Journal of Applied Data Sciences
Vol. 6, No. 2, May 2025, pp. 1026-1036

The Integration of DEMATEL and SAW Methods for Developing a Research Performance Assessment Model for Lecturers

Muh. Nurtanzis Sutoyo[1,*], Alders Paliling[2]

[1,2]*Faculty of Information Technology, Universitas Sembilanbelas November Kolaka, Jl. Pemuda No. 339, Kolaka 93517, Indonesia*

(Received: November 5, 2024; Revised: December 15, 2024; Accepted: January 17, 2025; Available online: March 4, 2025)

Abstract

This work aims to integrate two decision analytic methodologies, DEMATEL and SAW, to develop a comprehensive and effective model for assessing research performance among instructors. These strategies aim to rectify the deficiencies of traditional evaluation models, which often neglect the complexity of interconnections among performance metrics. This study utilizes research performance data from lecturers, encompassing publication count, journal quality, impact, funding, and cooperation. SAW is employed to calculate aggregate scores utilizing weights obtained from the DEMATEL analysis, whereas DEMATEL is utilized to delineate and assess the interrelationships among the evaluation criteria. The results indicate that the quantity of publications significantly influences research quality, succeeded by research impact and journal quality. Alternative A, with a maximum score of 0.996, demonstrated that the professor excelled in nearly all categories. A clear and objective evaluation methodology was developed by integrating DEMATEL with SAW. The development of more flexible criterion weights to accommodate shifts in academic practices and research priorities is a significant implication for future investigations. To evaluate this model's appropriateness and effectiveness in various academic contexts, it must be further assessed across multiple topic areas and types of educational institutions. This study facilitates the implementation of big data technology in academic performance evaluation, enhancing the accuracy and relevance of assessment methods.

Keywords: Academic Performance Evaluation, DEMATEL, SAW, MCDM, Faculty Research Performance

1. Introduction

Academic performance, especially in research, is essential for the reputation and progress of higher education institutions in the context of globalization and heightened scientific competition. Evaluating the research performance of faculty members is crucial for ascertaining academic career advancement and for selecting suitable resources and incentives to devote to them. The necessity to consider multiple aspects equitably and impartially is a primary reason for the complexity of this evaluation process [1],[2].

Conventional techniques for evaluating research performance typically employ linear approaches, which inadequately represent the intricate interactions among diverse evaluation elements, including research cooperation, publication volume, journal quality, and research impact. These constraints may lead to assessments that fail to adequately represent a faculty member's true performance. Consequently, a more methodical and comprehensive strategy is necessary. This method must effectively demonstrate the intricacy and dynamics of the evaluation criteria [3],[4],[5].

The decision-making trial and evaluation laboratory (DEMATEL) method is optimal for analyzing and modeling cause-and-effect interactions among components in complex systems. This approach enables researchers to discern the essential elements that affect the system together [6],[7],[8]. Conversely, the SAW technique is extensively employed to aggregate scores from multiple criteria in a straightforward and comprehensible manner. This approach assesses each criterion according to its significance [9],[10].

SAW is a strategy utilized in Multiple Criteria Decision Making (MCDM). MCDM comprises strategies and procedures employed in scenarios requiring decision-making that accounts for several conflicting criteria. This strategy

***Corresponding author: Muh. Nurtanzis Sutoyo (mns.usn21@gmail.com)**
DOI: https://doi.org/10.47738/jads.v6i2.550

is effective in identifying the optimal decision among multiple possibilities by concurrently considering various elements or criteria. It frequently resolves issues that cannot be tackled only through conventional decision-making methods. MCDM facilitates systematic and impartial evaluations in complicated and uncertain scenarios, assisting decision-makers in effectively and efficiently organizing and prioritizing diverse possibilities [11],[12],[13],[14].

Over the past ten years, decision analysis methodologies have experienced considerable progress, especially with the Decision-Making Trial and Evaluation Laboratory (DEMATEL) and Simple Additive Weighting (SAW) strategies. DEMATEL, initially developed by the Geneva Research Center at Battelle Memorial Institute in the 1970s, has been effective in illustrating cause-and-effect interactions inside intricate systems. Additionally, it is frequently utilized to address issues necessitating structure mapping and influence assessment. Numerous investigations have employed DEMATEL, as noted by Esfahani et al [15]. This study employed the DEMATEL approach to examine social media addiction, highlighting the viewpoints of researchers and psychotherapists. It concluded that personality traits, psychosocial influences, and comorbid symptoms significantly contribute to the emergence of social media addiction. This research utilizes the DEMATEL approach to assess the factors facilitating electronic waste management within India's circular economy [16]. Barrios et al. [17] DEMATEL is employed to measure the interdependencies and feedback among the components of the decision-making process in order to evaluate the success of pork suppliers in mitigating the bullwhip effect. A case study of the Colombian pork supply chain indicates that the primary parameters for evaluating supplier success are financial profile and service level. Li et al. [18] Formulating a DEMATEL methodology for the selection of leagile suppliers within China's textile sector. This study compiled parameters affecting supplier selection from academic literature and field specialists. The main criteria were assessed during the supplier selection process. The findings aid industry managers in evaluating their suppliers according to pertinent standards and enhancing the global supply chain's resilience and agility. Additionally, the DEMATEL technique was employed to ascertain the principal factors affecting the adoption of cloud computing in micro, small, and medium-sized manufacturing firms in India [19].

