used across various industrial sectors.
- **Comparing PSI with the other MCDM methods:** This is performed through conducting a comparison between the PSI with other common approaches, aiming to identify situations where the PSI offers specific benefits, and where alternative methods may be more suitable. This will help guide future applications and research.

2.2. Bibliographic Search Process

Figure 1 displays the different stages of a systematic review in this comprehensive literature search. This study examined Science Direct and Web of Science databases for the keywords "Preference Selection Index" or "PSI," which helped identify 225 papers for potential review. Seventy-three duplicate papers were removed before the screening.

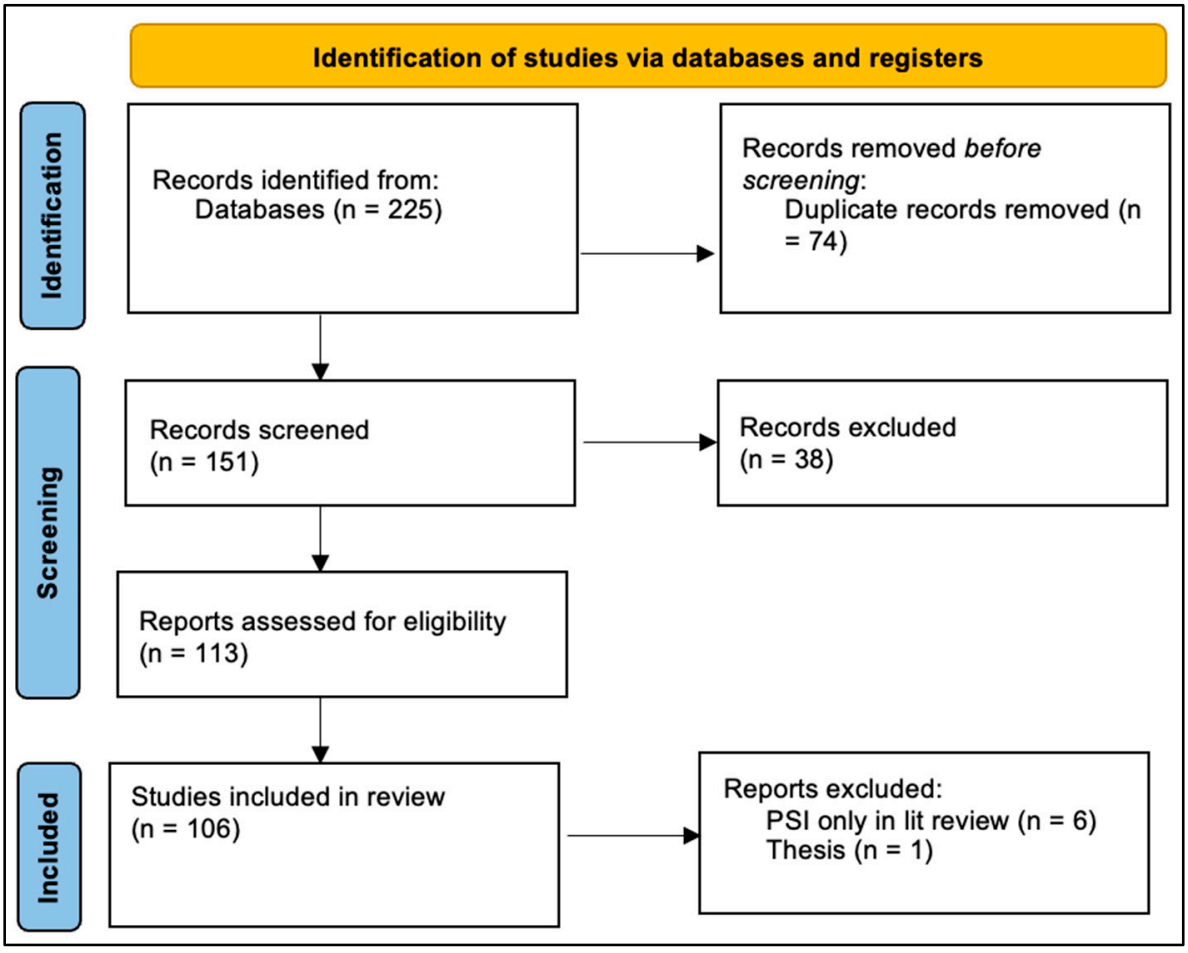


Figure 1. The PRISMA flow diagram for study selection process.

After screening the titles and abstracts of 152 papers, 38 were eliminated because they did not match the inclusion criteria. The remaining 114 papers were reviewed for eligibility. Seven papers were removed (six included PSI only in the literature review, and one was a thesis), resulting in a final list of 107 research papers included in the review. Table 1 provides a summary of the web search results.

Table 1. Web search results.

Keywords Used for Searching	Science Direct	Web of Science
"Preference Selection Index" OR "PSI"	140	85
Total	225	

2.3. Inclusion and Exclusion Criteria

This review covers all publications published up to 25 April 2024 and focuses on the application and comparison of PSI in various decision-making contexts. The exclusion criterion considered in this study is stated below:

- Exclusion Criterion: Chapters, theses, and reports.

Figure 2 illustrates the annual distribution of published papers from 2010 to 2024, indicating a considerable increase in research activity. The number of publications has steadily increased, with a peak observed in 2022. This pattern demonstrates the PSI's growing interest and applicability in diverse research areas. Figures 3 and 4 display word clouds that summarize essential themes and concepts extracted from the abstracts and keywords of the publications under review.

