



Hybrid Logarithmic Percentage Change-Driven Objective Weighting and Grey Relational Analysis Method in Employee Contract Renewal

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Abstract—Contract employees are individuals who are hired for a specific period of time within a company or organization for a specific purpose. They usually do not have permanent employee status and are bound by work contracts that govern their tenure, salary, and other obligations. Despite not having long-term job security, contract employees often bring specialized skills or experience needed for specific projects. They are often instrumental in handling temporary projects, fulfilling temporary company needs, or filling temporary vacancies. One of the main problems in determining employee contract renewal is the lack of transparency and clear communication from the company. Employees often feel confused or uncertain about the criteria used by management in determining whether or not their contract will be renewed. Lack of clear information can cause anxiety and uncertainty among employees, and impair their performance and motivation. Hybrid Logarithmic Percentage Change-Driven Objective Weighting and Grey Relational Analysis (HLOPCOW-GRA) is an approach that combines two analysis methods, namely LOPCOW and GRA to improve accuracy and reliability in decision making. HLOPCOW-GRA provides an advantage in combining LOPCOW's advantage in handling dynamic data fluctuations with GRA's advantage in analyzing relative relationships between criteria, this approach allows decision makers to gain a deeper understanding of the factors that affect the final outcome. The results of alternative ranking showed that the first place with a GRA final value of 0.1406 was obtained by EM alternatives, second place with a GRA final value of 0.1366 was obtained by SVR alternatives, third place with a GRA final value of 0.1366 was obtained by SVR alternatives, third place with a GRA final value of 0.1406 was obtained by EM alternatives. The final GRA value of 0.1245 obtained alternative ASR.

Keywords: Determining; HLOPCOW-GRA; Hybrid; Grey Relational Analysis; Logarithmic Percentage Change-Driven Objective Weighting

1. INTRODUCTION

Contract employees are individuals who are hired for a specific period of time within a company or organisation for a specific purpose. They usually do not have permanent employee status and are bound by labour contracts that govern their tenure, salary, and other obligations. Despite not having long-term job security, contract employees often bring specialised skills or experience needed for specific projects. They are often instrumental in handling temporary projects, fulfilling temporary company needs, or filling temporary vacancies. While contract employees often do not get the same benefits as permanent employees, such as welfare or long-term job security, they are still a valuable asset to companies with the work flexibility they offer (Cappelli & Eldor, 2023). For contract employees themselves, they can expand their professional network, gain new experiences, and develop relevant skills in various work environments. Despite their challenges, contract employees often demonstrate high levels of commitment and dedication to their work, prompting companies to reconsider their employment contract models and expand opportunities for more inclusive career development. Employee contract renewal is the process by which a company decides to extend the tenure of a contract employee after the initial contract expires (Lim & Mali, 2023). The decision to extend a contract can be influenced by various factors, including the employee's performance during the initial contract period, the company's need for the employee's skills or experience, and ongoing projects or work. For employees, an extension provides an opportunity to continue doing the work they love and continue to develop their career with the company. The process of extending an employment contract usually involves evaluating an employee's performance, negotiating salary or benefits, and adjusting to job requirements or responsibilities that may change over time. One of the main problems in determining employee contract renewal is the lack of transparency and clear communication from the company. Employees often feel confused or uncertain about the criteria used by management in determining whether or not their contract will be renewed. Lack of clear information can cause anxiety and uncertainty among employees, and impair their performance and motivation. In addition, bias or discrimination in the contract extension determination process can also be a serious problem. There is a risk that the decision to extend a contract is influenced more by non-performance factors, such as personal preference or prejudice, rather than an objective assessment of the employee's performance and contribution. This can create unfairness in the workplace and undermine employee confidence in a fair evaluation system.

Research related to the extension of employee contracts using decision support systems, among others the decision support system uses the ORESTE method and aims to simplify and speed up all calculations regarding the



extension of employee employment contracts(Cholil, 2021). SMART method to determine contract extension employees based on predetermined criteria by the company, the contract employee extension system is implemented to facilitate contract employee extension decisions(Ignatius Joko Dewanto et al., 2023). SAW method can have a positive impact because it has a strong basis, namely the decision obtained based on employee performance with the results of the decision obtained if the employee's score is more than 0.7 the employee's employment contract will be extended, if less than 0.7 the employee's employment contract will be terminated(Rahmawati & Rachman, 2023). Decision Support System using the Elimination and Choice Translation Reality (ELECTRE) method so that the system is used for the fairness factor for employees in selecting employees who will be terminated contracts and employees who are extended contracts(Husaini et al., 2021). The application of the Gray Relational Analysis (GRA) Method in employee performance appraisal is a recommendation for companies in determining employee incentives using a decision support system model(Hafiz, 2024). Based on previous research that has been carried out using the ORESTE, SMART, SAW, GRA, and ELECTRE methods, it becomes a separate reference for the research to be carried out, in this research by applying the grey relational analysis method.

