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Decision Support Systems and Automated Platforms for Scholarship Selection: A Comprehensive Review

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Abstract: *The demand for higher education continues to escalate, causing a rise in the number of scholarship appli- cations that academic institutions are receiving. As a result, these institutions have been under a lot of pressure to devise efficient, consistent, and transparent processes for selecting the recipients of such scholarships [1], [2]. The traditional man- ual methods of scholarship evaluation are usually associated with incidents of administrative delays, subjectivity in decision- making, and difficulties in handling large datasets [1], [8]. To address these issues, researchers have suggested the application of Decision Support Systems (DSS), Multi-Criteria Decision- Making (MCDM) models such as Simple Additive Weighting (SAW), Fuzzy Multiple Attribute Decision Making (FMADM), and PROMETHEE together with the implementation of digital scholarship management systems [2], [3], [9]. Such measures not only free the evaluators from monotonous tasks but also ensure impartiality through multi-criteria and make the processing of documents more accessible [1]–[3]. In addition, the use of software project risk management concepts helps to ensure that the systems developed for academic decision-making are stable and reliable [4]–[7].*

This review identifies, assesses, and synthesizes the research evidence concerning algorithmic and system-based approaches to academic decision making, their effectiveness, and the potential openness of new avenues for future research [2], [3], [9], [14]. The manuscript is a digital revolution roadmap in the selection of scholarship recipients..

Keywords*:* Decision Support Systems, Scholarship Selec- tion, SAW, FMADM, PROMETHEE, Risk Management, Au- tomation, Digital Platforms, Multi-Criteria Decision Making

I. INTRODUCTION

Expansion of higher education systems globally has led to a parallel increase in the dependency on student financial aid [1]. Scholarships among different financial aids remain the most vital instruments which not only help to reduce students' economic burden but also promote academic excellence and social equity [1], [2]. The rise in the number of the applicants, however, causes the creation of big challenges for the evalu- ation institutions in the operational sphere which are heavily responsible for the scholarship application processes [2]. The traditional evaluation methods are greatly dependent on the manual processing of data—reviewers have to look through a large number of applications, verify the supporting documents, compare the academic records of the candidates, analyze the demographic or socio-economic data, and assess the eligibility of the applicants according to pre-established criteria [1]. The whole process is very time-consuming when done by a human and is also prone to errors such as scoring inconsistency, misinterpretation of the criteria, and difficulties in managing large amounts of data [2]. Furthermore, the manual procedure of scholarship selection is quite often subject to the following problems:

- The subjectivity of the assessment, which depends on the point of view of a particular reviewer.
- The presence of redundant data as a result of paper-based submission.

• The difficulty in tracking the progress of the application.
• The lack of transparency about the reasons for rejection or acceptance.
• The delayed communication between reviewers and ap- plicants.

Decision support systems (DSS), multi-criteria decision- making (MCDM) models, and automated digital platforms have been progressively acknowledged by researchers and organizations as a means to surmount these barriers [2], [3], [8], [9]. These instruments supply the applicant evaluation process with a more objective and organized manner, which hinges upon the numerical representation of the applicants' qualifications [2], [13].

A. Rise of Decision Support Systems in Scholarship Selection

Decision Support Systems (DSS) refer to a set of computa- tional tools, algorithms, databases, and automated workflows which by their nature support the decision-makers in reaching coherent and logical decisions [8]. In the scholarship selection scenario, DSS can extend their functionalities offering these advanced features:

• Automated data validation.
• Multi-criteria comparison across applicants.
• Weighted scoring based on institutional priorities.
• Statistical ranking.
• Document verification.
• Batch processing of large applicant datasets [2], [8], [9].

Several research works have come to the conclusion that DSS lead to the shortening of evaluation time, the improvement of justice, and the reduction of the human error risk [1], [2].

B. Multi-Criteria Decision-Making Approaches

Choosing the best candidate for a scholarship is a decision- making process in which the evaluator has to simultaneously take into account many factors, such as but not limited to:

• Grade Point Average (GPA).
• Family income.
• Number of dependents.
• Semester level.
• Extracurricular performance.
• Community engagement [2], [3].