The report additionally investigates the obstacles to embracing sustainable internet consumption. It emphasizes that prior methodologies frequently presume uniform influence among all difficulties and necessitate more information, thereby compromising the correctness of the analytical outcomes. The study recommends incorporating DEMATEL into the system to resolve this issue [20]. Du and Li [21] devised the hierarchical DEMATEL technique for complex systems by accounting for multiple system components, diverse types of influence, and decision-making hierarchies. DEMATEL is employed in diverse applications, including personnel selection, analysis of factors affecting fuel consumption in vehicles, halal supply chain risk management, selection of transportation projects, and evaluation of service quality and its influence on individuals' sustainable intention to utilize mHealth services during the COVID-19 pandemic.

Conversely, the SAW approach is straightforward and user-friendly for consolidating evaluation data based on evaluated criteria. This strategy is highly favored in multicriteria decision-making processes. SAW has been utilized in numerous investigations, as indicated by Rasadi et al [22]. The application of the SAW approach to ascertain the prioritization of constructing disaster mitigation infrastructure at the village level. The planning process can address the genuine needs of the village community with a decision support system utilizing the SAW technique. This allows them to prioritize the most essential infrastructure for disaster mitigation. Simanungkalit et al. [23] This study examines the application of the Simple Additive Weighting (SAW) approach within a Decision Support System to identify the top universities in Medan. The SAW technique evaluates various characteristics, such as accreditation, faculty quality, tuition rates, infrastructure and laboratory facilities, and the success rate of alumni. The objective is to aid prospective students in choosing the optimal university according to established criteria assessed via the SAW method. This work develops an optimal and reasonable choice strategy for evaluating and selecting the leading colleges based on quantitative and objective criteria.

Irawan [24] Examining the determination of employee bonuses at PT. Mayatama Solusindo utilizing the SAW approach through a web-based system. This approach aims to enhance the decision-making process about bonuses, which are contingent upon employee performance. The SAW approach facilitates the computation and assessment of employee performance with metrics like supervisor evaluations, tenure, attendance, and disciplinary warnings. Meshram [25] This study examines the utilization of the SAW and Technique for Order Preference by Similarity to

Ideal Solution (TOPSIS) methodologies in establishing conservation priorities for sub-catchments in India. The watershed's morphometric properties and remote sensing/GIS technology were employed to identify erosion-prone zones. These methods necessitate minimal expenditure and time to identify places susceptible to erosion; however, they yield essential information for enhanced water resource management. Meidelfi et al. [26] The SAW method was employed to identify appropriate final project subjects for students. This approach was utilized during the pandemic, when in-person meetings were restricted, necessitating the expert team to operate remotely, so rendering a group decision support system essential. Seventy percent of the final proposals accepted were assessed in this study. Numerous research employing the SAW approach, including [27] for selecting brake friction composite formulations and [28] for flood risk mapping.

Combining the DEMATEL and SAW methodologies into a unified performance evaluation model for faculty research elucidates the interactions and influences among different research components. We can quantify and condense the judgment into a coherent and comprehensible score. This model will produce an evaluation system that is robust, flexible, transparent, and easily understood by all stakeholders.

This research is unusual due to the concurrent application of two techniques, a topic that has not been extensively explored in evaluating faculty research performance. This study is anticipated to yield novel insights into performance evaluation methodologies and propose recommendations for the development of research policies in higher education institutions. This approach enables a more equitable and impartial evaluation of research performance, whilst providing more motivation for professors to improve the impact and quality of their research.

This project aims to establish a more adaptable and efficient performance assessment system that incorporates DEMATEL and SAW. This framework will align with academic dynamics and contemporary requirements.

2. Method

To establish a research performance evaluation model for faculty members, several critical procedures must be undertaken. The effective formulation and execution of the model are a component of this research procedure. This procedure encompasses research design, data collecting, relationship analysis using DEMATEL, and ranking via the SAW method.

This study's criteria were chosen for their significance in representing lecturers' research performance: publication count, journal quality, research impact, funding, and collaboration. Scientific publications serve as a direct measure of academic productivity, with the quantity of publications indicating the extent to which a lecturer consistently generates scholarly works. Journal quality, often assessed through impact factors and certifications, reflects the caliber of the research produced, where publications in esteemed journals signify substantial contributions to specific fields. Research impact is quantified by citation counts, highlighting the degree to which a lecturer's work contributes to the global scientific community. Citations endorse the significance and relevance of research results within academic circles. The quantum of research funds obtained demonstrates the lecturer's capacity to secure financial backing from funding organizations, showcasing their ability to conceive and execute relevant research projects. Additionally, the degree of collaboration reveals the lecturer's capability to engage across disciplines or institutions, broadening research parameters, diversifying perspectives, and enhancing the quality of research outcomes. These considerations underline the importance of the chosen criteria in evaluating research performance. Figure 1 delineates the procedures undertaken in this investigation.

