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OUTSOURCED EMPLOYEE RECRUITMENT DECISION SUPPORT SYSTEM WITH FUZZY TOPSIS INTEGRATED REST API METHOD

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Abstract—*PT Dina Mika Muda Mandiri is a logistics and transportation company that is facing challenges in recruiting outsourced employees to meet the company's standards with complex assessment criteria. In overcoming this problem, the research developed a decision support system that is integrated with Rest API and the Fuzzy Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method. The system aims to improve the efficiency and accuracy of candidate selection by evaluating criteria such as interviews, knowledge, testing, curriculum vitae (CV), processing time, and salary. Two case studies were conducted involving 36 applicants for a website upgrade project and 24 applicants for an outsourced goods transit system. The results demonstrate that the decision support system integrated with Fuzzy TOPSIS significantly enhanced the selection process, improving accuracy by 91% for the website upgrade project and 97% for the goods transit system when compared to traditional human resource development (HRD) decision criteria. This demonstrates the system's effectiveness in aligning with HRD standards, making the recruitment process more effective, accurate and efficient. Future research should explore methods to refine the weighting of criteria and integrate expert opinions or more sophisticated machine learning algorithms to support more objective decision support systems in outsourcing employee recruitment.*

Keywords*: decision support system, outsourcing, Rest API, TOPSIS.*

Intisari—PT Dina Mika Muda Mandiri merupakan perusahaan logistik dan transportasi yang sedang menghadapi tantangan dalam merekrut karyawan *outsourcing* untuk memenuhi standar perusahaan yang kompleksitas kriteria penilaian. Dalam mengatasi permasalahan ini, penelitian mengembangkan sistem pendukung keputusan yang terintegrasi dengan *Rest API* dan metode *Fuzzy Technique for Order Preference by Similarity to Ideal Solution (TOPSIS).* Sistem ini bertujuan untuk meningkatkan efisiensi dan akurasi seleksi kandidat dengan mengevaluasi kriteria seperti wawancara, pengetahuan, pengujian, *curriculum vitae (CV),* waktu proses, dan gaji. Dua studi kasus dilakukan yang melibatkan 36 pelamar untuk proyek upgrade situs web dan 24 pelamar untuk sistem transit barang *outsourcing*. Hasil penelitian menunjukkan bahwa sistem pendukung keputusan yang terintegrasi dengan Fuzzy TOPSIS secara signifikan meningkatkan proses seleksi, dengan peningkatan akurasi sebesar 91% untuk proyek upgrade situs web dan 97% untuk sistem transit barang, jika dibandingkan dengan kriteria keputusan sumber daya manusia (HRD) tradisional. Hal ini membuktikan efektivitas sistem dalam menyelaraskan dengan standar HRD, menjadikan proses rekrutmen lebih efektif, akurat dan efisien. Penelitian mendatang sebaiknya mengeksplorasi metode untuk menyempurnakan pembobotan kriteria dan mengintegrasikan pendapat ahli atau algoritma pembelajaran mesin yang lebih canggih untuk mendukung sistem pendukung keputusan yang lebih objektif dalam rekrutmen karyawan *outsourcing.*

Kata Kunci*: outsourcing, Rest API, sistem pendukung keputusan. TOPSIS.*

INTRODUCTION

In the era towards modern digitalization today, advances in technology, information and communication have not been obtained a significant increase in utilization in various fields of human life. One form of utilizing technology and information is not optimal data analysis, decision modelling and future design directions made through decision support systems [1]. This encourages logistics and freight transportation companies such as PT. Dinamika Muda Mandiri to build a decision support system for recruiting outsourced employees.

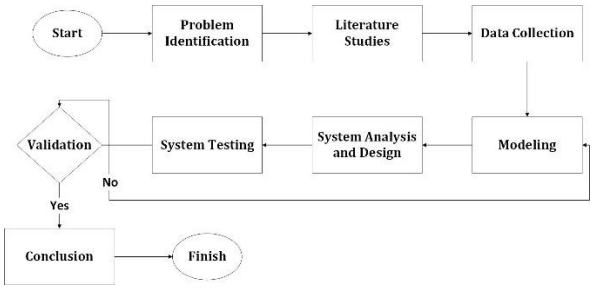
The problem that exists in this company lies in the way to recruit outsourced employees who still use registration forms in the form of writing and information about outsourcing [2] vacancies needed by the company is still unclear so that the recruitment process becomes inaccurate and less efficient. The outsourcing [3] job vacancies that the company needs today are about website upgrading projects and also freight transit systems [4]. Overcoming problems in the company by reviewing research that has been carried out previously, it is considered important and necessary to build a decision support system [5] for recruiting new employees and a website information platform that contains information about outsourcing job vacancies at PT. Dinamika Muda Mandiri become more maximal. Therefore, it was the idea to build an integrated website information platform system that uses the Rest API [6][7] so that it can be used by various types of programming languages and also multiplatform so that the website becomes more efficient after deployment. This system was created in order to help the decision-making process and implement an outsourced employee recruitment form on the website's information platform.