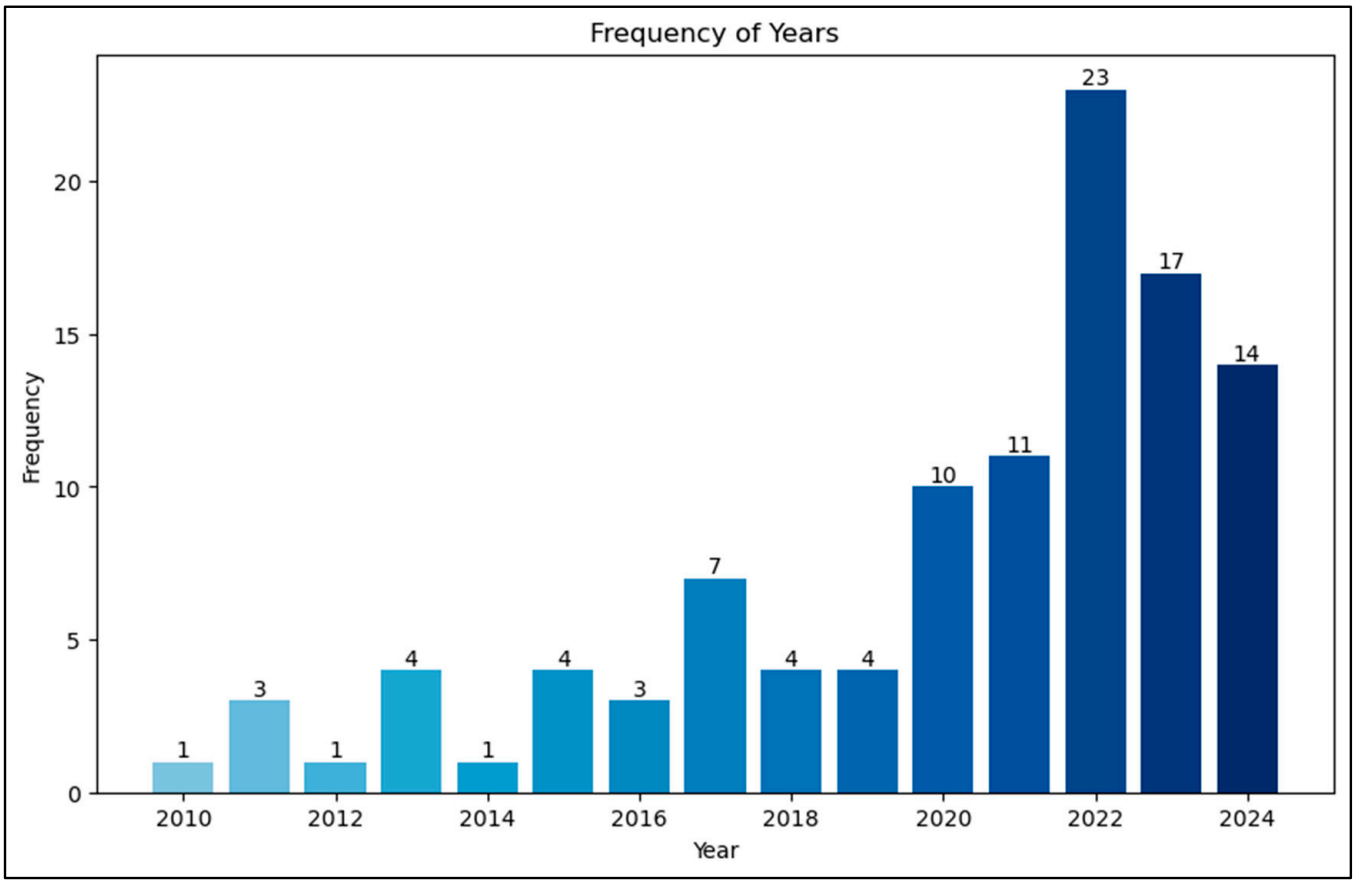


Figure 2. Annual distribution of published articles on the PSI approach (2010–2024).



Figure 3. Word cloud of key themes from articles' abstracts related to the PSI.



Figure 4. Word cloud of most frequently used keywords in the articles related to the PSI.

2.4. Problem Scoping

The systematic review scope is defined in this section. The aim is to investigate and illustrate the following through a concept map of research focus shown in Figure 5:

- **The PSI methodology:** It focuses on theoretical and mathematical formulations, especially in steps where the weights of criteria are calculated and used to rank several alternatives.
- **The PSI alternatives and attributes:** It emphasizes the PSI adaptability for many alternatives and attributes, presenting several challenges in certain decision contexts.
- **The PSI applications:** It demonstrates the PSI efficiency across various sectors by categorizing the applications into industries, including healthcare, manufacturing, and renewable energy.
- **The PSI limitations, integration and comparison with other MCDM techniques:** These topics center on the performance of the PSI, starting with its limitations. This can open up opportunities for improvements in methodology or integrating it with other MCDM methods, leveraging the strength of all methods.

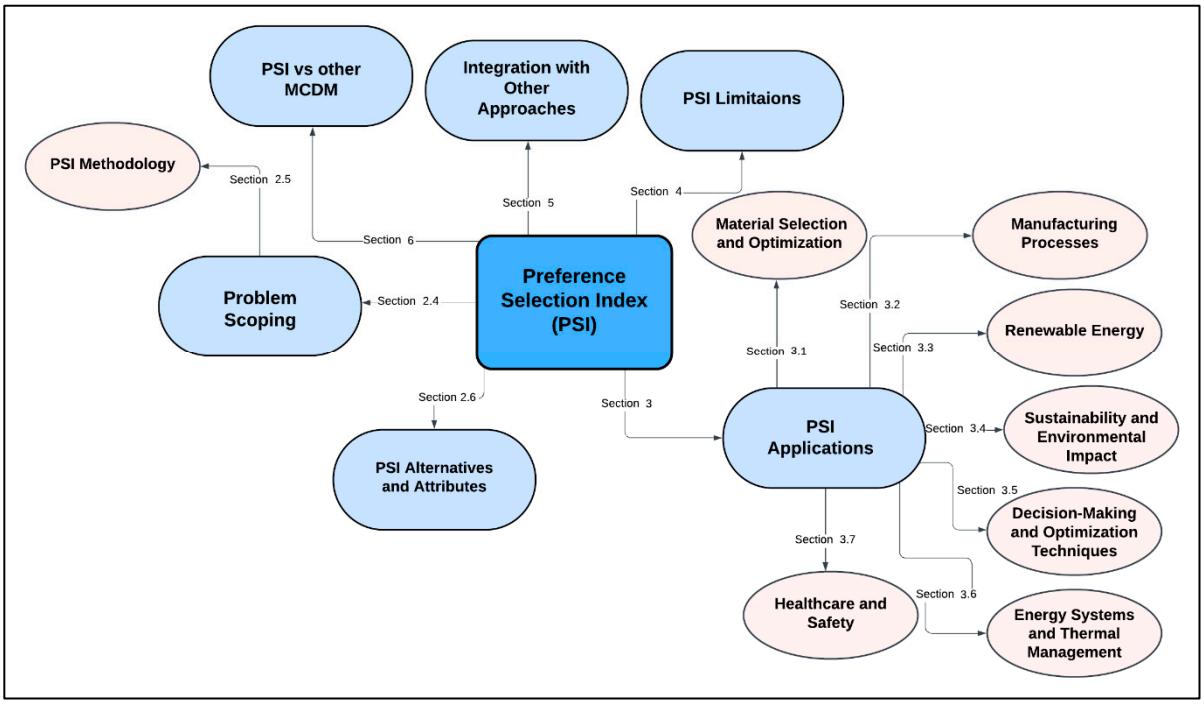


Figure 5. The concept map of the research focus areas for the PSI approach.

Together, these streams provide a comprehensive overview that clarifies the review's methodology, which focuses on addressing the PSI application diversity and method adaptability.