Figure 1. Research Steps

2.1. Research Design

This study will utilize a quantitative methodology with an exploratory framework to amalgamate two distinct decision-making techniques, DEMATEL and SAW. The main goal is to create a model that can evaluate faculty research performance in a more thorough and impartial way.

2.2. Data Collection

The data required for this research includes various aspects related to faculty research performance, such as the quantity of publications, journal quality (including impact factor), citation count, secured research funding, and the extent of research collaborations. This information is primarily obtained from the university's internal database, which provides comprehensive records of faculty achievements and activities. Additionally, expert assessments are conducted to determine the relative significance and interconnections among the criteria within the model. These assessments play a crucial role in ensuring that the evaluation framework accurately reflects the priorities and relationships inherent in academic research performance.

2.3. Implementation of DEMATEL

The steps for implementing DEMATEL are as follows [24]:

Step 1: A panel of experts and dimensions/criteria are established. In this stage, an expert panel is selected to gather subjective opinions. Challenges are identified and discussed based on literature and expert opinions.

Step 2: The initial direct relationship matrix is created. This matrix is formed by combining the challenges and criteria. A value of 0 indicates no influence; 1 indicates very low influence; 2 indicates low influence; 3 indicates high influence; and 4 indicates very high influence.

x_{ij}^{k} indicating the level of influence of criterion i on criterion j. Suppose there are M experts and n criteria, then there will be a non-negative matrix of dimension n X n. The value of x_{ij}^{k} is 0, which indicates that there is no effect for i = j. The following formula can be used to generate the average matrix A.

$$a_{ij} = \frac{1}{M}\sum_{k=1}^{M} x_{ij}^{k} \tag{1}$$

Step 3: Create a normalized direct relation matrix D. The matrix D contains values ranging from 0 to 1.

$$D = AxS \tag{2}$$

for $S = min\left(\frac{1}{max\sum_{j=1}^{n} a_{ij}}, \frac{1}{max\sum_{i=1}^{n} a_{ij}}\right)$

Step 4: Create the total relationship matrix T.

$$T = (I - D)^{-1} \tag{3}$$

I is the identity matrix.

Matrix normalization in the DEMATEL methodology is an essential procedure to guarantee that the components of the direct relationship matrix adhere to a consistent scale range (from 0 to 1). This approach not only aids in result interpretation but also guarantees that the generated values remain unaffected by the initial scale of raw data, which may differ between criteria.

Matrix normalization profoundly affects analytical results, notably by guaranteeing that the weights of criteria are computed in proportion to each criterion's influence. This technique enables criteria with dominant associations to maintain prominence without compromising the overall results. Moreover, normalization aids in alleviating the impact of high values (outliers) or disparities in the initial data, which may cause bias in the study of correlations across criteria. Consequently, matrix normalization guarantees more precise and representative outcomes in the computation of weights and the interrelations among items in the assessment model [29],[30].

Step 5: Each criterion has a calculated relationship and relevance.

$$R_i = \sum_{j=1}^{n} t_{ij} \tag{4}$$

$$C_j = \sum_{j=1}^{n} t_{ij} \tag{5}$$

The term R_i + C_j is known as "Prominence" while R_i - C_j is referred to as "Relation". The phrase "Prominence" *(R_i + C_j)* denotes the aggregate impact of a criterion inside the system, incorporating both the influence exerted *(R_i)* and the influence received *(C_j)* from other criteria. A greater "Prominence" score indicates a more substantial importance of that criterion within the overall model. The word "Relation" *(R_i - C_j)* denotes the characterization of the criterion as either a cause (positive) or an effect (negative). A positive number signifies that the criterion likely affects other criteria, whereas a negative value suggests that the criterion is predominantly influenced by others.

Step 6: Create a cause-and-effect diagram by mapping the dataset *(R_i + C_j : R_i - C_j)*

2.4. Implementation of SAW

The SAW technique is a multi-attribute decision-making approach in which the decision is based on the weighted values of each criterion. This approach identifies the optimum value among various possibilities. SAW necessitates an initial normalization of the decision matrix to provide comparisons with all possible evaluations [9],[31],[32].

The SAW method was used for this study because it effectively incorporates weights obtained from DEMATEL analysis and generates final scores that are comprehensible to all stakeholders. SAW enables multi-criteria assessment by incorporating quantifiable criterion values (benefit criteria). The principal benefit of SAW compared to other methodologies, such as TOPSIS or AHP, is its uncomplicated normalizing procedure, which facilitates the computation of alternative scores on a consistent scale [33],[34].