The Grey Relational Analysis (GRA) method is an approach used to evaluate the relative relationships between two or more uncertain or incomplete data sets(Esangbedo et al., 2022; Gerus-Gościewska & Gościewski, 2022; Mausam et al., 2023). GRA combines the concept of grey relations with statistical analysis to identify and analysis relationships between input and output variables. In GRA, data is converted into grey degrees to consider the uncertainty or vagueness of the information. Through the calculation of the grey relation, GRA enables the relative assessment of the contribution of each variable to the final outcome, thus enabling more informed and effective decision-making. GRA can be used to identify the most influential factors in a system or process, as well as to design improvement or optimization strategies. By considering aspects of uncertainty and vagueness in data, GRA provides useful flexibility in dealing with situations where data is incomplete or imperfect. In addition, the method is relatively easy to implement and can provide valuable insights for decision-makers in complex or ambiguous situations(Marode et al., 2024; Sintaro, 2023). Therefore, GRA remains a popular and relevant analytical tool in various research contexts and practical applications. The GRA method in determining criteria weights is often one of the sensitive points, one of the weaknesses of GRA is that this method does not provide direct guidance for determining criteria weights. Therefore, GRA studies often require additional steps to subjectively determine criteria weights or use other approaches to assign criteria weights. Such approaches allow decision makers to assign relative importance to each criterion, which can then be used as the basis for GRA analysis. To solve the problem of criteria weights in GRA, the Logarithmic Percentage Change-Driven Objective Weighting method is used.

Logarithmic Percentage Change-Driven Objective Weighting (LOPCOW) is a criterion weighting method in decision support systems that aims to address uncertainty and dynamics in data(Dua et al., 2024; YILMAZ, 2023). The method takes an approach based on the logarithmic percentage change of the corresponding criterion values over time. By using logarithms, LOPCOW balances the impact of significant changes in criteria that have relatively low or high values. This approach allows for the identification of criteria that have a consistent and significant influence on the final outcome, as well as accounting for possible dynamics in the environment or conditions being analysis(Ecer & Pamucar, 2022). LOPCOW provides a robust and adaptive method for determining appropriate criteria weights in complex or changing contexts. By accounting for logarithmic percentage changes of criteria values over time, LOPCOW can provide more stable weights to criteria that may experience large fluctuations in their value ranges(Pamucar & Biswas, 2023). This allows decision makers to more effectively identify criteria that have a significant contribution to the ultimate goal or desired outcome. In addition, the use of a logarithmic approach allows LOPCOW to capture non-linear relationships between criteria, which are often missed by other criteria weighting methods(Setiawansyah & Sulistiyawati, 2024). However, the use of LPCOW also requires a good understanding of the data used and careful interpretation of the results, given the special characteristics of the logarithmic approach. LOPCOW offers an innovative and effective approach in determining criteria weights in decision support systems, especially in contexts involving dynamic and uncertain data.

Hybrid Logarithmic Percentage Change-Driven Objective Weighting and Grey Relational Analysis (HLOPCOW-GRA) is an approach that combines two analysis methods, namely LOPCOW and GRA, to improve accuracy and reliability in decision making. In HOLPCOW-GRA, LOPCOW is used to determine the relative weights of various criteria by considering the logarithmic percentage change of the criteria values over time. Once the weight of the criteria is established, the GRA is then applied to analyze the relative relationship between the criteria and assess the performance of alternatives based on the grayness of the GRA results. By combining these two methods, HLOPCOW-GRA overcomes the weaknesses of each method separately, such as uncertainty in determining the weight of criteria and sensitivity to parameter selection in the GRA. This approach provides a more solid and holistic foundation in decision making, especially in situations where dynamic data and information complexity require more in-depth and structured analysis. HLOPCOW-GRA provides an advantage in uniting LOPCOW's advantages in handling dynamic data fluctuations with GRA's advantages in analyzing relative relationships between criteria. Thus, this approach allows decision makers to gain a deeper understanding of the factors that influence the final outcome, while considering the dynamics and uncertainties in the analyzed environment. One of the key advantages of using Hybrid LOPCOW and GRA is the combination of approaches that provide a comprehensive, data-driven framework for evaluating employee performance. By combining LOPCOW, which enables holistic performance measurement by considering logarithmic percentage changes of various indicators, and GRA, which allows analysis of the relative relationship between



employees and established evaluation criteria, organizations can gain deeper and measurable insights into individual contributions to organizational goals. This hybrid approach allows for more objective and informed decision making in terms of employee contract renewals, assisting organizations in retaining valuable talent and improving the overall performance of the company on an ongoing basis.