2.5. The PSI Methodology

The PSI methodology employs a systematic approach to address decision-making problems in which the process of assigning weights to criteria is a challenging one. The method is defined in the following steps, complemented by mathematical formulations [5,9]:

Step I: The objective is identified, and all related criteria and alternatives are determined for the purpose of deciding the given problem.
Step II: The decision matrix X_{ij} is constructed as shown in Table 2. For explaining the X_{ij}, let C be a set of decision criteria, where $C = \{C_j \text{ for } j = 1, 2, 3, \ldots, m\}$, A is a set of alternatives, where $A = \{A_i \text{ for } i = 1, 2, 3, \ldots, n\}$, and X_{ij} is representing the performance of alternative A_i under the effect of criterion C_j.

Table 2. The decision matrix X_{ij}.

Alternatives (A_i)	**Criteria (C_j)**				
	C_1	C_2	C_3	...	C_m
A_1	$X_{1\times1}$	$X_{1\times2}$	$X_{1\times3}$	...	$X_{1\times m}$
A_2	$X_{2\times1}$	$X_{2\times2}$	$X_{2\times3}$	...	$X_{2\times m}$
A_3	$X_{3\times1}$	$X_{3\times2}$	$X_{3\times3}$	...	$X_{3\times m}$
...	...	...	...	...	...
A_n	$X_{n\times1}$	$X_{n\times2}$	$X_{n\times3}$	...	$X_{n\times m}$

Step III: The decision matrix data are then normalized; therefore, the values in the decision matrix are transformed into a 0–1 range. In the positive expectancy case (i.e., profit), the normalization is performed using Equation (1):

$$R_{ij=}\frac{X_{ij}}{X_j^{max}} \tag{1}$$

However, in the negative expectancy case (i.e., cost), normalization is performed using Equation (2):

$$R_{ij=}\frac{X_j^{min}}{X_{ij}} \tag{2}$$

where X_{ij} is the attribute measure in the decision matrix (i = 1, 2, 3, . . ., n and j = 1, 2, 3, . . ., m).
Step IV: The preference variation value (PV_j) is calculated using Equation (3):

$$PV_j = \sum_{i=1}^{n} [R_{\mathrm{ij}} - \overline{R_j}]^2 \tag{3}$$

where $\overline{R_j}$ is the meaning of the normalized j criteria and computed based on Equation (4):

$$\overline{R_j} = \frac{1}{N}\sum_{i=1}^{n} R_{ij} \tag{4}$$

Step V: The preference value (PV_j) deviation (Φ) is calculated for every criterion in the matrix using Equation (5):

$$\Phi = 1 - PV_j \tag{5}$$

Step VI: The overall preference value (Ψ) is calculated using Equation (6) for each criterion in the decision matrix:

$$\Psi_{j=}\frac{\Phi_j}{\sum_{j=1}^{m}\Phi_j} \tag{6}$$

It is worth mentioning here that the overall summation of the preference value of all criteria must be one.
Step VII: The value of the Preference Selection Index (I_i) is calculated using Equation (7):

$$I_i = \sum_{j=1}^{m}\left(R_{ij} \times \Psi_{\mathrm{j}}\right) \tag{7}$$

Step VIII: All the alternatives in the decision matrix are then ranked based on the I_i value, where alternatives with the highest I_i value must be selected first.

2.6. The PSI Alternatives and Attributes

The distribution of alternatives and attributes used in various research demonstrates the PSI's adaptability, making it an important tool in various decision-making aspects. As shown in Figure 6, the number of attributes typically ranges between 5 and 15, indicating that the PSI method can handle a balanced set of criteria in most scenarios. However, there are studies where up to 40 attributes are used, highlighting the PSI's ability to handle these complex decision-making contexts, which require a comprehensive analysis.

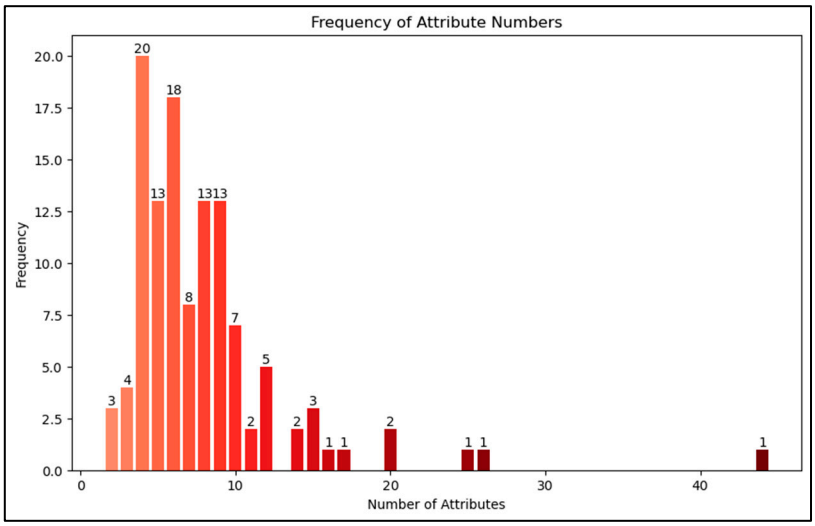


Figure 6. Distribution of attributes' numbers in the PSI applications.

Figure 7 shows that, while most of the PSI applications evaluate less than 25 alternatives simultaneously, the PSI approach is also feasible in scenarios with more than 200 alternatives [10]. This demonstrates the PSI's capability to manage various operational scenarios, ranging from precise assessments to significant strategic decision-making problems.

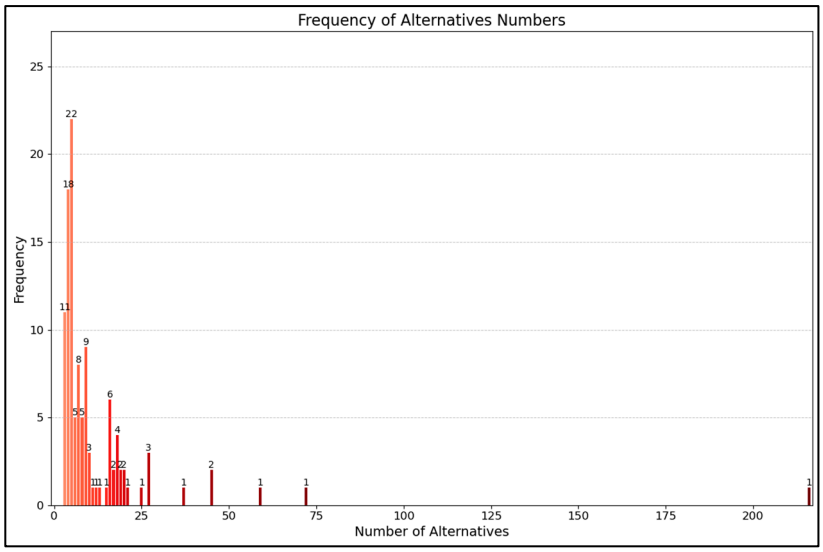


Figure 7. Distribution of alternatives' numbers in the PSI applications.