This study reveals that the criteria weights derived from DEMATEL indicate the relative impact of each criterion on research performance. SAW is utilized to amalgamate these weights with the performance data of each alternative, facilitating a thorough assessment based on normalized criteria.

SAW was given precedence in this research for several reasons. First, it offers an efficient aggregation process, as it operates without requiring complex assumptions or iterations, unlike other MCDM approaches. This makes it particularly effective when combined with weights derived from DEMATEL. Second, SAW provides clarity of interpretation, as the scores it generates directly represent preferences based on the highest value. This feature enhances its accessibility and ease of understanding, especially for non-technical users. Lastly, SAW demonstrates compatibility with DEMATEL, enabling the integration of DEMATEL-derived weights while maintaining a focus on the cause-effect correlations previously analyzed. These characteristics make SAW a suitable choice for this study.

This work presents an evaluation method through the adoption of SAW that is both data-driven and intuitive, facilitating its use across diverse institutional contexts.

The normalization formula in the SAW methodology.

$$r_{ij} = \begin{cases} \dfrac{x_{ij}}{max_i\, x_{ij}} & \text{if } j \text{ is the benefit attribute} \\ \dfrac{min_i\, x_{ij}}{x_{ij}} & \text{if } j \text{ is the cost attribute} \end{cases} \tag{6}$$

The term *r*ij refers to the normalized performance assessment of alternative A_i on attribute C_j. Where *i* is *1,2,…,m* and *j* is the sequence *1,2,…,n*. The preference value for each alternative V_i is calculated using the following equation.

$$V_i = \sum_{j=1}^{n} w_j r_{ij} \tag{7}$$

V_i is the preference value for each alternative, w_j is the weight value, and r_i is the normalized performance rating.

3. Results and Discussion

This section delineates the outcomes of employing the DEMATEL and SAW methodologies in the formulation of a research performance evaluation model for lecturers. The study commences with the mapping of relationships among performance evaluation criteria with DEMATEL, yielding relative weights for each criterion predicated on the influence and interconnectivity of components. Thereafter, the SAW approach is utilized to compute aggregate scores for each alternative according to the derived weights. This analysis identifies the criteria that most significantly influence research performance and evaluates each lecturer's performance based on final scores. These results offer profound insight into the interplay of criteria and the possibility for improving overall academic performance assessment.

3.1. Results

This study seeks to develop a complete performance evaluation model for faculty research by integrating two analytical methodologies: DEMATEL and SAW. The criteria employed for the evaluation of research performance are defined in table 1.

Table 1. Research Performance Criteria

Code	Criteria	Description
C1	Number of Publications	The total number of scientific publications produced by faculty members in one year
C2	Journal Quality	Subjective assessment of the journal for publication, on a scale of 1 (low) to 10 (high)
C3	The Impact of Research	Measured by the number of citations from the produced publications
C4	Research Fund	The total amount of research funding successfully obtained in one year (IDR)
C5	Research Collaboration	The number of research projects involving collaboration, with a scale of 0 indicating no collaboration, 1 for cross-disciplinary collaboration, and 2 for cross-institutional collaboration

Data were gathered by identifying and recording the variables influencing the research performance of lecturers, all sourced from the university's internal records. Table 2 illustrates the research performance of a speaker.

Table 2. Research Performance

Year	C1	C2	C3	C4	C5
2021	1	6	4	0	0
	1	5	2	2000000	1
	1	4	3	2000000	1
	1	1	0	0	1
2022	1	4	4	4500000	2
	1	6	3	2000000	1
2023	1	5	4	2000000	1
	1	4	3	0	0
	1	5	6	0	0

Table 3 summarizes the research performance of faculty members during the previous three years.

Table 3. Recapitulation of Lecturer Research Performance

Alternative	C1	C2	C3	C4	C5
A	9	40	29	12500000	7
B	7	35	34	9500000	5
C	9	38	31	10500000	6
D	8	37	31	9500000	6

E	7	34	25	8500000	5

Note: A= ; B= ; C= ; D= ; E=

Utilize the DEMATEL approach to ascertain the causal relationships among the defined evaluation criteria. This approach elucidates the manner in which the criteria affect and interrelate with one another. The computations executed via the DEMATEL approach rely on the assessments of four specialists. To commence the DEMATEL method, construct four non-negative matrices of dimensions 5 x 5.

$$X^1 = \begin{bmatrix} 0 & 3 & 1 & 1 & 4 \\ 1 & 0 & 2 & 3 & 1 \\ 3 & 1 & 0 & 2 & 3 \\ 1 & 4 & 2 & 0 & 4 \\ 3 & 3 & 1 & 3 & 0 \end{bmatrix} X^2 = \begin{bmatrix} 0 & 2 & 2 & 2 & 2 \\ 1 & 0 & 3 & 1 & 3 \\ 1 & 3 & 0 & 3 & 2 \\ 1 & 3 & 2 & 0 & 3 \\ 3 & 3 & 1 & 3 & 0 \end{bmatrix}$$

$$X^3 = \begin{bmatrix} 0 & 2 & 2 & 4 & 3 \\ 1 & 0 & 4 & 3 & 4 \\ 1 & 3 & 0 & 3 & 4 \\ 2 & 2 & 1 & 0 & 4 \\ 2 & 1 & 3 & 3 & 0 \end{bmatrix} X^4 = \begin{bmatrix} 0 & 2 & 2 & 4 & 3 \\ 1 & 0 & 4 & 3 & 4 \\ 1 & 3 & 0 & 3 & 4 \\ 2 & 2 & 1 & 0 & 4 \\ 2 & 2 & 4 & 4 & 0 \end{bmatrix}$$