As a multi-criteria problem, it is possible to use MCDM methods for this purpose, such as:

• Simple Additive Weighting (SAW).
• Fuzzy Multi-Attribute Decision Making (FMADM).
• PROMETHEE Outranking Method [2], [3], [10], [14].

Each of the methods is capable of handling ambiguous or uncertain data, converting linguistic variables (e.g., "low income," "high performance") into numerical values, and producing ordered lists of potential candidates [2], [11], [14].

C. Digital Scholarship Management Platforms

Besides MCDM algorithms, the rise of online scholarship management systems has revolutionized the workflow from submission to decision [1]. These steps are facilitated by the platforms:

• Paperless application collection.
• Automated applicant scoring.
• Real-time status tracking.
• Reviewer dashboards.
• Communication modules for notifications.
• Centralized storage of student records.
• Integration with institutional databases [1], [9].

Digital platforms have been shown to be a means of drastically cutting down the processing time and thus raising the level of satisfaction not only among students but also administrators [1].

D. The Essential Nature of Risk Management in Software Projects

Reliability of scholarship decision systems is one of the most indispensable, yet frequently overlooked, considerations [4]. If not carefully designed, the systems might experience:

- Data corruption.
- Privacy breaches.
- System crashes during peak application periods.
- Incorrect scoring or ranking.
- Loss of applicant trust [4], [5].

To forestall these issues, risk management frameworks for software projects play a pivotal role in ensuring that scholarship platforms stay operationally stable under real-world situations [4]–[7].

E. Purpose of This Review

The primary purpose of this paper is to study in depth:

- Computational techniques for scholarship recipient selec- tion.
- Decision-support machinery and their subsystems.
- Web-based solutions designed for the management of academic scholarships.
- Risk management frameworks that can be utilized in system architecture.
- A comparative analysis of different methods in candidate selection.
- The existing problems as well as the future prospects of the automated scholarship selection field [1]–[4], [8]– [10], [14].

II. BACKGROUND AND LITERATURE REVIEW

The global academic scene has been substantially altered over the last few years by technological advancements, the increased number of students, and the growing reliance on financial aid programs [1]. In particular, scholarship programs constitute the most essential financial aids that enable students from different socio-economic backgrounds to obtain quality education [1], [2]. Due to the continuous rise in the number of scholarship applicants, institutions have been experiencing operational bottlenecks related to administrative evaluation, verification of the accuracy of documents, and maintenance of selection fairness [2]. The situation change has not only motivated researchers and educational institutions to embrace systematic, computational, and automatic methods for decid- ing on scholarships that are more efficient [2], [3], [9].

The next chapter briefs the procedures of scholarship se- lection, the evolution of decision support systems (DSS), and multi-criteria decision-making (MCDM) models which are the major tools of current automated scholarship systems [2], [8], [9], [14]. In addition to this, the review serves the digital transformation in the education sector and talks about the utilization of risk management techniques in system design and work [1], [4]–[7].

A. Traditional Scholarship Selection Methods

Previously, scholarship committees were heavily dependent on manual, paper-based operations that helped them to handle documentation, establish eligibility, and rank candidates [1]. The steps of such a procedure were usually:

- Filing applications via printed forms.
- Verification of documents by administrative personnel.
- Selection of the most worthy candidates based on the directives of the established policy.
- Evaluation by either weighted criteria or the committee's discretion.
- Final decision and public announcement.

In contrast, manual operations have several major disadvan- tages among which are:

• Highly time-consuming workflows: Going through hun- dreds or thousands of applications is very exhausting from the viewpoint of the administrative personnel.
• Subjective interpretation: Reviewers might interpret the criteria differently which will lead to inconsistency in scoring.
• Human errors: Incorrect calculations, documents wrongly filed, or failure to check the documents thoroughly can result in fairness being compromised.
• Scalability issue: The influx of a large number of new applicants will put a strain on manual systems.
• Communication at a snail's pace: The time that passes before the applicants get an answer from the people who processed their applications puts a brake on their expectations.
• Lack of transparency: Those who are not chosen may not get the understanding why [1], [2], [8].
Research has shown that the efficiency of scholarship sys- tems which are done manually decreases significantly when the number of candidates exceeds a certain limit [2]. More- over, as educational institutions are moving towards digital solutions, manual systems are gradually becoming less and less compatible with the requirements of modern administrations [1], [9].