3. Applications of the PSI

Table 3 presents a detailed outline demonstrating various industries where the PSI method has been successfully implemented. Subsequent sections will explore the PSI's adaptability in addressing diverse application areas with unique challenges.

3.1. Material Selection and Optimization

Material selection and optimization are the most frequent applications for the PSI method. Studies by [5,11] have shown that the PSI method is utilized in selecting materials for structural components, such as wind blades and buses designed to run on alternative fuels. Further insights into the PSI have been provided by [6,12], which expanded the scope by including sustainable materials for vehicle framers, and non-conventional engineering

materials. Recent investigations by [13,14] have presented how the PSI enhances the efficiency of material characteristics for multiple applications. These studies show that the PSI is a versatile material in engineering and material science.

3.2. Manufacturing Processes

The PSI approach is used in this domain to enhance decision-making in system design and industrial processes. Therefore, the versatility of the PSI is reflected in different applications, including the development of multi-attribute technologies for optimal equipment of the facility layout, according to [9], and the selection of autonomous guided vehicles, as illustrated by [15]. In addition, the PSI has been applied in combination with other general approaches, such as the Single Minute Exchange of Die (SMED) method, as presented by [16], to effectively reduce the setup time.

Moreover, the PSI has been used in many production resources to enhance many production factors, which in turn has improved the quality of products and streamlined the production process. Madić et al. [17] employed the PSI in the optimization of the laser cutting parameters of stainless steel to effectively enhance the quality and productivity. This study also provides valuable insights into corporate decision-making due to the effectiveness of the PSI method in complex problem-solving issues, which are apparent in today's industrial settings, making a significant contribution to operational excellence.

While several studies successfully applied the PSI to optimize manufacturing processes, an important assessment reveals several methodological weaknesses. For instance, the majority of PSI implementations relied on deterministic assumptions without providing a sensitivity test of changing results due to parameter change. Hence, a few studies, including [16] and [17], provided hybrid decision models to deal with the process variability. Furthermore, the use of real industrial data for validation was very limited in most studies, which restricts the generalizability of findings. This suggests that while PSI is effective for structured optimization, future research should enhance methodological rigor by including cross-validation with empirical data and robustness checks.

3.3. Renewable Energy

It is crucial to identify the policies for implementing and prioritizing renewable energy sources and sites, and the PSI is very helpful in this aspect. Studies such as [18] and [19] have utilized the PSI to improve the selection process for renewable energy policies. These studies have illustrated that the PSI can effectively integrate environmental, policy-making, and financial aspects. In addition, Rong and Yu [20] have utilized the PSI in a decision support system to enhance the process of choosing sites for offshore wind farms, ensuring optimal locations for sustainability and energy efficiency.

3.4. Sustainability and Environmental Impact

Borujeni and Gitinavard [21] successfully utilized the PSI to evaluate the selection of mining contractors, with a particular focus on sustainability within the mining industry. Similarly, Reddy et al. [22] illustrated a sustainable performance index for concrete that utilized the PSI to evaluate the environmental advantages of using supplementary cementitious materials such as fly ash and Ground Granulated Blast-furnace Slag (GGBS). Waste management and energy efficiency are two areas where PSI's role is unmatched in its versatility. To illustrate how and why PSI is relevant to the advancement of environmentalism in today's world, refer to [23] for the prospects of e-waste recycling, and to [24] for the potential of energy conservation in a hospital.

Studies in sustainability show varying degrees of rigor from a methodological point of view. Even though the PSI provides a direct ranking mechanism, it usually overlooks interdependence and uncertainty between sustainability criteria. The lack of weighting

in most studies, such as [21,22], makes the analysis very simple; however, it may affect accuracy in multi-criteria trade-offs. Integrating PSI with fuzzy or entropy approaches might mitigate this limitation by introducing uncertainty modeling or objective weights.

3.5. Decision-Making and Optimization Techniques

The widespread use of the PSI, ranging from the analysis of the educational pathways to enhancing industrial operations, underscores the necessity for the development of more precise and efficient decision-making frameworks. The use of the PSI in various academic and business decisions, such as in the selection of a PhD program in [25] and the use of ChatGPT in business efficiency in [26] depicts PSI's significant contribution to decision-making.

Furthermore, the ability of the method to be integrated into MCDM approaches was also observed when used by [27,28]. These models assist researchers and organizations in managing the decision-making processes when faced with complicated issues, such as identifying third-party logistics providers and evaluating product concepts. This means that the PSI is an important approach for organizations in all sectors and beneficial for enhancing daily and long-term decision-making.

3.6. Energy Systems and Thermal Management

Obeidat and Traini [29] used the PSI efficiently in the context of evaluating different water desalination technologies. They were able to determine the most suitable water treatment techniques based on the PSI approach. This demonstrates how PSI can integrate advanced MCDM approaches to enhance the sustainable management of limited resources.

The PSI has also guided the optimization of energy parameters in several cutting-edge applications. For instance, in their studies, refs. [30,31] utilized the PSI to optimize the design and function of thermal solar collectors, thus increasing energy capture and efficiency. Such analysis shows that by utilizing the PSI, the variability of system design aspects can be fine-tuned to achieve highly efficient systems, which is beneficial for advancements in renewable energy technologies and reducing adverse environmental effects.

3.7. Healthcare and Safety

Some of the advantages that may be associated with the PSI include improved frameworks for resilience and decision-making in both the healthcare and safety sectors. In the study by [32], during the turbulent years of the COVID-19 pandemic, the PSI was utilized to validate a significant factor contributing to the reliability of the healthcare supply chain in sustaining the resilience of healthcare systems to shocks, thereby demonstrating the applicability and usefulness of PSI. Similarly, ref. [33] have used the PSI in assessing the feasibility of implementing an open-access repository for handling information on natural disasters in the Iranian context. They highlighted the method's effectiveness in improving disaster preparedness and response.

The PSI has also assisted in selecting crucial equipment and conducting safety evaluations. Kundu et al. [34] investigated an instance of the PSI to understand its applicability in selecting Magnetic Resonance Imaging (MRI) systems in private hospitals. The goal was to design the systems and ensure that all identified systems meet the requirements of the healthcare providers and patients. The PSI was also implemented by [35] to evaluate road safety performance in East Asia Summit (EAS) countries, providing better policy recommendations and actions to improve road safety in terms of reducing traffic accidents.