2. RESEARCH METHODS

2.1 Research Problem Analysis

Research problem analysis is a critical stage in the research process where the process of identifying, analyzing, and formulating problems will be the focus of research (Setiawansyah et al., 2023). These steps involve a deep understanding of the context and background of the problem, formulating relevant research questions, identifying key variables, and considering the potential implications of the research. Analysis of research problems helps ensure that the research conducted has a clear direction, is relevant, and can make a significant contribution to the understanding and solution of the problem under study. The results of the analysis of the research problem conducted obtained criteria in the extension of the employee's employment contract as in table 1.

Table 1. Criteria Data

Criteria Name
Employee Performance
Qualification
Competence
Presence
Responsibility

Table 1 criteria data is the result of research problem analysis by conducting interviews with the company in determining the criteria used for determining the extension of employee employment contracts.

In the process of assessing alternative employee employment contract renewals, the collected data becomes the key to effective decision making. The data includes employee performance evaluations, attendance records, competencies, and contributions made to the team or project. Through careful and evidence-based data analysis, companies can identify employees who have strong performance and the potential to contribute significantly in the future. In addition, data also allows management to gain deeper insights into employee development needs and provides a clear basis for making decisions regarding the renewal of employment contracts, taking into account the needs of the company as well as individual expectations of employees. Thus, the use of assessment data is key in ensuring objective, fair, and oriented decisions on the long-term success of the company and employees. Data on the assessment of alternative renewals of the employee's employment contract are shown in table 2.

Table 2. Assessment Data

Alternative Name	Employee Performance	Qualification	Competence	Presence	Responsibility
ASR	85	88	90	100	95
GHY	80	86	93	97	98
BS	84	89	89	95	100
EM	87	90	90	100	94
SVR	88	87	89	98	96
AYP	82	84	86	96	100
GSD	86	88	88	95	97
YP	88	83	90	100	95

Table 2 assessment data is the result of research problem analysis by conducting interviews with the company in the assessment of employees to be used to determine the extension of employee employment contracts.

2.2 Research Framework

A research framework is a structure or plan used to compile and organize the main elements of a study. It includes concepts, theories, variables, relationships between variables, as well as methodologies to be used in research. Research frameworks help to plan and direct studies in a clear and structured manner, making it easier to collect data, analyze information, and compile research results (Sulistiani et al., 2023). The research framework also helps ensure that the research is relevant, cohesive, and understandable to the target reader. This research framework forms a clear guide for conducting research, ensuring that all relevant aspects are well considered and integrated. The framework of the research carried out as in Figure 1.

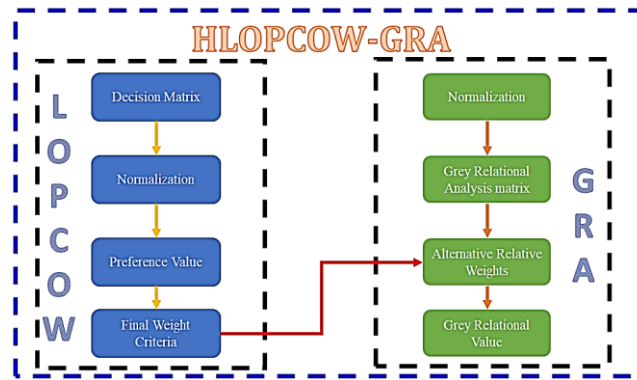


Figure 1. Research Framework Hybrid Logarithmic Percentage Change-Driven Objective Weighting and Grey Relational Analysis Method

The research framework is formed in figure 1, the next step is to carry out each stage in a structured manner according to the plan that has been prepared. It involves the thorough implementation of problem identification, collection of relevant and accurate data, in-depth analysis of the information obtained, selection of appropriate methods or strategies of resolution, careful implementation of solutions, and evaluation of the results. Thus, this conceptual framework provides clear direction in addressing the problem at hand, as well as ensuring effectiveness and efficiency in the problem-solving process.

2.3 Logarithmic Percentage Change-Driven Objective Weighting

The LOPCOW (Logarithmic Percentage Change-Driven Objective Weighting) method is a method used in multi-criteria decision making. This method is based on a logarithmic percentage change of the measured objective attribute value against an existing alternative. In the context of research or decision making, the LOPCOW method helps in determining the relative weight of each criterion by taking into account the logarithmic percentage change of each criterion against the existing preferences. The LOPCOW method can be used to overcome the problem of assessing different criteria in situations where the scale of values or preferences is not linear. The first stage in the LOPCOW method is to create a decision matrix, the decision matrix is made with the following equation.

$$X = \begin{bmatrix} x_{11} & x_{21} & x_{2n} \\ x_{12} & x_{22} & x_{2n} \\ x_{m1} & x_{m2} & x_{mn} \end{bmatrix} \quad (1)$$

The decision matrix is made in the form of rows and columns. Each row in the decision matrix represents an existing alternative, while the column represents the criteria used.