B. Digital Transformation in Scholarship Selection

The transition from manual scholarship decision-making systems to digitally automated ones has been enabled by advances in information technology [1]. Modern digital plat- forms offer:
• Internet-based application portals.
• Online submission of documents.
• Applicant auto-scoring.
• Integration of databases.
• Live tracking.
• Email notification automation.
• Reviewer dashboards [1], [9].
Such systems result in a substantial reduction of the work- load that is heavy for the administration and at the same time increase transparency, traceability, and fairness [1], [2]. A good example is the APPly platform that got high usability ratings from both students and staff because of its speed and automatic features [1].
Digital platforms also play a vital role in providing such benefits as:
• Extremely shortening the processing time.
• Being paperless.
• Ensuring data accuracy.
• Creating stronger audit trails.
• Immediate error identification.
• Access control along with security [1], [4].
The adoption of digital scholarship management systems aligns with the global trends in e-governance and digital public services [1], [9]. With education systems undergoing technological integration, the role of cloud computing, APIs, and data mining is expected to be more significant [9], [14].

C. Introduction to Decision Support Systems (DSS)

Decision Support Systems (DSS) are computer-based in- struments that help humans cope with complex decision-making situations by providing data structuring, modeling, and evaluation functionalities [8]. In scholarship selection, DSS usually incorporate:
• Data processing modules.
• Ranking or scoring algorithms.
• Multi-criteria evaluation models.
• User-facing dashboards.
• Database backends [2], [8], [9].

1) Components of a Scholarship DSS: A DSS for scholar- ship selection usually consists of:
• Input Module: obtains the raw data of the applicants (for example, GPA, financial situation, number of depen- dents).
• Processing or Model Module: performs mathematical evaluation or scoring via SAW, FMADM, PROMETHEE, or custom logic [2], [3].
• Database Module: stores the structured data of appli- cants and the results of their evaluation.
• Output Module: displays the ranked results, reports, and recommendations to the decision-makers.
• Knowledge Module (optional): made up of institutional rules, decision policies, or heuristics [8], [9].

2) Benefits of DSS in Scholarship Selection:
• Facilitates a consistent evaluation of all applicants.
• Eliminates the impact of subjective bias.
• Raises the level of precision by using mathematical modeling.
• Enables the processing of large datasets.
• Provides the opportunity for rapid reevaluation in case of criteria changes.
• Assists in the objective comparison of closest cases [2], [8], [9].
DSS models explain the way the numbers are generated; therefore, they provide the institutions with the possibility of thoroughly defending their decisions if they receive opposi- tions [8].

D. Multi-Criteria Decision-Making (MCDM) Methods
The scholarship selection process is a prime example of a problem that requires the simultaneous evaluation of numerous criteria. Multi-Criteria Decision-Making (MCDM) methods are specifically designed to handle such cases efficiently [13], [14]. There are three main MCDM methods which are the primary focus of the scholarship selection literature:
1) Simple Additive Weighting (SAW): The SAW method evaluates applicants by calculating the weighted sum of nor- malized criteria. Because of its ease, openness, and straight- forward calculation, it is very widely used [2], [13].
SAW determines the worth of the alternative by summing up the values of normalized criteria that are weighted by corresponding criteria. Formally,

$$V_i = \sum_{j=1} w_j \cdot r_{ij}$$

where Vi is the final score for applicant i, wj is the weight assigned to criterion j, and rij is the normalized value of applicant i on criterion j [2], [13]. The alternative with the highest value is regarded as the best and ranked number one.
a) Normalization Process: Normalization is a procedure whereby criteria having different units (e.g., GPA and income) become comparable. SAW may carry out either:
Benefit criteria normalization (where larger values imply a better result):

$$r_{ij} = \frac{x_{ii}}{\max(x_i)}$$

b) Weight Assignment: SAW encourages decision- makers to assign weights to the criteria by stating that each weight reflects the relative importance of the criterion [2], [13]. For example:

$$r_{ii} = \frac{\min(x_i)}{x_{ij}}$$

• GPA – 0.40
• Family Income – 0.30
• Number of Dependents – 0.10
• Semester Level – 0.20
The weights must satisfy Σ wj = 1 [13].