Calculate the average of matrix A using equation (1).

$$A = \begin{bmatrix} 0.000 & 2.250 & 1.750 & 2.750 & 3.000 \\ 1.000 & 0.000 & 3.250 & 2.500 & 3.000 \\ 1.500 & 2.500 & 0.000 & 2.750 & 3.250 \\ 1.500 & 2.750 & 1.500 & 0.000 & 3.250 \\ 2.500 & 2.250 & 2.250 & 3.250 & 0.000 \end{bmatrix}$$

Using equation (2), calculate the normalized direct relationship matrix D. The calculation results are displayed as follows.

$$D = Ax \frac{1}{\max\limits_{1 \le i \le 7} \sum_{j=1}^{5} a_{ij}} \begin{bmatrix} 0.000 & 0.692 & 0.538 & 0.846 & 0.923 \\ 0.308 & 0.000 & 1.000 & 0.769 & 0.923 \\ 0.462 & 0.769 & 0.000 & 0.846 & 1.000 \\ 0.462 & 0.846 & 0.462 & 0.000 & 1.000 \\ 0.769 & 0.692 & 0.692 & 1.000 & 0.000 \end{bmatrix}$$

Calculate matrix T using equation (3).

$$T = D(I - D)^{-1} = \begin{bmatrix} -0.503 & -0.237 & -0.259 & -0.240 & -0.259 \\ -0.252 & -0.645 & -0.084 & -0.269 & -0.258 \\ -0.195 & -0.220 & -0.612 & -0.252 & -0.247 \\ -0.165 & -0.159 & -0.238 & -0.669 & -0.206 \\ -0.091 & -0.249 & -0.227 & -0.214 & -0.754 \end{bmatrix}$$

Perform calculations for each related criterion using equation (4), and for criteria that are relevant, use equation (5). Then, create a cause-and-effect diagram that maps the dataset. The cause-and-effect diagram will be displayed in table 4.

Table 4. Cause-and-Effect Diagram for Each Performance

Criteria	Ri	Ci	Ri + Ci	Ri - Ci	Identify
C1	-1.498	-1.205	-2.702	-0.293	Effect
C2	-1.508	-1.510	-3.018	0.003	Cause
C3	-1.525	-1.419	-2.944	-0.106	Effect
C4	-1.437	-1.644	-3.081	0.208	Cause
C5	-1.535	-1.724	-3.259	0.189	Cause

The DEMATEL computation results have established the priority criteria and their respective weights as follows: w_1 = 0.351, w_3 = 0.229, w_2 = 0.191, w_4 = 0.160, and w_5 = 0.070. The final score for the faculty research performance evaluation is calculated using the SAW technique, following the identification of correlations and weights among criteria by DEMATEL.

This study employs the DEMATEL technique, which utilizes expert panel evaluations to develop the relationship matrix among assessment criteria. This method facilitates the detection of intricate cause-and-effect interactions; yet, its dependence on subjective assessments introduces the potential for biases that may affect the final outcomes.

Numerous potential biases were identified in this research. One such bias arises from involving experts from a singular institution, which may limit the variety of perspectives. To address this, the expert panel was composed of professors from diverse backgrounds, encompassing various fields and extensive experience in research and academic administration. Another potential bias is variability in assessments, as experts may differ in their evaluation of inter-criteria linkages due to personal experiences or preferences. To mitigate this, the evaluations were aggregated using the average matrix from all experts, creating a consensus that reduces variability. Additionally, institutional influences on expert judgment may occur, as assessments can be affected by local institutional factors, such as research policies or university priorities. As a result, it is important to acknowledge that the findings of this research are most relevant to similar contexts, while further testing is required to establish broader generalizability.

To enhance the model's reliability, several mitigating actions were implemented. Focus group discussions (FGD) were facilitated to achieve consensus among specialists, ensuring a collective agreement on key aspects of the model. Additionally, clear instructions were provided to specialists on how to evaluate inter-criteria correlations. This step was crucial in minimizing subjective interpretations and ensuring consistency in assessments, thereby strengthening the overall reliability of the model.

The computation procedure for the SAW method is delineated as follows.