The second stage in the LOPCOW method is to calculate the normalization of the matrix using the following equation.

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

The normalization matrix is calculated for each alternative based on all existing criteria, the symbol m represents the number of criteria for each existing alternative, while x_{ij} is the value of the decision matrix.

The third stage in the LOPCOW method is to calculate the preference value using the following equation.

$$PV_{ij} = 100 * \left| \frac{\sqrt{\sum_{i=1}^m n_{ij}^2}}{\ln \frac{m}{\sigma}} \right| \quad (3)$$

The preference value is symbolized by PV_{ij} , while n_{ij} is the value of matrix normalization.

The final stage in the LOPCOW method is to calculate the final weight of each criterion using the following equation.

$$w_j = \frac{PV_{ij}}{\sum_{j=1}^n PV_{ij}} \quad (4)$$

The final weight value is symbolized by W_j . The LOPCOW method has the advantage of overcoming the problem of complexity in decision making by integrating various criteria and taking into account logarithmic percentage changes.

2.3 Grey Relational Analysis

Grey Relational Analysis (GRA) is a method used to analyze relationships between multiple factors or variables. This method is especially useful when dealing with complex systems where traditional statistical methods may not be applicable due to insufficient data or the presence of ambiguities. The first stage in GRA normalizes the matrix using the following equation.



$$X_{ij} = \frac{x_{ij} - x_{min}}{x_{max} - x_{min}} \tag{5}$$

The second stage calculates the value of the alternate relative weight using the following equation.

$$V_{ij} = x_{ij} * w_j \tag{6}$$

The last stage calculates the value of the gray relational coefficient between each pair of variables, the gray relational coefficient measures the degree of similarity or correlation between variables using the following equation.

$$GRG_i = \frac{1}{n} \sum_{j=1}^n V_{ij} \tag{7}$$

One of the main advantages of GRA is its ability to cope with uncertainty and complexity in systems analysis. GRA does not depend on any particular assumptions about data distribution, so it can be used even when the data does not meet traditional statistical assumptions.

3. RESULTS AND DISCUSSION

The application of the LOPCOW method which is a method of determining objective weighting based on logarithmic percentage changes, together with GRA in the process of extending employee employment contracts can provide a comprehensive and structured approach. In LOPCOW, objective weights are given based on logarithmic percentage changes of various employee evaluation criteria, such as performance, attendance, and contribution to the team. Furthermore, GRA is used to analyze gray relationships between employees based on these criteria, allowing identification of relationships and relative comparisons between employees. The integration of these two methods allows companies to combine quantitative and qualitative aspects in employee evaluation, as well as evaluate relationships between complex variables to take more informational and objective contract renewal decisions. With this approach, management can ensure that decisions made are supported by strong data and in-depth analysis, thereby increasing efficiency and fairness in the management of the company's human resources, and companies can improve their human resource management processes and create a more productive and high-performance work environment.

3.1 Implementation of the LOPCOW Method for the Determination of Criterion Weights

The application of Logarithmic Percentage Change-Driven Objective Weighting (LOPCOW) in the determination of criteria weighting provides a structured and data-driven approach to employee evaluation in the context of employment contract renewal. By considering logarithmic percentage changes of each evaluation criterion, LOPCOW allows companies to give more proportional weight to criteria that undergo significant changes over time. This allows management to accommodate dynamics in employee performance and contributions over time, resulting in more accurate and objective assessments. With this approach, companies can make contract renewal decisions based on robust data and in-depth analysis, and ensure that awards and recognitions are given according to the actual contribution of each employee. By using logarithmic percentage changes as a basis for determining criteria weighting, LOPCOW also allows companies to be more sensitive to small changes that may occur in employee performance. The first stage in the LOPCOW method is to create a decision matrix using (1), the results of the decision matrix are made as follows.

$$X = \begin{bmatrix} x_{11} & x_{21} & x_{31} & x_{41} & x_{51} \\ x_{12} & x_{22} & x_{32} & x_{42} & x_{52} \\ x_{13} & x_{23} & x_{33} & x_{43} & x_{53} \\ x_{14} & x_{24} & x_{34} & x_{44} & x_{54} \\ x_{15} & x_{25} & x_{35} & x_{45} & x_{55} \\ x_{16} & x_{26} & x_{36} & x_{46} & x_{56} \\ x_{17} & x_{27} & x_{37} & x_{47} & x_{57} \\ x_{18} & x_{28} & x_{38} & x_{48} & x_{58} \end{bmatrix} \quad X = \begin{bmatrix} 85 & 88 & 90 & 98 & 95 \\ 80 & 86 & 93 & 97 & 98 \\ 84 & 89 & 89 & 95 & 99 \\ 87 & 90 & 90 & 98 & 94 \\ 88 & 87 & 89 & 98 & 96 \\ 82 & 84 & 86 & 96 & 96 \\ 86 & 88 & 88 & 95 & 97 \\ 88 & 83 & 90 & 98 & 95 \end{bmatrix}$$