c) SAW Layer Example in Scholarship Selection: The SAW model usually consists of:
• Determining criteria.
• Building the decision matrix.
• Normalizing data.
• Assigning weights.
• Calculating the weighted sum.
• Ranking candidates by their final scores [2].
This brings SAW to the level of the most suitable method for institutions with a large number of applicants and where simplicity and fast computational speed are of great impor- tance.

d) Strengths and Weaknesses of SAW: Strengths
• Implementation can be easily done in Excel, SQL, DSS, etc.
• Computation is very fast and is therefore suitable for large-scale evaluations.
• A very transparent method which can also be easily explained to partners.
• Fully compatible with well-measured criteria [2], [31].
Weaknesses
• Performance deteriorates highly due to weight errors.
• Not able to work with uncertain or linguistic data (“low income,” “high GPA”).
• Linear compensation may not represent real situations in some cases [2], [30], [31].
SAW may serve as a reliable foundation for more compli- cated hybrid selection systems [2], [14].

2) Fuzzy Multi-Attribute Decision Making (FMADM): FMADM is a combination of fuzzy set theory and multi-criteria decision-making [2], [11]. It is very good in cases where the criteria are ambiguous, subjective, or linguistic in nature.
Most of the time people tend to use subjective words when talking about the following:
• Low income.
• Medium academic performance.
• High need.
• Very high GPA.
If one tries to present these concepts by clear numbers they will undoubtedly fail. Fuzzy logic solves this problem by using membership functions that take qualitative input and return the corresponding quantitative fuzzy values [11].
For a fuzzy set, the membership degree for each element is
The result of such operations is a set of non-dimensional numbers that vary between 0 and 1 [2].
between 0 and 1 [11]. An example membership function for income could be:
• Income < Rs. 1,50,000 – 1 (High Need).
• Income between Rs. 1,50,000 and Rs. 4,50,000 – 0.5 (Medium Need).
• Income > Rs. 4,50,000 – 0 (Low Need).
a) FMADM Workflow: The FMADM steps are usually implemented in this order:
• Representing criteria by fuzzy numbers.
• Converting fuzzy numbers into crisp scores.
• Normalizing crisp scores (like SAW).
• Ranking candidates using an MCDM method (usually SAW or weighted average) [2], [11].
b) Hybrid FMADM–SAW Approach: The most typical hybrid model references:
• FMADM is a tool for transforming linguistic expressions into crisp scores.
• SAW is employed for deriving the final ranking [2].
The main feature of this combined method is that it handles uncertainty and computational speed which makes it an ideal scholarship evaluation tool [2], [14].

c) Strengths and Weaknesses of FMADM: Strengths
• Allows for subjectivity and vagueness.
• Imitates human decision-making in a socially acceptable manner.
• Correctly reflects the nature of socio-economic criteria [2], [11].
Weaknesses
• Higher computational demands.
• Requirement for creating appropriate membership func- tions.
• Explanation can be challenging if the user is not familiar with fuzzy logic [11], [29].
FMADM is a method that shines when the input data are vague or symbolic.

3) PROMETHEE Method: PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluation) is an MCDM method based on pairwise comparisons. It is a method most frequently employed in cases where the ranking of alternatives has to be carried out with high precision [3], [10].
PROMETHEE determines winning options by looking at:
• Preference functions.
• Positive outranking flow ($\Phi+$).
• Negative outranking flow ($\Phi-$).
• Net outranking flow (Φ).
An entity's net flow is calculated as the difference between its positive and negative flows: $\Phi(a) = \Phi+(a) - \Phi-(a)$ [10].
The choices with a greater net flow are those that are more desirable.
PROMETHEE has several types of preference functions (usual, quasi, linear, level, linear with thresholds, Gaussian) that allow flexible modeling of preference intensity [10]. The typical workflow is:
• Determine criteria.
• Choose preference functions.
• Compute the preference index.
• Calculate outranking flows.
• Rank alternatives [3], [10].
Strengths
• Handles complicated decision environments.
• Suitable for candidates who are ranked closely.
• Offers high discriminatory power [3], [10].
Weaknesses
• Careful selection of thresholds is a must.
• Hard to comprehend for non-technical decision-makers.
• Computationally heavier than SAW [3], [10], [32].
A scholarship employing PROMETHEE could be an excel- lent way to address questions such as: which of all the closely matched applicants performed subtly better? [3].