Utilize equation (6) to standardize the criterion data for each alternative. In this instance, all criteria belong to the benefit category. This is the outcome of the normalizing computation.

$$r = \begin{bmatrix} 1.000 & 1.000 & 0.853 & 1.000 & 1.000 \\ 0.778 & 0.875 & 1.000 & 0.760 & 0.714 \\ 1.000 & 0.950 & 0.912 & 0.840 & 0.857 \\ 0.889 & 0.925 & 0.912 & 0.760 & 0.857 \\ 0.778 & 0.850 & 0.735 & 0.680 & 0.714 \end{bmatrix}$$

Using equation (7), calculate the preference value for each option, and the results will be as follows.

$V_1 = 0.996$
$V_2 = 0.840$
$V_3 = 0.935$
$V_4 = 0.878$
$V_5 = 0.762$

Alternative A received the highest score of 0.996 from the SAW method calculations. Therefore, Alternative A is the lecturer with the best research performance.

3.2. Discussion

This study utilizes the DEMATEL method to ascertain the weights of criteria by analyzing the cause-and-effect correlations among the established criteria. The implementation presumes that all criteria originally possess equal significance prior to examining their interrelations. This method is useful for creating a baseline model, but it fails to consider variations in the significance of criteria influenced by institutional environments or particular fields.

The results indicate that the quantity of publications (C1) is the most critical factor in assessing lecturers' research success, as determined by DEMATEL analysis. C1, with a weight of 0.351, is the most significant criterion in comparison to Research Impact (C3) and Journal Quality (C2). This highlights the significance of publication volume in evaluating academic production, while not undermining the value of quality factors.

ISSN 2723-6471

Other factors, such as Research Funding (C4) and Research Collaboration (C5), although pertinent, possess lesser weights, signifying that while essential for maintaining research activities, their relative influence on performance evaluation is diminished.

These findings correspond with quantitative methodologies and institutional agendas that frequently prioritize publication productivity as a principal measure of lecturers' performance. Nevertheless, they also underscore a possible bias against specific areas, such as the humanities, where collaboration and quality frequently take precedence over publishing volume.

Subsequent assessment with the SAW approach corroborates these results, with Alternative A attaining the best score (0.996), indicating uniform performance across many evaluation criteria. These results underscore the significance of a comprehensive approach to evaluating research performance, which prioritizes not only quantity but also other interconnected factors.

Although the model yields substantial findings, conducting a sensitivity analysis on the criterion weights could augment its validity across various scenarios, particularly when implemented in different institutions or fields of study. Furthermore, incorporating long-term impact measurements, such as policy alterations or societal effects, would enhance the model's significance in global assessment frameworks.

To enhance the model's usefulness, future studies can explore greater flexibility in weight assignment through various methodologies. One approach involves integrating surveys or interviews with institutional stakeholders to align criterion weights with their strategic priorities, ensuring the model reflects organizational objectives. Another method is to assign criterion weights based on academic disciplines, such as emphasizing Funding (C4) for science and technology fields or prioritizing Collaboration (C5) for social sciences and humanities. Additionally, evaluating the model under different weighting scenarios can provide valuable insights into how weight modifications influence assessment results. This evaluation would offer a deeper understanding of the model's adaptability to diverse requirements and contexts, thereby increasing its practical applicability.

4. Conclusion

This study develops a robust model for evaluating faculty research performance by integrating two decision analysis techniques, DEMATEL and SAW. The DEMATEL study results reveal that the primary determinant of research performance is the quantity of publications, succeeded by research impact and journal quality. Research finance and collaboration are essential for advancing research; however, their impact is comparatively diminished. The SAW approach facilitates the aggregation of diverse assessment factors into an objective numerical score. According to the presented model, alternative A (0.996) is the optimal selection.

5. Declarations

5.1. Author Contributions

Conceptualization: M.N.S. and A.P.; Methodology: M.N.S.; Software: M.N.S.; Validation: M.N.S. and A.P.; Formal Analysis: M.N.S. and A.P.; Investigation: M.N.S.; Resources: A.P.; Data Curation: A.P.; Writing Original Draft Preparation: M.N.S. and A.P.; Writing Review and Editing: A.P. and M.N.S.; Visualization: M.N.S. All authors have read and agreed to the published version of the manuscript

5.2. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

5.3. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

5.4. Institutional Review Board Statement

Not applicable.

5.5. Informed Consent Statement

Not applicable.

5.6. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] A. Andika, F. J. Y. Louwisia, C. F. Susilo, and A. Victoria, "Factors Affecting Indonesian Higher Education Institution Students' Academic Achievement in the Industry 4.0 Era," *ELS J. Interdiscip. Stud. Humanit.*, vol. 4, no. 3, pp. 270–282, 2021, doi: 10.34050/elsjish.v4i3.15003.

[2] W. Xu, "A Research on the Influence of College Student Time Management on Their Academic Development," vol. 480, no. Mmet, pp. 104–109, 2020, doi: 10.2991/assehr.k.201023.019.

[3] A. S. Griffith and Z. Altinay, "A framework to assess higher education faculty workload in U.S. universities," *Innov. Educ. Teach. Int.*, vol. 57, no. 6, pp. 691–700, 2020, doi: 10.1080/14703297.2020.1786432.