The second stage of the LOPCOW method is to calculate matrix normalization using (2), the results of the matrix normalization calculation are as follows.

$$n_{11} = \frac{x_{11}}{8+(x_{11}^2+x_{12}^2+x_{13}^2+x_{14}^2+x_{15}^2+x_{16}^2+x_{17}^2+x_{18}^2)}$$

$$n_{11} = \frac{85}{8+(85^2+80^2+84^2+87^2+88^2+82^2+86^2+88^2)} = \frac{85}{57866} = 0.00147$$

The overall result of the calculation for matrix normalization is as in table 3.

Table 3. Matrix Normalization

Alternative Name	Employee Performance	Qualification	Competence	Presence	Responsibility
ASR	0.00147	0.00146	0.00141	0.00130	0.00128
GHY	0.00138	0.00142	0.00145	0.00129	0.00132
BS	0.00145	0.00147	0.00139	0.00126	0.00134



Alternative Name	Employee Performance	Qualification	Competence	Presence	Responsibility
EM	0.00150	0.00149	0.00141	0.00130	0.00127
SVR	0.00152	0.00144	0.00139	0.00130	0.00129
AYP	0.00142	0.00139	0.00135	0.00128	0.00129
GSD	0.00149	0.00146	0.00138	0.00126	0.00131
YP	0.00152	0.00137	0.00141	0.00130	0.00128

The third step in the LOPCOW method is to calculate the preference value using (3), the result of the preference value is as follows.

$$PV_1 = 100 * \left| \frac{\sqrt{n_{11}^2+n_{12}^2+n_{13}^2+n_{14}^2+n_{15}^2+n_{16}^2+n_{17}^2+n_{18}^2}}{\ln \frac{8}{\sigma_{n_{11},18}}} \right|$$

$$PV_1 = 100 * \left| \frac{0.004156792}{\ln 81517,07543} \right| = 100 * \left| \frac{0.004156792}{11.30856779} \right| = 100 * 0.0003676 = 0.03676$$

The overall result of the calculation for preference value is as in table 4.

Table 4. Preference Value

Criteria	Employee Performance	Qualification	Competence	Presence	Responsibility
PV	0.03676	0.03510	0.03353	0.02922	0.02989

The last stage in the LOPCOW method is to calculate the final weight of each criterion using (4), the final weight result of the criteria as follows.

$$W_1 = \frac{PV_1}{PV_1+PV_2+PV_3+PV_4+PV_5} = \frac{0.03676}{0.03676+0.03510+0.03353+0.02922+0.02989} = \frac{0.03676}{0.16450} = 0.2235$$

$$W_2 = \frac{PV_2}{PV_1+PV_2+PV_3+PV_4+PV_5} = \frac{0.03510}{0.03676+0.03510+0.03353+0.02922+0.02989} = \frac{0.03510}{0.16450} = 0.2134$$

$$W_3 = \frac{PV_3}{PV_1+PV_2+PV_3+PV_4+PV_5} = \frac{0.03353}{0.03676+0.03510+0.03353+0.02922+0.02989} = \frac{0.03353}{0.16450} = 0.2038$$

$$W_4 = \frac{PV_4}{PV_1+PV_2+PV_3+PV_4+PV_5} = \frac{0.02922}{0.03676+0.03510+0.03353+0.02922+0.02989} = \frac{0.02922}{0.16450} = 0.1766$$

$$W_5 = \frac{PV_5}{PV_1+PV_2+PV_3+PV_4+PV_5} = \frac{0.02989}{0.03676+0.03510+0.03353+0.02922+0.02989} = \frac{0.02989}{0.16450} = 0.1817$$

The above results are the final results of each weight criterion using the LOPCOW method in determining the weights for criteria in the extension of employee employment contracts.