The method used [8][9] in outsourced employee recruitment decisions is the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) [10][11][12][13]. This is because Fuzzy TOPSIS [14][15] can carry out selected solutions [16]. The optimal option is not only to have the shortest distance to the positive ideal breakdown, but also to have the farthest distance to the negative ideal breakdown [17]. Then it is supported by the implementation of the REST API [18] to store data on prospective outsourcing employees on the website information platform [19]. Another research [20] was conducted to obtain decision-making for poor student beneficiaries using the simple addive weigtihing method by creating a system using Microsoft Visual Basic.Net 2010.

The purpose of this study is to overcome the gap from previous research by building an outsourcing employee recruitment decision support system that is integrated with the outsourcing employee recruitment information platform. The REST API method is used to obtain alternative data from prospective employees and the application of the Fuzzy TOPSIS method in the decision-making process. This research is expected to provide solutions in increasing effectiveness, efficiency and accuracy in the recruitment process as well as increasing system interoperability and scalability.

MATERIALS AND METHODS

The flow of this research covering problem identification, literary studies, data collection, modelling, system analysis and design, system testing, validation and conclusions of images can be seen below [21].



Source: (Research Result, 2024)

Figure 1. Research Stages

Problem Identification

Identify the problem by analyzing the problem. The problem begins with analysis, namely the absence of a form in the form of a website to store data on prospective outsourced employees who are interested in applying at PT. And it is also difficult to make outsourced employee on boarding decisions that meet the standards of the company's criteria. Then the outsourcing job vacancies that exist in the company today are the need regarding upgrading the company profile website of PT.

Literature Studies

Literature studies related to learning and understanding the theory used. Some of the theories explored include supporting aspects of the use of decision support systems, the TOPSIS fuzzy approach, and employee recruitment theory [22]. Then there are still many things to learn at this stage, such as:

1. Creation of a good website information platform using the React JS framework.

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2. Decision support system creation with laravel 8 framework.
3. How to integrate the information platform with the decision support system through the use of REST API.
4. Steps to perform fuzzy TOPSIS calculations manually.

Data Collection

Next is data collection which is carried out through direct interviews with connected parties of PT Dinamika Muda Mandiri, namely:

1. The data obtained from HRD is in the form of assessment criteria for prospective outsourced employees.
2. Data on prospective outsourced employees from website information platforms that have passed the selection, namely data experience of more than one year, will be used as alternative data in the decision support system.
3. Data on the results of interviews of prospective outsourced employees with HRD so that they can obtain criteria data in the form of values that will be processed by the decision support system. Alternative data is obtained from the outsourced employee recruitment website information platform and then integrated into the outsourced employee recruitment decision support system, while the criteria data is obtained from the assessment carried out by HRD.

Here are the data collection steps using the Fuzzy TOPSIS method [23]:

1. Create a normalized decision matrix.

The Fuzzy TOPSIS method requires obtaining performance ratings for each alternative (Ai) on each normalized criterion (Ci).

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij^2}}} \quad (1)$$

Description:
r_{ij} = normalized decision matrix
x_{ij} = weight of criteria to j on alternative to i
i = alternative i
j = criterion j

2. Calculating a weighted normalized decision matrix.

$$\begin{bmatrix} r_{11}w_1 & r_{12}w_2 & r_{ij}w_j \\ r_{21}w_1 & r_{22}w_2 & r_{ij}w_j \\ r_{31}w_1 & r_{32}w_2 & r_{ij}w_j \end{bmatrix} = \begin{bmatrix} y_{11} & y_{12} & y_{ij} \\ y_{21} & y_{22} & y_{ij} \\ y_{31} & y_{32} & y_{ij} \end{bmatrix} \quad (2)$$