Table 3. Overview of PSI applications in various sectors.

Article	Main Focus	Application Area
[5]	Selecting the appropriate material for engineering applications (structural components and wind turbine blades).	Material Selection and Optimization
[11]	Choosing the best alternative fuel buses utilizing unique fuzzy multi-criteria decision-making approaches.	Material Selection and Optimization
[6]	Using the PSI approach to select materials in engineering applications.	Material Selection and Optimization
[12]	Developing a sustainable material selection strategy for automobile bodies and including quantitative sustainability measures.	Material Selection and Optimization
[3]	Selecting materials that maximize strength and workability in Al/SiC composites.	Material Selection and Optimization
[36]	Optimizing nano-fillers to improve the three-dimensional performance of brake friction materials.	Material Selection and Optimization
[37]	Selection of 7075 aluminum alloy composites supplemented with alumina nanoparticles.	Material Selection and Optimization
[38]	Evaluating the impact of production procedures on the microstructure and mechanical characteristics of AZ80-0.5Ca-1.5Al203 nanocomposite.	Material Selection and Optimization
[39]	Characterizing biodegradable composites and optimizing phase combinations.	Material Selection and Optimization
[40]	Improving the selection of marine application materials based on physical, mechanical, and corrosive properties.	Material Selection and Optimization
[41]	Evaluating copper-based alloy composites supplemented with marble dust for applicability in bearing applications.	Material Selection and Optimization
[42]	Evaluating and optimizing the mechanical characteristics of waste marble dust-filled glass Fiber-Reinforced Polymer Composites.	Material Selection and Optimization
[43]	Optimizing nonwoven epoxy composites for better durability and wear resistance	Material Selection and Optimization
[44]	A performance-based ranking of ceramic particle-reinforced AA2024 alloy composite materials.	Material Selection and Optimization
[45]	Determining the ideal brake friction composite composition.	Material Selection and Optimization
[46]	Reviewing material selection for impact-resistant polymer matrix composites, focusing on natural fibers as suitable reinforcements.	Material Selection and Optimization
[47]	Optimizing the sliding and mechanical properties of a Ti/Ni metal powder particle-reinforced Al 6061 alloy composite.	Material Selection and Optimization
[48]	Focusing on the development and mechanical characterization of innovative polymer-based flexible composites and stacking sequence optimization.	Material Selection and Optimization
[49]	Optimizing material selection for ship bodies using manufactured zirconium dioxide and silicon carbide-filled aluminum hybrid metal alloy composites.	Material Selection and Optimization
[50]	Selecting the best material for suspension coil springs.	Material Selection and Optimization
[51]	Selecting the optimal formulation of various fillers for dental composites.	Material Selection and Optimization
[52]	Improving the selection of ceramic particulate-reinforced dental restorative composite materials.	Material Selection and Optimization

Table 3. *Cont.*

Article	Main Focus	Application Area
[53]	Focusing on the anti-fatigue lightweight design of heavy tractor frames.	Material Selection and Optimization
[54]	Examining the impact of various copper (Cu) and zinc (Zn) compositions in brass on the fade and recovery behavior of phenolic-based friction composites used in brakes.	Material Selection and Optimization
[55]	Optimizing material selection for Fiber-Reinforced Polymer Composites (FRPCs) in multi-layered armor systems.	Material Selection and Optimization
[56]	Selecting the best waste marble dust-filled sustainable polymer composite.	Material Selection and Optimization
[57]	Evaluating the tribological behavior of chemically modified Jatropha oils as bio-lubricants in a boundary lubrication regime.	Material Selection and Optimization
[58]	Investigating the influence of Ghatti gum content on the mechanical characteristics of epoxy composites.	Material Selection and Optimization
[59]	Evaluating the physical, mechanical, and sliding wear properties of ZA27-Gr alloy composites.	Material Selection and Optimization
[60]	Optimizing frame weight while retaining structural integrity and performance.	Material Selection and Optimization
[13]	Optimizing the wear characteristics of ceramic coatings, especially Cr2O3/TiAlN.	Material Selection and Optimization
[14]	Modeling and optimization of hybrid Kevlar/glass fabric-reinforced polymer composites to improve impact resistance in low-velocity applications.	Material Selection and Optimization
[61]	Optimizing and ranking the mechanical and tribological characteristics of the AA2024 alloy.	Material Selection and Optimization
[9]	Selecting the best facility layout design.	Manufacturing Processes
[15]	Selecting autonomous guided vehicles.	Manufacturing Processes
[16]	Enhancing the traditional SMED method to save setup time in manufacturing operations.	Manufacturing Processes
[62]	Evaluating the optimal production system design.	Manufacturing Processes
[63]	Evaluating layout options to improve an industry's performance.	Manufacturing Processes
[17]	Optimizing process parameters for laser cutting stainless steel to improve multiple quality and productivity attributes simultaneously.	Manufacturing Processes
[64]	Analyzing facility layout alternatives.	Manufacturing Processes
[65]	Selecting optimal process settings for Polylactic Acid FDM, considering the influence on mechanical properties and surface roughness.	Manufacturing Processes
[66]	Ranking the performance factors in Flexible Manufacturing Systems (FMS).	Manufacturing Processes
[67]	Identifying appropriate three-dimensional scanning process settings to increase the overall quality of reverse-engineered models.	Manufacturing Processes
[68]	Evaluating the best 3D printer for producing automotive spoilers.	Manufacturing Processes
[69]	Focusing on the parametric analysis and multi-response optimization of laser surface texturing of titanium super alloy.	Manufacturing Processes
[70]	Focusing on the multi-objective optimization and experimental investigation of Electro-Discharge cutting (EDM) parameters.	Manufacturing Processes