3.2 Implementation of the GRA Method for Determining the Renewal of an Employee Contract

The implementation of the GRA (Grey Relational Analysis) Method in determining employee contract renewal is a systematic and effective approach in evaluating individual performance and contribution to organizational goals. By analyzing various factors such as productivity, attendance, quality of work, and competence, GRA allows managers to identify the employees who are most valuable to the company. Thus, contract renewal decisions can be taken objectively and data-based, minimizing risks and maximizing profits for the company and the employees concerned. In addition, GRA can also assist in the development of more efficient and sustainable employee development strategies, thus creating a more productive and satisfying work environment for all parties involved. By applying the GRA method, companies can identify performance patterns that have the potential to improve operational efficiency and effectiveness. In addition, this method makes it possible to assess the impact of external factors that might affect employee performance, such as changes in the work environment or company policies. Thus, the implementation of the GRA method not only helps in decision-making regarding employee contract renewal, but also in planning a more holistic and sustainable human resource development strategy to achieve the company's long-term goals.

The first stage in GRA is to normalize the matrix using (5), the calculation results of the matrix normalization are as follows.

$$X_{11} = \frac{x_{12}-x_{min11,18}}{x_{max11,18}-x_{min11,18}} = \frac{85-80}{88-80} = \frac{5}{8} = 0.625$$

$$X_{12} = \frac{x_{12}-x_{min11,18}}{x_{max11,18}-x_{min11,18}} = \frac{80-80}{88-80} = \frac{0}{8} = 0$$

$$X_{13} = \frac{x_{13}-x_{min11,18}}{x_{max11,18}-x_{min11,18}} = \frac{84-80}{88-80} = \frac{4}{8} = 0.5$$

$$X_{14} = \frac{x_{14}-x_{min11,18}}{x_{max11,18}-x_{min11,18}} = \frac{87-80}{88-80} = \frac{7}{8} = 0.825$$

$$X_{15} = \frac{x_{15}-x_{min11,18}}{x_{max11,18}-x_{min11,18}} = \frac{88-80}{88-80} = \frac{8}{8} = 1$$

$$X_{16} = \frac{x_{16}-x_{min11,18}}{x_{max11,18}-x_{min11,18}} = \frac{82-80}{88-80} = \frac{2}{8} = 0.25$$

$$X_{17} = \frac{x_{17}-x_{min11,18}}{x_{max11,18}-x_{min11,18}} = \frac{86-80}{88-80} = \frac{6}{8} = 0.75$$

$$X_{18} = \frac{x_{18}-x_{min11,18}}{x_{max11,18}-x_{min11,18}} = \frac{88-80}{88-80} = \frac{8}{8} = 1$$

$$X_{21} = \frac{x_{21}-x_{min21,28}}{x_{max21,28}-x_{min21,28}} = \frac{88-83}{90-83} = \frac{5}{7} = 0.714$$

$$X_{22} = \frac{x_{22}-x_{min21,28}}{x_{max21,28}-x_{min21,28}} = \frac{86-83}{90-83} = \frac{3}{7} = 0.429$$

$$X_{23} = \frac{x_{23}-x_{min21,28}}{x_{max21,28}-x_{min21,28}} = \frac{89-83}{90-83} = \frac{6}{7} = 0.857$$

$$X_{24} = \frac{x_{24}-x_{min21,28}}{x_{max21,28}-x_{min21,28}} = \frac{90-83}{90-83} = \frac{7}{7} = 1$$



$$X_{25} = \frac{x_{25} - x_{min21;28}}{x_{max21;28} - x_{min21;28}} = \frac{87-83}{90-83} = \frac{4}{7} = 0.571$$

$$X_{26} = \frac{x_{26} - x_{min21;28}}{x_{max21;28} - x_{min21;28}} = \frac{84-83}{90-83} = \frac{1}{7} = 0.143$$

$$X_{27} = \frac{x_{27} - x_{min21;28}}{x_{max21;28} - x_{min21;28}} = \frac{88-83}{90-83} = \frac{5}{7} = 0.714$$

$$X_{28} = \frac{x_{28} - x_{min21;28}}{x_{max21;28} - x_{min21;28}} = \frac{83-83}{90-83} = \frac{0}{7} = 0$$

$$X_{31} = \frac{x_{31} - x_{min31;38}}{x_{max31;38} - x_{min31;38}} = \frac{88-86}{93-86} = \frac{2}{7} = 0.571$$

$$X_{32} = \frac{x_{32} - x_{min31;38}}{x_{max31;38} - x_{min31;38}} = \frac{93-86}{93-86} = \frac{7}{7} = 1$$

$$X_{33} = \frac{x_{33} - x_{min31;38}}{x_{max31;38} - x_{min31;38}} = \frac{89-86}{93-86} = \frac{3}{7} = 0.429$$

$$X_{34} = \frac{x_{34} - x_{min31;38}}{x_{max31;38} - x_{min31;38}} = \frac{88-86}{93-86} = \frac{2}{7} = 0.571$$