Description:
w_j = weight of criterion j
y_{ij} = elementsof a weighted normalized
r_{ij} = normalized matrix

3. To determine the positive ideal solution matrix and the negative ideal solution matrix.

$$A^+ = (y_1^+, y_2^+, y_n^+) \quad A^- = (y_1^-, y_2^-, y_n^-) \quad (3)$$

Description:
y^+ = max y_{ij}, if j is an attribute of profit
min y_{ij}, if j is the cost attribute
y^- = min y_{ij}, if j is an attribute of profit
max y_{ij}, if j is the cost attribute

4. Calculating the distance between the values of each alternative and the positive ideal solution matrix (D^+) and the negative ideal solution matrix (D^-) involves the following steps:

$$D_i^+ = \sqrt{\sum_{j=1}^{m} (y_i^+ - y_{ij})^2}$$
$$D_i^- = \sqrt{\sum_{j=1}^{m} (y_{ij} - y_i^-)^2} \quad (4)$$

Description:
D_i^+ is an element of the matrix of positive ideal solutions
D_i^- is an element of the matrix of the ideal solution negative

5. Specifies a preference value for each alternative. The value of preference is the proximity of an alternative to the ideal solution.

$$V_i = \frac{D_i-}{(D_i-)+(D_i+)} \quad (5)$$

Description:
Value of V_i the larger ones indicate alternative priorities.

Modelling

In the process of recruiting outsourced employees for the case research of PT Dinamaika Muda Mandiri, there are sequences, namely:

1. Determine the variety of manpower to be offered by the company. The types of labor offered include upgrading the company's company profile website and goods transit system.
2. Setting standards for the variety of labor. The standard is divided into 6 criteria.

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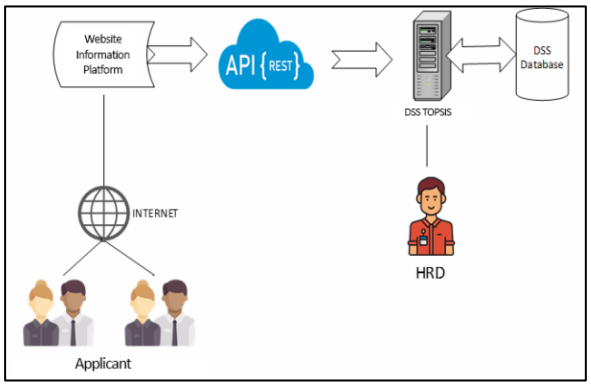
Determining the criterion weight of each alternative i.e. [5, 5, 5, 3, 4]. This weight is the burden given to each standard to prove the level of importance presented into the value. Each criterion can have similar or different weight values. The higher the value of the weight shared the greater the impact in the calculation.

System Analysis and Design

The analysis and design of the system covers various important aspects necessary to develop a decision support system tailored to the recruitment of outsourced employees. This system aims to improve the effectiveness, efficiency and objectivity of candidate selection by assisting the HR team. The integration of the Fuzzy TOPSIS method with the REST API ensures secure and efficient data communication. The analysis and design of the system also incorporates the system architecture, which describes the relationship between the components and the flow of data from the enrolment platform to the HR evaluation process. In addition, a use-case system diagram clarifies the interaction between actors (such as applicants and HR) and key system functions. This diagram helps in understanding the role of each actor and their interactions in the system.