Table 3. *Cont.*

Article	Main Focus	Application Area
[71]	Optimizing turning processes to produce the minimum surface roughness and maximum material removal rate (MRR).	Manufacturing Processes
[72]	Optimizing electrical discharge machining (EDM) process parameters for titanium alloy machining.	Manufacturing Processes
[73]	Selecting an appropriate setting for FDM printing techniques.	Manufacturing Processes
[74]	Selecting capacity expansion plans in manufacturing.	Manufacturing Processes
[75]	Focusing on the selection of the optimal electrical energy equipment.	Energy Systems and Thermal Management
[30]	Optimizing the V-down perforated baffled roughened rectangular channel.	Energy Systems and Thermal Management
[31]	Optimizing the characteristics of a solar thermal collector with impinging air jets.	Energy Systems and Thermal Management
[76]	Prioritizing energy performance in a rectangular channel with impinging air jets.	Energy Systems and Thermal Management
[77]	Optimizing the parameters of single arc protrusion ribs in a solar air heater	Energy Systems and Thermal Management
[78]	Developing novel heat transfer and pressure loss correlation for solar air heaters with internal conical ring obstacles.	Energy Systems and Thermal Management
[79]	Selecting the best cleaning procedure for solar panels (PVs).	Energy Systems and Thermal Management
[80]	Improving static voltage stability margin in power systems.	Energy Systems and Thermal Management
[81]	Ranking various water desalination systems.	Energy Systems and Thermal Management
[82]	Investigating the effect of novel elongated jet hole designs on the thermal efficiency of solar air heaters.	Energy Systems and Thermal Management
[83]	Focusing on the energy, economic, environmental, and climatic aspects of a solar combisystem for various consumption usages.	Energy Systems and Thermal Management
[84]	Selecting the best settings for a solar heat collector with a dimpled-V pattern roughened surface.	Energy Systems and Thermal Management
[85]	Selecting the appropriate phase change material (PCM) for solar adsorption cooling systems (SAC).	Energy Systems and Thermal Management
[10]	Designing a multi-stage optimization-based decision-making framework for sustainable hybrid energy systems in the residential sector.	Energy Systems and Thermal Management
[29]	Ranking water desalination methods to find the best method for different types of feed water.	Energy Systems and Thermal Management
[18]	Focusing on renewable energy policy selection.	Renewable Energy
[19]	Focusing on the selection of renewable energy policy.	Renewable Energy
[20]	Developing a decision support system to prioritize offshore wind farm sites.	Renewable Energy
[27]	Focusing on the influence of various criterion weight strategies in the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method of multi-criteria decision-making.	Decision-Making and Optimization Techniques
[86]	Focusing on the various criterion decision-making processes in hotel site selection and their relationship to post-purchase consumer feedback.	Decision-Making and Optimization Techniques

Table 3. *Cont.*

Article	Main Focus	Application Area
[87]	Evaluating product concepts using a hybrid approach.	Decision-Making and Optimization Techniques
[88]	Evaluating product concepts using a hybrid approach to select the best warehouse site using GPSI and GPIV methods.	Decision-Making and Optimization Techniques
[89]	Developing a new hesitant fuzzy ranking model to address the ranking challenge of non-traditional manufacturing processes.	Decision-Making and Optimization Techniques
[90]	Assessing students' performance levels using the Moodle Learning Management System (LMS) based on usability criteria.	Decision-Making and Optimization Techniques
[91]	Evaluating traffic solutions in school zones to cut waiting time and increase safety levels.	Decision-Making and Optimization Techniques
[92]	Selecting third-party logistics providers.	Decision-Making and Optimization Techniques
[93]	Creating a novel multidimensional process type FMEA technique to optimize risk assessments.	Decision-Making and Optimization Techniques
[94]	Selecting support systems in underground mines.	Decision-Making and Optimization Techniques
[95]	Selecting magnets for permanent magnet synchronous machines (PMSMs).	Decision-Making and Optimization Techniques
[26]	Analyzing the potential benefits and applications of ChatGPT as a tool for increasing corporate efficiency and effectiveness.	Decision-Making and Optimization Techniques
[96]	Developing a novel technique for group decision-making to deal with data uncertainty and imprecision.	Decision-Making and Optimization Techniques
[97]	Developing a revolutionary multi-criteria decision-making and game theory-based framework for sentiment analysis and aspect ranking in customer reviews.	Decision-Making and Optimization Techniques
[28]	Evaluating and selecting third-party logistics (3PL) service providers for vehicle manufacturing firms.	Decision-Making and Optimization Techniques
[98]	Selecting the best vehicle routing software (VRS) for last-mile delivery companies.	Decision-Making and Optimization Techniques
[99]	Benchmarking the country's supply chain performance.	Decision-Making and Optimization Techniques
[100]	Evaluating organization's digital transformation capabilities (DTC).	Decision-Making and Optimization Techniques
[101]	Evaluating crowdfunding projects.	Decision-Making and Optimization Techniques
[102]	Ranking European nations using data from the Global Entrepreneurship Monitor (GEM).	Decision-Making and Optimization Techniques
[103]	Analyzing the performance and efficiency of European electric vehicles (EVs) in the European Union market.	Decision-Making and Optimization Techniques
[25]	Selecting a university for a doctoral program in industrial engineering in the United States.	Decision-Making and Optimization Techniques
[21]	Assessing sustainable mining contractor selection challenges.	Sustainability and Environmental Impact
[22]	Developing a Sustainable Performance Index (SPI) for self-compacting concretes that use supplementary cementitious materials (SCMs) such as fly ash and GGBS.	Sustainability and Environmental Impact

Table 3. *Cont.*

Article	Main Focus	Application Area
[23]	Investigating recovery options for electrical and electronic waste.	Sustainability and Environmental Impact
[104]	Comparing biomass pelleting techniques to determine the most efficient and cost-effective approach.	Sustainability and Environmental Impact
[105]	Identifying key challenges to green human resource management (GHRM) adoption in Ghana.	Sustainability and Environmental Impact
[106]	The feasibility and impact of employing marble dust as reinforcement in composites for various industrial applications.	Sustainability and Environmental Impact
[107]	Evaluating coalfields in Bangladesh for their potential to conduct underground coal gasification (UCG).	Sustainability and Environmental Impact
[108]	Identifying the most effective natural fiber for insulating products used in commercial buildings.	Sustainability and Environmental Impact
[109]	Evaluating the impact of the COVID-19 pandemic on medical waste disposal.	Sustainability and Environmental Impact
[110]	Addressing the hurdles to eliminating illegal gold mining (IGM) in Ghana to suggest sustainable mining practices.	Sustainability and Environmental Impact
[111]	Improving the green supplier selection process in the textile sector.	Sustainability and Environmental Impact
[24]	Evaluating energy-saving solutions to minimize energy usage and CO2 emissions in healthcare facilities.	Sustainability and Environmental Impact
[32]	Investigating the facilitators of resilience in the healthcare supply chain during the COVID-19 pandemic.	Healthcare and Safety
[33]	Assessing the possibility of establishing a natural disaster information management open-access repository (NDIM-OAR) in Iran.	Healthcare and Safety
[34]	MRI system selection for private hospitals.	Healthcare and Safety
[35]	Evaluating road safety performance in the EAS countries.	Healthcare and Safety

4. PSI Limitations

Despite the huge advantages of the PSI method, it has some limitations that might impact its effectiveness in solving decision-making problems. Table 4 summarizes the significant limitations of the PSI method, including the explanations and references to studies that address these issues.

Table 4. The PSI limitations.