$$X_{35} = \frac{x_{35} - x_{min31;38}}{x_{max31;38} - x_{min31;38}} = \frac{89-86}{93-86} = \frac{3}{7} = 0.429$$

$$X_{36} = \frac{x_{36} - x_{min31;38}}{x_{max31;38} - x_{min31;38}} = \frac{86-86}{93-86} = \frac{0}{7} = 0$$

$$X_{37} = \frac{x_{37} - x_{min31;38}}{x_{max31;38} - x_{min31;38}} = \frac{88-86}{93-86} = \frac{2}{7} = 0.286$$

$$X_{38} = \frac{x_{38} - x_{min31;38}}{x_{max31;38} - x_{min31;38}} = \frac{88-86}{93-86} = \frac{2}{7} = 0.571$$

$$X_{41} = \frac{x_{41} - x_{min41;48}}{x_{max41;48} - x_{min41;48}} = \frac{98-93}{98-93} = \frac{5}{5} = 1$$

$$X_{42} = \frac{x_{42} - x_{min41;48}}{x_{max41;48} - x_{min41;48}} = \frac{97-93}{98-93} = \frac{4}{5} = 0.667$$

$$X_{43} = \frac{x_{43} - x_{min41;48}}{x_{max41;48} - x_{min41;48}} = \frac{93-93}{98-93} = \frac{0}{5} = 0$$

$$X_{44} = \frac{x_{44} - x_{min41;48}}{x_{max41;48} - x_{min41;48}} = \frac{98-93}{98-93} = \frac{5}{5} = 1$$

$$X_{45} = \frac{x_{45} - x_{min41;48}}{x_{max41;48} - x_{min41;48}} = \frac{98-93}{98-93} = \frac{5}{5} = 1$$

$$X_{46} = \frac{x_{46} - x_{min41;48}}{x_{max41;48} - x_{min41;48}} = \frac{96-93}{98-93} = \frac{3}{5} = 0.333$$

$$X_{47} = \frac{x_{47} - x_{min41;48}}{x_{max41;48} - x_{min41;48}} = \frac{93-93}{98-93} = \frac{0}{5} = 0$$

$$X_{48} = \frac{x_{48} - x_{min41;48}}{x_{max41;48} - x_{min41;48}} = \frac{98-93}{98-93} = \frac{5}{5} = 1$$

$$X_{51} = \frac{x_{51} - x_{min51;58}}{x_{max51;58} - x_{min51;58}} = \frac{95-94}{99-94} = \frac{1}{5} = 0.2$$

$$X_{52} = \frac{x_{52} - x_{min51;58}}{x_{max51;58} - x_{min51;58}} = \frac{98-94}{99-94} = \frac{4}{5} = 0.8$$

$$X_{53} = \frac{x_{53} - x_{min51;58}}{x_{max51;58} - x_{min51;58}} = \frac{99-94}{99-94} = \frac{5}{5} = 1$$

$$X_{54} = \frac{x_{54} - x_{min51;58}}{x_{max51;58} - x_{min51;58}} = \frac{94-94}{99-94} = \frac{0}{5} = 0$$

$$X_{55} = \frac{x_{55} - x_{min51;58}}{x_{max51;58} - x_{min51;58}} = \frac{96-94}{99-94} = \frac{2}{5} = 0.4$$

$$X_{56} = \frac{x_{56} - x_{min51;58}}{x_{max51;58} - x_{min51;58}} = \frac{96-94}{99-94} = \frac{2}{5} = 0.4$$

$$X_{57} = \frac{x_{57} - x_{min51;58}}{x_{max51;58} - x_{min51;58}} = \frac{97-94}{99-94} = \frac{3}{5} = 0.6$$

$$X_{58} = \frac{x_{58} - x_{min51;58}}{x_{max51;58} - x_{min51;58}} = \frac{95-94}{99-94} = \frac{1}{5} = 0.2$$

The third stage calculates the alternative relative weight value using (7), the result of calculating the relative weight value is as follows.