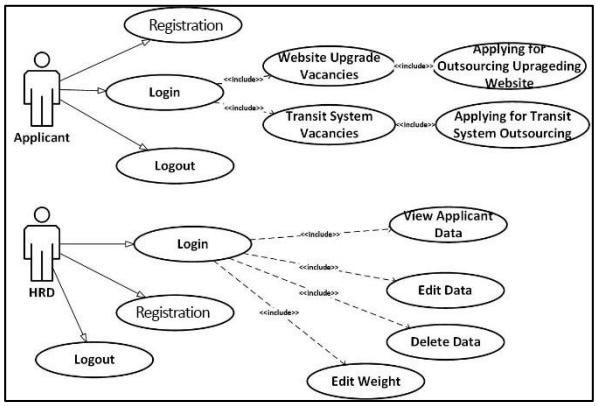
1. System Architecture



Source: (Research Result, 2024)
Figure 2. System Architecture

Based on Figure 2 describes how these information systems and platforms run and are integrated. This outsourced employee recruitment decision support system can be accessed by HRD by entering usernames and passwords into the system.
The website information platform serves to obtain data on prospective outsourced employees who will be at PT Dinamika Muda Mandiri. Rest API technology is used to integrate existing data on the website information platform in the form of JSON into alternative data in the decision support system. This system will produce output in the form of a list of prospective outsourced employees in the form of rankings using the Fuzzy TOPSIS method from the first to the last ranking. HRD only needs to select outsourced employees based on these rankings as a result of the decision.
This outsourced employee recruitment decision support system can be accessed by HRD by entering usernames and passwords into the system. Meanwhile, the website information platform functions to obtain data on prospective outsourced employees who will be at PT Dinamika Muda Mandiri. Rest API technology is used to integrate existing data on the website information platform in the form of JSON into alternative data in the decision support system. This system will produce output in the form of a list of prospective outsourced employees in the form of rankings using the Fuzzy TOPSIS method from the first to the last ranking. HRD only needs to select outsourced employees based on these rankings as a result of the decision.

2. Use Case System Diagram



Source: (Research Result, 2024)
Figure 3. Use Case System Diagram

Based on Figure 3 shows a diagram of the use case of each actor, namely: prospective outsourced employees and SPK admins. Actors of prospective outsourced employees can register for registration on the website's information platform. SPK admin actors can make setting criteria weights such as viewing and editing weight data as well as interview result data such as viewing, deleting, and changing data.

System Testing

1. Black box testing on the website information platform, especially in the process of checking the experience of applicants through the REST API. Based on testing in that way, the platform can run as expected.

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2. Black box testing on the decision support system of the outsourced employee selection method using Fuzzy TOPSIS, has been tested several times on the system. As a result, the system runs smoothly with no bugs or errors.

Validation

Related to the experiment that is carried out in the form of comparing the results of the ranking itself with the results of the ranking processed through the system so that the alternative data that is the result of the ranking of the Fuzzy TOPSIS method can be verified as correct. However, if at the time of validation the final result is not appropriate, it will return to the third stage, namely modelling and the author can correct the process that has been carried out so that it can obtain conformity in the final result.

Conclusion

How to inference the results of research that has been carried out. In this stage, there is an output in the form of the final results of the ranking so that it can be used as a reference for recruiting new outsourced employees. At the conclusion stage, all stages that have been carried out before can be tested for validity so that the results of the rankings obtained are really in accordance with the research that has been carried out.

RESULTS AND DISCUSSION

After taking steps in the method, benchmark data is obtained along with the choice of acceptance of prospective outsourced employees of PT Dina Mika Muda Mandiri. The data is obtained from other website information platform APIs, then integrated into the decision support system. Processing uses the TOPSIS method to generate weights from each benchmark, this method helps the existence of indicators of alternative criteria and variables as helpers to determine decisions. Furthermore, it is solved using the fuzzy method to determine the ranking of prospective outsourced employees. HRD can simplify its work, by logging in and inputting outsourced employee assessments, so that companies can obtain qualified and competent human resources in their fields of expertise. The implementation of the decision support system with the integrated REST API method and the Fuzzy TOPSIS approach offered significant advantages for PT Dina Mika Muda Mandiri in streamlining their outsourced employee recruitment process. The TOPSIS method provided a comprehensive evaluation of candidates, while the integration with the REST API facilitated data retrieval. There is a limitation in the implementation of TOPSIS is subjectivity in assigning weight to criteria. Overall, this system is a valuable contribution to improving recruitment decision making in the context of outsourcing for PT Dina Mika Muda Mandiri.

1. JSON Platform Information Website Selection

The initial selection process for checking the applicant's experience is carried out with the Web service Rest API. The decision support system will retrieve the data of applicants passed from the selection of the website information platform. The image is the contents of the JSON file on the applicant's Rest API which contains the results of checking applicant data and a minimum experience of more than 1 to register to become a prospective outsourced employee.