Limitation	Definition/ Explanation	Studies
Lack of attribute weighting	The PSI often fails to account for the varying importance of different factors, assuming the same importance, which may not represent actual decision-making scenarios	[5,9,13,22,23,26,32,34,42,48, 49,51,53,54,57,60,62,64,66,67, 72,75,79,83,85,92,104,107]
Simplistic and inflexible approach	The PSI technique may oversimplify complicated decision-making scenarios, possibly missing accurate differences and interrelationships among criteria	[5,9,11,18,21,32,34,40,43,54, 68,88,92]

Table 4. *Cont.*

Limitation	Definition/ Explanation	Studies
Inadequacy in complex or detailed analyses	Although the PSI is valuable for quick assessments, it may not suffice for thorough evaluations in complex situations or accurately distinguishing between closely ranked options, which is crucial for precisely balanced decision-making contexts.	[17,40,78]
Inadequate integration with the other decision-making techniques	The PSI may need to integrate other approaches to enhance its analytical capabilities and effectively manage multidimensional data, especially in complex or fluctuating contexts	[35]
Oversimplification in multi-criteria decisions	The PSI may place excessive importance on some performance indicators, leading to biased decision results	[53]
Real-world applications challenges	Implementing the PSI technique may present specific challenges, particularly in real-life cases, where it is necessary to understand multiple, sometimes even conflicting, factors	[33,57,68]

5. Integration with the Other Decision-Making Approaches

5.1. The PSI Integration with the AHP

According to Saaty, the AHP is an analytic, systematic decision-making tool developed in the early 1980s [25]. It translates sophisticated evaluations and judgments into a simpler, hierarchical form in which challenges with quantifying benefits or intangible items can be treated mathematically [25]. Therefore, the AHP method is a useful technique in decision-making problems involving multiple criteria, alternatives, and subjective judgments [112]. Integrating the PSI with the AHP is beneficial due to the following:

- Enhanced accuracy: The integration between both the AHP and PSI, as illustrated in [16,75], modifies the weakness of PSI in the case of evaluating complex scenarios through the facilitation of criteria weighing and prioritization. Therefore, the PSI–AHP integration provides more accuracy when making decisions.
- Robust decisions framework: Applying both the AHP and PSI techniques would enable a more resilient decision-making process, especially when selecting materials or in turbulent industrial applications and environments [54]
- Focused and efficient analysis: According to [25], the application of AHP was practical in managing many alternatives and attributes when PSI was used in the selection of a PhD program in industrial engineering at U.S. universities. This made the comprehensive AHP method less demanding, ultimately resulting in improvement in the overall reviews for decision-making.

5.2. The PSI Integration with the TOPSIS

The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is an effective technique for order preference, which is often used to select the most suitable solution in multi-criteria systems. These goals rank alternatives efficiently based on the concept of distance from the optimal solution. This technique is suggested to be used when measuring multi-criteria because of its sensible structure and low computational complexity [113]. The integration between the TOPSIS and the PSI offers several benefits to decision-making processes, including as follows:

- Enhanced decision accuracy: Integrating the PSI with the TOPSIS, as mentioned in [9,15], aims at reducing the PSI limitations when facing complex environments. This

helps increase the accuracy of the decision-making process, as, on the one hand, there is the use of the TOPSIS capacity for determining the proximity of each option to the optimal solution, which complements the PSI approach.

- Comprehensive evaluation: Applying both the TOPSIS and PSI methods together leads to an even more comprehensive evaluation, which is particularly useful when the differentiation between criterion weights is crucial. As a result, the use of TOPSIS and PSI can be helpful when selecting materials for marine purposes, as, for instance, depicted in [40].
- Robustness in complex environments: Combining both the PSI and the TOPSIS is described by [16] for the utilization in industrial environments and minimizing the setup time in the processes. This methodology effectively performs a structured analysis considering multiple overlapping and interacting factors.
- Handling complexity and uncertainty: In their research, ref. [27] provided sufficient empirical evidence to show how the TOPSIS application with intuitionistic fuzzy data efficiently manages fuzzy data and enhances the decision-making results.

5.3. Integration of the PSI with the Fuzzy Set Theory

The integration of the fuzzy set theory and the PSI has proven that it has several beneficial applications in improving decision-making problems, with a high level of uncertainty and vagueness. The fuzzy set theory is also able to cope with uncertain and qualitative data through techniques such as linguistic variables and fuzzy numbers. This makes it very advantageous and beneficial in such subjective judgments [114]. The integration between the fuzzy set theory and the PSI offers several benefits to decision-making processes, including as follows:

- Handling of uncertainties and vagueness: Modifications were introduced by [11] for improving the PSI under fuzzy environments, to augment its applicability in various decision-making scenarios. This improvement enables the PSI to address language complexities and noise data, which is often evident in real-world conditions.
- Robust decision framework: According to the study by [21], applying fuzzy techniques, including the Hesitant Fuzzy Preference Selection Index (HFPSI), improves the robustness and reliability of decision-making models. This technique is very useful, especially in fields such as mining, which require making decisions under conditions of risk and uncertainty.
- Comprehensive decision-making: In the study by [19], in which they integrated hesitant fuzzy sets to improve the accuracy of the decision-making process in conjunction with the PSI in the case of uncertainty. This allowed for a more comprehensive examination of multiple characteristics and viewpoints, which is beneficial, especially when working in complex scenarios such as energy policy.
- Enhanced flexibility and accuracy: As explained by [32,34], by integrating fuzzy logic, the PSI may better handle the inherent uncertainty of data inputs and expert judgments, which are common in healthcare and the material selection process.

5.4. Integration of the PSI with the Entropy Method

The entropy method is an important MCDM decision-making approach as it helps objectively estimate the weights of the assigned criteria based on their variability. This technique uses empirical data to evaluate complex scenarios, which reduces the subjectivity in the decision-making process [115]. The integration between the PSI and the entropy methods provides several benefits, including as follows:

- Objective criteria weighting: The entropy method's ability to establish weights based on criteria diversity is crucial for ensuring balanced and data-driven decision-

making processes. Chauhan et al. [76] highlighted this in their study on energy systems optimizations.

- Systematic evaluation and risk management: As mentioned in [93], this integration between the PSI and the entropy method is helpful in cases where a detailed examination is required and risk assessment is critical, especially in the aerospace and military sectors. It also guarantees that all the relevant standards are expansively evaluated.

The comparative evaluation across sectors shows that PSI provides higher stability and efficiency in structured industrial contexts where decision parameters are well-defined, such as material selection and manufacturing sectors. On the other hand, its direct application in the sustainability and healthcare sectors tends to be limited by the need for weighting and uncertainty. Hybrid PSI models, such as PSI–AHP, PSI–TOPSIS, PSI–Fuzzy, effectively mitigate these limitations by improving the interpretive accuracy and adaptability, although they slightly decrease simplicity in computations. Therefore, PSI variant selection should consider both data characteristics and problem complexity.