[4] Lisnawita, F. C. Lucky Lhaura Van, Fajrizal, A. Zamsuri, and M. Syarawi, "Developing Decision Support System: Assessing the Lecturers' Performance with Additive Weighting Method," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 175, no. 1, pp. 1–8, 2018, doi: 10.1088/1755-1315/175/1/012100.

[5] M. Indrawan, B. Alamsyah, and I. Fatmawati, "UNPAB Lecturer Assessment and Performance Model based on Indonesia Science and Technology Index," *J. Phys. Conf. Ser.*, vol. 1175, no. 1, pp. 1–10, 2019, doi: 10.1088/1742-6596/1175/1/012268.

[6] M. Yazdi, F. Khan, R. Abbassi, and R. Rusli, "Improved DEMATEL methodology for effective safety management decision-making," *Saf. Sci.*, vol. 127, no. September 2019, pp. 1–17, 2020, doi: 10.1016/j.ssci.2020.104705.

[7] S. L. Si, X. Y. You, H. C. Liu, and P. Zhang, "DEMATEL Technique: A Systematic Review of the State-of-the-Art Literature on Methodologies and Applications," *Math. Probl. Eng.*, vol. 2018, no. 1, pp. 1–33, 2018, doi: 10.1155/2018/3696457.

[8] L. Rolita, B. Surarso, and R. Gernowo, "The Decision Making Trial and Evaluation Laboratory (Dematel) and Analytic Network Process (ANP) for Safety Management System Evaluation Performance," *E3S Web Conf.*, vol. 31, no. 1, pp. 1–7, 2018, doi: 10.1051/e3sconf/20183112006.

[9] H. Taherdoost, "Analysis of Simple Additive Weighting Method (SAW) as a MultiAttribute Decision-Making Technique: A Step-by-Step Guide," *J. Manag. Sci. Eng. Res.*, vol. 6, no. 1, pp. 21–24, 2023, doi: 10.30564/jmser.v6i1.5400.

[10] Hamidah, O. Rizan, D. Wahyuningsih, H. A. Pradana, and S. Ramadella, "SAW Method in Supporting the Process of Admission of New Junior High School Students," in *2020 8th International Conference on Cyber and IT Service Management, CITSM 2020*, 2020, pp. 1–5, doi: 10.1109/CITSM50537.2020.9268874

[11] M. Sousa, M. F. Almeida, and R. Calili, "Multiple criteria decision making for the achievement of the un sustainable development goals: A systematic literature review and a research agenda," *Sustain.*, vol. 13, no. 8, pp. 1–37, 2021, doi: 10.3390/su13084129.

[12] A. E. Vasegaard, M. Picard, F. Hennart, P. Nielsen, and S. Saha, "Multi criteria decision making for the multi-satellite image acquisition scheduling problem," *Sensors (Switzerland)*, vol. 20, no. 5, pp. 1–23, 2020, doi: 10.3390/s20051242.

[13] I. Emovon and O. S. Oghenenyerovwho, "Application of MCDM method in material selection for optimal design: A review," *Results Mater.*, vol. 7, no. 6, pp. 1–21, 2020, doi: 10.1016/j.rinma.2020.100115.

[14] G. Yannis, A. Kopsacheili, A. Dragomanovits, and V. Petraki, "State-of-the-art review on multi-criteria decision-making in the transport sector," *J. Traffic Transp. Eng. (English Ed.*, vol. 7, no. 4, pp. 413–431, 2020, doi: 10.1016/j.jtte.2020.05.005.

[15] M. Dalvi-Esfahani, A. Niknafs, D. J. Kuss, M. Nilashi, and S. Afrough, "Social media addiction: Applying the DEMATEL approach," *Telemat. Informatics*, vol. 43, no. June, pp. 1–14, 2019, doi: 10.1016/j.tele.2019.101250.

[16] M. Sharma, S. Joshi, and A. Kumar, "Assessing enablers of e-waste management in circular economy using DEMATEL method: An Indian perspective," *Environ. Sci. Pollut. Res.*, vol. 27, no. 12, pp. 13325–13338, 2020, doi: 10.1007/s11356-020-07765-w.

[17] M. Ortiz-Barrios, C. Miranda-De la Hoz, P. López-Meza, A. Petrillo, and F. De Felice, "A case of food supply chain management with AHP, DEMATEL, and TOPSIS," *J. Multi-Criteria Decis. Anal.*, vol. 27, no. 1–2, pp. 104–128, 2020, doi: 10.1002/mcda.1693.

[18] Y. Li, A. Diabat, and C. C. Lu, "Leagile supplier selection in Chinese textile industries: a DEMATEL approach," *Ann. Oper. Res.*, vol. 287, no. 1, pp. 303–322, 2020, doi: 10.1007/s10479-019-03453-2.