Source: (Research Result, 2024)

Figure 4. JSON selection results

The code in Figure 4 can be seen below:

```
public function create(request $request)
    {
        $img_path = "";
        if ($request->img_path != null) {
            $file = $request->file('img_path');
            $fileName = time() . md5(time()) . '.' . $file-
>getClientOriginalExtension();
            $file->move(public_path()                    .
'/uploads/image_path/', $fileName);
```

```
        $img_path = '/uploads/image_path/' . $fileName;
    }
    $page1 = new Page1 ;
    $page1->name = $request->input('name');
    $page1->email = $request->input('email');
    $page1->pendidikan = $request->input('pendidikan');
    $page1->experience = $request->input('experience');
    $page1->img_path=$img_path;

    if ($page1->experience >= 2) {
      $status = 'lulus';
      $data_kriteria = [
        'name' => $request->input('name'),
        'pendidikan' => $request->input('pendidikan'),
        'wawancara' => $request->input('wawancara'),
        'pengetahuan' => $request->input('pengetahuan'),
        'testing' => $request->input('testing'),
        'cv' => $request->input('cv'),
        'waktu_pengerjaan' => $request->input('waktu_pengerjaan'),
        'gaji' => $request->input('gaji'),
        'img_path' => $img_path
      ];

      $kriteria = Kriteria::create($data_kriteria);
    }else{
      $status = 'tidak lulus';
    }
    $page1->status = $status;
    $page1->save();

    $response = [
      'success' => true,
      'message' => 'you have regist',
      'data' => $page1
    ];
    return Response($response);
  }
```

2. Identify Criteria
   a. Interview: In the form of the value of the results of the interview conducted.
   b. Knowledge: In the form of an insight assessment of the outsourcing work needed by the company.
   c. Testing: In the form of the value of the applicant's skill testing results.
   d. CV: Assessment of applicants' CV by HRD.
   e. Processing Time: How long the project has been approved.
   f. Salary: In the form of a project work salary that has been determined by the applicant.

3. Implementation of the TOPSIS Fuzzy Method
   a. The first step in carrying out the Fuzzy TOPSIS method is to determine the decision matrix in the data collection table according to the predetermined Fuzzy weighting value.
   b. Furthermore, the normalization process of the decision matrix in the data collection table is carried out.

Outsourced upgrade website:

$X_1 = \sqrt{537} = 23, 17326$

$R_{11} = \frac{2}{23,17326} = 0, 08631$

$R_{12} = \frac{4}{23,17326} = 0, 17261$

$R_{13} = \frac{4}{23,17326} = 0, 17261$

Until the 36th iteration

Applicants outsource goods transit system:

$X_1 = \sqrt{438} = 20, 92845$

$R_{11} = \frac{5}{20,92845} = 0, 23891$

$R_{12} = \frac{2}{20,92845} = 0, 09556$

$R_{13} = \frac{4}{20,92845} = 0, 19113$

Until the 24th iteration

   c. Dividing the weight of each standard value by the preference weight of each criterion: W = (5, 5, 5, 5, 3, 4).

Applicants outsource upgrading websites:

$y_{11} = 5 \times 0.08631 = 0, 43153$

$y_{12} = 5 \times 0, 17261 = 0, 86306$

$y_{13} = 5 \times 0, 17261 = 0, 86306$

Applicants outsource goods transit system:

$y_{11} = 5 \times 0, 23891 = 1, 19455$

$y_{12} = 5 \times 0, 09556 = 0, 47782$

$y_{13} = 5 \times 0, 19113 = 0, 95564$

   d. Establish the ideal solution of each of them. Whether it's a positive ideal solution or a negative ideal solution. Here are the results of each ideal solution.

Table 1. The Ideal Solution to Positive and Negative Applicants Upgrading Websites

	C1	C2	C3	C4	C5	C6
Positive	1.07882	1.14950	1.17201	1.07983	0.36028	0.42111
Negative	0.43153	0.22990	0.23440	0.43193	0.60048	0.70186

Source: (Research Result, 2024)

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Table 2. Ideal Solution for Positive and Negative Freight Transit System Applicants

	C1	C2	C3	C4	C5	C6
Posit	1.19	1.45	1.44	1.24	0.42	0.61
ive	455	309	097	379	954	237
Nega	0.47	0.29	0.28	0.49	0.71	1.02
tive	781	061	819	751	591	062

Source: (Research Result, 2024)

Table 1 and 2 are the result of positive and negative ideal solutions on the criteria of each alternative. The way to determine it is to classify the attributes of each criterion, if the attributes are beneficial then the ideal positive solution is the highest value of the alternative and vice versa. Then if the attribute is cost then the ideal solution is positive, namely the lowest value of the alternative and vice versa.

e. Determine the range between the choice of Ai and the positive ideal solution and determine the distance between the alternative Ai and the negative ideal solution. So that the distance between the weighted value of each alternative to the positive ideal solution and the negative ideal solution is obtained as follows:

Calculating the Ideal Breaking Distance for Positive Applicants Upgrading Websites.

$$D_1^+ \sqrt{(1.07882 - 0.43153)^2 + (1.14950 - 0.91960)^2 + (1.17201 - 0.46881)^2 + (1.07983 - 0.86387)^2 + (0.36028 - 0.60048)^2 + (0.42111 - 0.73030)^2}$$

Calculating the distance of the ideal solution for negative applicants upgrading websites

$$D_1^- \sqrt{(0.43153 - 0.43153)^2 + (0.91960 - 0.22990)^2 + (0.46881 - 0.23440)^2 + (0.86387 - 0.43193)^2 + (0.60048 - 0.60048)^2 + (0.73030 - 0.70186)^2}$$

Calculating the distance of the ideal solution of positive goods transit system applicants

$$D_1^+ \sqrt{(1.19455 - 1.19455)^2 + (1.45309 - 0.29062)^2 + (1.44097 - 0.57639)^2 + (1.24379 - 1.24380)^2 + (0.42954 - 0.57273)^2 + (0.61237 - 0.81650)^2}$$

Calculating the distance of the ideal solution negative applicants transit system goods

$$D_1^- \sqrt{(1.19455 - 0.47781)^2 + (0.29062 - 0.29061)^2 + (0.57639 - 0.28819)^2 + (1.24380 - 0.49751)^2 + (0.57273 - 0.71591)^2 + (0.81650 - 1.02062)^2}$$

f. The final stage sets the preference value of each alternative. In this section the best alternative is the alternative alongside the highest preference value.

Outsource upgrading websites

$V_1 = \frac{0.84688}{0.84688 + 1.07215} = 0.44131$

$V_2 = \frac{0.63790}{0.63790 + 1.36092} = 0.31914$

$V_3 = \frac{1.14712}{1.14712 + 0.64221} = 0.64109$

Applicants outsourcing goods transit system

$V_1 = \frac{1.10266}{1.10266 + 1.47004} = 0.42860$

$V_2 = \frac{1.14763}{1.14763 + 1.47504} = 0.43758$

$V_3 = \frac{0.97752}{0.97752 + 1.18193} = 0.45267$

g. Results of Alternative Ranking of outsourced Employees:
Upgrading Website Rank 1: Mohamad Iqbal with a preference value on the program of 0.74729 and a preference value in the HRD calculation of 0.81251. So the accuracy of the system with the calculation of HRD:

$X = \frac{0,74729}{0,81251} = 0,91 \times 100\% = 91\%$

Transit System Rank 1: Alwi Aulia with a preference value on the program of 0.88677 and a preferntion value in the HRD calculation of 0.86418.

$X = \frac{0,86418}{0,88677} = 0,97 \times 100\% = 97\%$

The test was carried out by applying the Fuzzy TOPSIS method to alternative data of prospective employees that had been integrated through the Rest API. Once the preference value of each alternative is calculated based on the established criteria (such as experience, interview, CV, etc.), the results are validated by comparing the rating generated by the system with the traditional calculations commonly used by HRD. For example, in the case of website development, Mohamad Iqbal received the highest ranking with a preference value of 0.74729, which was measured again using HRD calculations of 0.81251. The validity of the system is evaluated by calculating the percentage of match between the system preference value and the value calculated by HRD, which in this case reaches 91%. A similar validation process was carried out for the goods transit system, where Alwi Aulia received the highest rating with a preference value of 0.88677 and HRD validation of 0.86418, with a match percentage of 97%.

CONCLUSION

This study confirms that integrating Rest API technology and the application of the Fuzzy TOPSIS method in the employee recruitment outsourcing decision support system is effective in optimizing the selection process based on the predetermined minimum experience criteria. The consistency of the final selection results with the traditional calculations used by HRD shows the reliability of this system in facilitating an effective, efficient and accurate decision-making process. In particular, the use of the Fuzzy TOPSIS method successfully identified Mohammad Iqbal as a top candidate for a website improvement project, illustrating his ability to handle the complexity of decision-making in the recruitment process. However, the study also identifies some noteworthy limitations, such as potential biases in the weighting of criteria that can affect the objectivity of results, and challenges in integrating diverse data sources through REST APIs. To overcome these limitations, future measures should consider the scalability and complexity of data in more depth and integrate the application of more advanced machine learning algorithms to improve the objectivity and reliability of decision-making in outsourcing employee recruitment.

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