In summary, the integration analyses highlight a methodological evolution in PSI research. Hybrid MCDM approaches such as PSI–AHP, PSI–TOPSIS, and PSI–Fuzzy, address core weaknesses such as oversimplification, sensitivity to input parameters, and equal weighting. Those studies implementing these integrations (i.e., [16,19,27]) demonstrated improved interpretability and decision stability. This integration reflects a methodological trend toward more adaptive PSI, moving beyond the static assumptions of earlier MCDM approaches.

6. Comparing the PSI with Other Decision-Making Approaches

6.1. Comparing the PSI with Graph Theory and Matrix Approach (GTMA)

When comparing the algorithms, both Maniya and Bhatt [5] and Chatterjee and Chakraborty [6] noticed the advantages of the PSI over the Graph Theory and Matrix Approach (GTMA). They found that the PSI is more straightforward and faster in computation. The PSI is famous for its easier implementation and less calculation when compared with GTMA, which possesses some attribute weighting and analysis. This means that the GTMA requires more data processing than is needed under the PSI, as the GTMA requires extensive data processing.

6.2. Comparing the PSI with the TOPSIS

The PSI is of a less complex and computationally demanding alternative for TOPSIS. The PSI is especially valued for its streamlined approach in multi-criteria decision-making processes. Both the studies in [5,79] have utilized the PSI approach for ranking alternatives, and found it a beneficial tool as it achieves optimal results without involving additional mathematical computations as needed by the TOPSIS. Several studies, such as those conducted by [6] and [65], highlighted the primary benefit of the PSI approach, in which it eliminates the procedure of attribute weighting and, therefore, reduces the time taken in the preliminary stages of the decision-making processes.

This capability is beneficial in conditions where quick decision-making is required, and the speed, along with the simplicity in the evaluation, are critical. In addition, as revealed by [3,48], the effectiveness of the proposed PSI model could be further recognized concerning the identification of the most suitable solutions for material selection, and other applications. The PSI similarly delivers this with high levels of reliability and robustness, as are seen with TOPSIS, though aggregated in a less procedural model in its approach to TOPSIS.

6.3. The PSI Comparison with the AHP

The PSI, as a decision-making tool, is more advantageous for the use in multi-criteria decision-making than AHP, as the PSI offers a more straightforward and practical approach. In the problem-solving process, and compared with the AHP, the PSI consumes fewer computational resources and does not require making pairwise comparisons and attribute weighting. Furthermore, the PSI avoids the need for complex weighting techniques. It is especially applied in scenarios requiring quick decisions with limited resources. According to [9] and [65], the researchers suggest that the PSI effectively streamlines the inherent operational complexity of the AHP. It is highlighted that the PSI does not need the complex weight allocations that the AHP requires, hence enabling a more straightforward and speedy decision-making process. Further, both [36,79] found that applying the PSI reduces the reliance on numerical computations and subjective inputs, leading to a faster decision-making process and a considerable reduction in bias resulting from human judgment.

6.4. The PSI Comparison with the Entropy Method

The PSI approach is often used alongside the entropy method in MCDM frameworks to identify unique advantages. Dammak et al. [27] and Chauhan et al. [76] conducted a comparison between the PSI's simple and less computationally demanding methodology and the entropy method's robust analytical depth. The entropy method is particularly effective in precisely measuring variability. The comparison emphasizes the PSI's ease of use and efficiency compared to the entropy method, which excels in handling complex criteria optimization and prioritization. Kashani et al. [83] and Uslu et al. [93] emphasized that while the PSI simplifies decision-making, including or comparing it with the entropy may significantly enhance the assessment process, especially in complex situations needing precise analysis.

6.5. The PSI Comparison with the Fuzzy Set Theory

The analysis of the results presented in the reviewed studies has indicated that the application of the PSI is especially designed for fuzzy environments, which gives critical benefits in situations where problems are uncertain and more challenging, concerning decision-making. In line with [11,23], the fuzzy-based PSI offers more flexibility and does not need rigid weight assignment, which makes it suitable for situations involving fuzzy data. In addition, [21,89] revealed that the PSI can address integration and the ability to perform qualitative and quantitative data efficiently. Due to this, the PSI is preferred in complex application areas such as materials selection and production procedures, as it is more effective than the standard fuzzy techniques in delivering measurable improvements by offering a more direct and adaptable approach.

In summary, and based on those reviewed studies, the main methodological strengths of PSI include transparency, computational simplicity, and suitability for MCDM ranking. On the other hand, the PSI has some weaknesses, including the lack of a weighting technique, insufficient empirical validation, and limited robustness testing. Those studies that integrated PSI with other MCDM approaches achieved more reliable and balanced results. Therefore, future research of PSI must focus on hybrid decision modeling, cross-domain validation, and uncertainty quantification to strengthen methodological reproducibility and reliability.

7. Conclusions

This systematic review provided a detailed analysis of the PSI decision-making approach and its usability in several decision-making situations. The PSI is suitable for MCDM due to its simplicity and low computational requirements. Precisely, the PSI is a

highly efficient tool when solving cases that require rapid decision-making; however, it has some weaknesses in handling complex situations.

The results indicated that decision-makers may benefit from the PSI efficiency, especially when resources are limited. However, the review establishes the need for additional studies to increase the scope of the PSI and its analysis. This might be achieved by improving the PSI with other decision-making techniques. These advancements have the potential to make the PSI more user-friendly and increase its capability to manage multifaceted data.

Further research should explore the potential integration of the PSI with modern decision-making techniques and its use in other domains to boost its efficacy and flexibility. Lastly, this review provides an argument for the PSI approach as a strategic but alterable decision support system that has the capacity to expand in exploring complex problems in various fields.

Adding to these methodological insights, many policy implementations and research directions may be drawn from this review. Future studies must mainly focus on the development of hybrid PSI models, which incorporate uncertainty modeling, weighting mechanisms, and sensitivity assessment to improve robustness of the results. To improve practical reliability, thorough comparative validation of PSI-based frameworks with real-world datasets is highly recommended. Furthermore, researchers may investigate the integration between the PSI approach with data-driven and AI-assisted decision-making techniques, particularly in sustainability evaluation, material selection, renewable energy, manufacturing system, and healthcare and safety. From a policy perspective, organizations and industries may implement PSI-based models to enhance transparent, evidence-based decision-making processes that balance complexity with efficiency. By adopting open data reporting and standardized examination protocols, policymakers may facilitate broader establishment and methodological consistency of PSI implementations in these sectors.

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