[19] R. D. Raut, B. B. Gardas, B. E. Narkhede, and V. S. Narwane, "To investigate the determinants of cloud computing adoption in the manufacturing micro, small and medium enterprises: A DEMATEL-based approach," *Benchmarking*, vol. 26, no. 3, pp. 990–1019, 2019, doi: 10.1108/BIJ-03-2018-0060.

[20] W. Song, Y. Zhu, and Q. Zhao, "Analyzing barriers for adopting sustainable online consumption: A rough hierarchical DEMATEL method," *Comput. Ind. Eng.*, vol. 140, no. February, pp. 1–32, 2020, doi: 10.1016/j.cie.2020.106279.

[21] Y. W. Du and X. X. Li, "Hierarchical DEMATEL method for complex systems," *Expert Syst. Appl.*, vol. 167, no. March, pp. 1–22, 2021, doi: 10.1016/j.eswa.2020.113871.

[22] A. Rasadi, B. Hidayat, and T. Ophiyandri, "Decision Support system in determining the priority of disaster mitigation infrastructure development in villages level using the Simple Additive Weight (SAW) method," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 708, no. 1, pp. 1–9, 2021, doi: 10.1088/1755-1315/708/1/012065.

[23] E. Simanungkalit, J. S. Tarigan, D. C. Sari, and A. S. Hasibuan, "Implementation of Simple Additive Weighting (SAW) Method in Decision Support System to Determine the Best University in Medan," *Int. J. Res. Vocat. Stud.*, vol. 2, no. 4, pp. 168–172, 2023, doi: 10.53893/ijrvocas.v2i4.190.

[24] Y. Irawan, "Decision Support System for Employee Bonus Determination With Web-Based Simple Additive Weighting (Saw) Method in Pt. Mayatama Solusindo," *J. Appl. Eng. Technol. Sci.*, vol. 2, no. 1, pp. 7–13, 2020, doi: 10.37385/jaets.v2i1.162.

[25] S. G. Meshram, E. Alvandi, C. Meshram, E. Kahya, and A. M. Fadhil Al-Quraishi, "Application of SAW and TOPSIS in Prioritizing Watersheds," *Water Resour. Manag.*, vol. 34, no. 2, pp. 715–732, 2020, doi: 10.1007/s11269-019-02470-x.

[26] D. Meidelfi, Yulherniwati, F. Sukma, D. Chandra, and A. H. Soleliza Jones, "The implementation of SAW and BORDA method to determine the eligibility of students' final project topic," *Int. J. Informatics Vis.*, vol. 5, no. 2, pp. 144–149, 2021, doi: 10.30630/joiv.5.1.447.

[27] N. Kumar, T. Singh, Grewal, A. Patnaik, and G. Fekete, "A novel hybrid AHP-SAW approach for optimal selection of natural fiber reinforced non-asbestos organic brake friction composites," *Mater. Res. Express*, vol. 6, no. 6, pp. 1–21, 2021.

[28] M. Safaripour and N. R. Andabili, "Miyandoab flood risk mapping using dematel and saw methods and dpsir model," *Adv. Environ. Technol.*, vol. 6, no. 3, pp. 131–138, 2020, doi: 10.22104/AET.2020.4766.1287.

[29] R. Jiang, "A Novel Normalization Method for Using in Multiple Criteria Decision Analysis," in *IEEE International Conference on Industrial Engineering and Engineering Management*, 2019, no. 4, pp. 268–272, doi: 10.1109/IEEM44572.2019.8978684

[30] I. Z. Mukhametzyanov, "On the Conformity of Scales of Multidimensional Normalization: an Application for the Problems of Decision Making," *Decis. Mak. Appl. Manag. Eng.*, vol. 6, no. 1, pp. 399–431, 2023, doi: 10.31181/dmame05012023i.

[31] M. A. Kasri and H. Jati, "Combination of K-Means and Simple Additive Weighting in Deciding Locations and Strategies of University Marketing," *Khazanah Inform. J. Ilmu Komput. dan Inform.*, vol. 6, no. 2, pp. 132–141, 2020, doi: 10.23917/khif.v6i2.11281.

[32] A. Fadlil, I. Riadi, and Y. Mulyana, "Integration of Fuzzy C-Means and SAW Methods on Education Fee Assistance Recipients," *Kinet. Game Technol. Inf. Syst. Comput. Network, Comput. Electron. Control*, vol. 4, no. 2, 2023, doi: 10.22219/kinetik.v8i2.1636.

[33] F. Ciardiello and A. Genovese, "A comparison between TOPSIS and SAW methods," *Ann. Oper. Res.*, vol. 325, no. 2, pp. 967–994, 2023, doi: 10.1007/s10479-023-05339-w.

[34] M. M. D. Widianta, T. Rizaldi, D. P. S. Setyohadi, and H. Y. Riskiawan, "Comparison of Multi-Criteria Decision Support Methods (AHP, TOPSIS, SAW & PROMENTHEE) for Employee Placement," *J. Phys. Conf. Ser.*, vol. 953, no. 1, pp. 1-6, 2018, doi: 10.1088/1742-6596/953/1/012116.