E. Importance of Software Project Risk Management
Complexity increase in scholarship systems leads to risk management becoming a necessary feature [4]. The process initiates with software project risk management by:
• Identifying potential threats.
• Evaluating the probability and the impact.
• Ranking risks.
• Implementing risk mitigation strategies.
• Monitoring results [4], [5].
Risks that frequently occur in scholarship DSS are:
• Incorrect weighting of criteria.

• Corruption of the database.
• Security vulnerabilities.
• System overloads during rush hours.
• Improper user training [4]–[7].

If risk management regulations are followed, scholarship systems can be assured to be reliable, scalable, and safe [4]–[7].

III. DECISION SUPPORT SYSTEMS (DSS) IN EDUCATION

DSS have become one of the most powerful tools in the educational field, capable of helping schools to make informed, precise, and scalable decisions in the areas of administration, teaching, and operations [8], [9]. As the ed- ucational environment is getting complicated with increasing students' number, diverse learning needs, and more usage of digital platforms, DSS provide well-organized, data-supported resolutions to facilitate the decision-making process in the concerned institutions [8].

A. The Role of DSS in Modern Educational Institutions

Optimizing decision-making processes in educational insti- tutions has become an urgent and growing need due to reasons such as:

• Enrollment rates continuously rising.
• Increasing demands for transparency and accountability.
• More data being available.
• Pressure to offer more efficient administrative services.
• Students wanting quick and accurate response interaction like never before [8], [9].

DSS are built to examine enormous data records and offer decision-makers useful analytical insights. In education, these insights can be used to make various decisions, such as:

• Keeping track of student progress.
• Making resource utilization more effective.
• Admission management.
• Curriculum planning.
• Grant processing.
• Scholarship selection [8], [9].

Implementing decision support systems in the education sector will help the system to be more efficient, less bureau-cratic, and more equitable [8].

B. An Educational Decision Support System Design

As a rule, a Decision Support System is structured with sev- eral layers, each of which is responsible for certain functions. In the domain of education, DSS design typically includes the following layers [8], [9]:

1) Data Management Layer: The data management layer collects data from various sources:

• Academic records of students.
• Demographic data.
• Financial records.
• Attendance records.
• Past scholarship data.

These data are stored in a central database system that not only opens them for processing and analysis but also secures them [8].

2) Model Management Layer: This layer holds the mathe- matical or computational models used for data analysis, such as:

• Weighted scoring algorithms (e.g., SAW).
• Fuzzy logic processors (FMADM).

• Outranking models (PROMETHEE).
• Predictive models.
• Statistical analysis tools [2], [3], [9].
It is the "brain" of the DSS, enabling complex evaluations and decisions [8].
3) User Interface Layer: The user interface layer is the ac- cess point of the DSS functions for administrators, reviewers, faculty, and students. It typically comprises:
• Interactive dashboards.
• Reporting tools.
• Data visualization modules.
• Workflow management screens.
• Application tracking and scoring interfaces [8], [9].
The proper kind of user interface facilitates the work of the system and diminishes the need for training [1], [8].
4) Knowledge Base Layer (Optional): Advanced DSS plat- form features include a knowledge base that can be thought of as a storage place for rules, policies, and experts' input, such as:
• Institutional scholarship rules.
• Eligibility requirements.
• Weighting principles.
• Decision-making policies [8], [9].
That layer is helpful in terms of time and user aspects when making consistent decisions.

C. Benefits of Using DSS in Schools
The implementation of DSS in the school system comes with many advantages [8], [9].
1) Enhanced Efficiency: By automating data handling and evaluation, DSS can substantially reduce the work that is commonly hard and is a side effect of tasks such as:
• Application sorting.
• Criteria verification.
• Score calculation.
• Report generation.
By implementing technology, institutions can manage a large number of scholarship applications, and the whole process is less time-consuming as compared to the manual one [1], [2].
2) Improved Accuracy and Consistency: Human evaluators can get tired, have their own biases and thus can make mistakes. On the contrary, DSS:
• Apply identical rules for all candidates.
• Compute the results with mathematical accuracy.
• Remove differences that arise from subjectively inter- preted rules [2], [8].
Assurance is given to the objectivity of all decisions and thus they can be repeated.
3) Data-Driven Decision Making: Decision Support Sys- tems enable executives to tap into historical data and trends which have a direct impact on:
• Policy review.
• Scholarship budget planning.
• Assessment of future candidate pool prediction [8], [9].
4) Scalability: DSS can scale up their capabilities to deliver the necessary workload when the number of applications rises considering their design. It is very important for educational organizations that have to deal with the annual increase of scholarship applications [8], [9].
5) Transparency and Fairness: Some of the documented examples that DSS provide are:
• Criteria values.
• Weighting schemes.
• Processing steps.

• Final scores.
This level of transparency not only helps the students to trust the system but also the administrators.

D. Educational DSS Applications Beyond Scholarship Selection

Although the current study is focused on the use of DSS for scholarship evaluation, DSS have also been a significant influence in other academic areas [8], [9]:

1) Academic Advising and Student Support: After ana- lyzing the educational records of students, these programs subsequently recommend:
• Courses.
• Programs.
• Remedial support [9].

2) Admissions and Enrollment Management: DSS render the following functions less cumbersome:
• Ranking applicants.
• Enrollment prediction.
• Seat allocation management [8], [9].

3) Institutional Resource Planning: Decision Support Sys- tems with the assistance of forecasts support decision makers in:
• Faculty workload planning.
• Classroom booking.
• Budget distribution [8], [9].

4) Student Performance Prediction: Artificial intelligence techniques can be integrated to identify students who are likely to fail and thus recommend support—a case of student performance prediction [9], [24].

E. DSS Challenges in Educational Implementation

Although there are numerous benefits of DSS in the educa- tional field, they also have some disadvantages, such as:
• Difficulties in guaranteeing data quality as a result of incomplete or inconsistent records.
• Resistance of workers towards automation implementa- tion.
• Insufficient training program for administrators and users.
• Worries about the confidentiality of sensitive student data.
• Difficulties in integrating the system due to the use of existing institutional platforms [4], [8], [9].
• The inability to scale up when there is a sudden increase in the number of applicants [1], [2].

The deployment of these factors must be addressed if the launching is to be successful.

IV. MODELS OF SCHOLARSHIP SELECTION: SAW, FMADM, AND PROMETHEE

Finding the most appropriate candidates for a scholarship from among the applicants is a task that involves a deep understanding of several facets, i.e., academic achievements, financial status, socio-economic background, personal achieve- ments, and family-related obligations [2]. As the criteria have quite different ranges, units, and weights, organizations seek computational methods to synthesize complex multidimen- sional data into one evaluation [13], [14]. That is why Multi- Criteria Decision-Making (MCDM) methods have been turn- ing into the core elements of automated scholarship selection systems [2], [3], [14].

This chapter features the three primary MCDM methods that are broadly concerned in the research of scholarship evaluation: Simple Additive Weighting (SAW), Fuzzy Multiple Attribute Decision Making (FMADM), and PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluation) [2], [3], [10]. In essence, any of these models might be of assistance to an entity in carrying out objective, transparent, and repeatable decision-making procedures [13], [14].

V. DIGITAL SCHOLARSHIP MANAGEMENT SYSTEMS

As educational institutes continue to expand, so does the demand for a scholarship system that can handle a large volume of applications while being transparent and fair. One of the effects of automation in educational scholarship platforms is that the number of staff required to perform manual tasks is greatly reduced while decision accuracy is improved. This section features the architecture, functionality, and benefits of the latest digital scholarship management systems focusing mainly on the automation of workflow, system usability, and integration with decision-support algorithms.

VI. SOFTWARE PROJECT RISK MANAGEMENT THEORY

VII. COMPARATIVE ANALYSIS OF SCHOLARSHIP SELECTION MODELS

The present chapter compares the three chief MCDM methods—SAW, FMADM, and PROMETHEE—in terms of the selection of scholarship recipients [2], [3], [14]. Each technique weighs the structure of the applicant data, the requirements of the institution, and the nature of the selection criteria differently. The paper evaluates these methods from the point of view of computational efficiency, interpretability, handling of uncertainty, scalability, and suitability for digital platforms [13], [14], [30].

A. Comparison Criteria

Criteria for systematic model evaluation included the fol- lowing aspects:

- Requirement for data.
- Handling of uncertainty.
- Ease of understanding.
- Computational complexity.
- Sensitivity to weight assignment.
- Discrimination power.
- Suitability for digital integration.
- Scalability [30], [31].

B. Summary Table of SAW, FMADM, and PROMETHEE

VIII. CHALLENGES, LIMITATIONS, AND FUTURE DIRECTIONS

TABLE I: Comparison of SAW, FMADM, and PROMETHEE for Scholarship Selection

Feature	SAW	FMADM	PROMETHEE
Handling of uncertainty	No support for vague or linguistic data	Excellent (uses fuzzy sets)	Partial (can model preferences via functions)
Computation time	Very fast, suitable for large applicant pools	Moderate, due to fuzzification and defuzzification	Slower; pairwise comparisons grow as $O(n^2)$
Model complexity	Low; simple weighted sum	Medium; requires fuzzy logic concepts	High; outranking flows and preference functions
Interpretability for non-technical users	High; easy to explain as a weighted score	Medium; fuzzy steps may need explanation	Low; outranking logic is harder to understand
Best suited scenarios	Large-scale evaluations with clear numerical data	Socio-economic and qualitative criteria (e.g., "low income")	Fine-grained ranking when candidates are very similar
Sensitivity to weight choices	High	Medium	Medium
Scalability in digital platforms	Excellent	Good	Moderate

IX. CONCLUSION

The transformation of scholarship award systems from man- ual, paper-based processes to automated, data-driven ones has not only brought about fairness, efficiency, and transparency, but it has also helped educational organizations to better cope with the ever-growing volume of scholarship applications worldwide [1], [2]. In such a case, the use of computational methods, digital platforms, and structured decision models is absolutely necessary for the sake of accuracy and consistency [2], [3], [8], [9]. This paper showed the potential interrelation of Decision Support Systems (DSS), MCDM models (i.e., SAW, FMADM, and PROMETHEE), and digital management platforms for scholarships in the future landscape of scholar- ship selection [1]–[3], [13], [14].

Individually, these methods embody several virtues: SAW is the simplest and quickest of the three to compute and thus very appropriate for the large number of applications; FMADM is more capable of handling linguistic and uncertain data; PROMETHEE may be applied in situations where the discrimination power is required the most and the ranking of the last candidates varies by only a few percentage points [2], [3]. These digital platforms empower the combined usage of methods through functionalities such as automated workflow, document management, and real-time communication, which consequently lead to time saved in administrative work and an increase of people's satisfaction with the procedure [1], [9].

Still, there are some issues. They include, among others: data quality; the danger of an incorrect setting of the algorithm; problems with the integration of systems into the existing institutional infrastructures; problems related to security and privacy [2]–[4]. Moreover, the integration of qualitative evalu- ation in fully automated systems is a difficulty and the estab- lishment of new platforms requires strong safety management structures to guarantee the stability and sustainability of these platforms [4]–[7], [21].

Briefly, the automated solutions combined with advanced decision-making models are potent instruments that may bring a fundamental change in the way scholarship is allocated. If institutions confront the current challenges directly, implement risk management practices, and accept new technologies, then they will be able to create systems that are not only accurate and efficient but also fair and trustworthy [4]–[7], [20], [24]. Therefore, this shift towards digital is a significant milestone in the essential journey of facilitating students and widening educational access globally [1], [2].

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