$$V_{11} = x_{11} * w_1 = 0.625 * 0.2235 = 0.1397$$

$$V_{12} = x_{12} * w_1 = 0 * 0.2235 = 0$$

$$V_{13} = x_{13} * w_1 = 0.5 * 0.2235 = 0.11197$$

$$V_{14} = x_{14} * w_1 = 0.875 * 0.2235 = 0.1397$$

$$V_{15} = x_{15} * w_1 = 1 * 0.2235 = 0.2235$$

$$V_{16} = x_{16} * w_1 = 0.25 * 0.2235 = 0.0559$$

$$V_{17} = x_{17} * w_1 = 0.75 * 0.2235 = 0.1676$$

$$V_{18} = x_{18} * w_1 = 1 * 0.2235 = 0.2235$$

$$V_{21} = x_{21} * w_2 = 0.714 * 0.2134 = 0.1524$$

$$V_{22} = x_{22} * w_2 = 0.429 * 0.2134 = 0.0915$$

$$V_{23} = x_{23} * w_2 = 0.857 * 0.2134 = 0.1829$$

$$V_{24} = x_{24} * w_2 = 1 * 0.2134 = 0.2134$$

$$V_{25} = x_{25} * w_2 = 0.571 * 0.2134 = 0.1219$$

$$V_{26} = x_{26} * w_2 = 0.143 * 0.2134 = 0.0305$$

$$V_{27} = x_{27} * w_2 = 0.714 * 0.2134 = 0.1524$$

$$V_{28} = x_{28} * w_2 = 0 * 0.2134 = 0$$

$$V_{31} = x_{31} * w_3 = 0.571 * 0.2038 = 0.1165$$

$$V_{32} = x_{32} * w_3 = 1 * 0.2038 = 0.2038$$

$$V_{33} = x_{33} * w_3 = 0.429 * 0.2038 = 0.0873$$

$$V_{34} = x_{34} * w_3 = 0.571 * 0.2038 = 0.1165$$

$$V_{35} = x_{35} * w_3 = 0.429 * 0.2038 = 0.0873$$

$$V_{36} = x_{36} * w_3 = 0 * 0.2038 = 0$$

$$V_{37} = x_{37} * w_3 = 0.286 * 0.2038 = 0.0582$$

$$V_{38} = x_{38} * w_3 = 0.571 * 0.2038 = 0.1165$$

$$V_{41} = x_{41} * w_4 = 1 * 0.1776 = 0.1776$$

$$V_{42} = x_{42} * w_4 = 0.667 * 0.1776 = 0.1184$$

$$V_{43} = x_{43} * w_4 = 0 * 0.1776 = 0$$

$$V_{44} = x_{44} * w_4 = 1 * 0.1776 = 0.1776$$

$$V_{45} = x_{45} * w_4 = 1 * 0.1776 = 0.1776$$

$$V_{46} = x_{46} * w_4 = 0.333 * 0.1776 = 0.0592$$

$$V_{47} = x_{47} * w_4 = 0 * 0.1776 = 0$$

$$V_{48} = x_{48} * w_4 = 1 * 0.1776 = 0.1776$$

$$V_{51} = x_{51} * w_5 = 0.2 * 0.1817 = 0.0363$$

$$V_{52} = x_{52} * w_5 = 0.8 * 0.1817 = 0.1454$$

$$V_{53} = x_{53} * w_5 = 1 * 0.1817 = 0.1817$$

$$V_{54} = x_{54} * w_5 = 0 * 0.1817 = 0$$

$$V_{55} = x_{55} * w_5 = 0.4 * 0.1817 = 0.0727$$

$$V_{56} = x_{56} * w_5 = 0.4 * 0.1817 = 0.0727$$

$$V_{57} = x_{57} * w_5 = 0.6 * 0.1817 = 0.1090$$

$$V_{58} = x_{58} * w_5 = 0.2 * 0.1817 = 0.0363$$

The last stage calculates the value of the gray relational coefficient between each pair of variables using (7), the result of calculating the value of the alternative gray relational coefficient is as follows.

$$GRG_1 = \frac{1}{5}(V_{11} + V_{21} + V_{31} + V_{41} + V_{51}) = \frac{1}{5}(0.1397 + 0.1524 + 0.1165 + 0.1776 + 0.0363) = \frac{1}{5}(0.6225) = 0.1245$$

$$GRG_1 GRG_2 = \frac{1}{5}(V_{12} + V_{22} + V_{32} + V_{42} + V_{52}) = \frac{1}{5}(0 + 0.0915 + 0.2038 + 0.1184 + 0.1454) = \frac{1}{5}(0.5591) = 0.1118$$

$$GRG_3 = \frac{1}{5}(V_{13} + V_{23} + V_{33} + V_{43} + V_{53}) = \frac{1}{5}(0.1117 + 0.1829 + 0.0873 + 0 + 0.1817) = \frac{1}{5}(0.5637) = 0.1127$$

$$GRG_4 = \frac{1}{5}(V_{14} + V_{24} + V_{34} + V_{44} + V_{54}) = \frac{1}{5}(0.1955 + 0.2134 + 0.1165 + 0.1776 + 0) = \frac{1}{5}(0.7030) = 0.1406$$

$$GRG_5 = \frac{1}{5}(V_{15} + V_{25} + V_{35} + V_{45} + V_{55}) = \frac{1}{5}(0.2235 + 0.1219 + 0.0873 + 0.1776 + 0.0727) = \frac{1}{5}(0.6830) = 0.1366$$

$$GRG_6 = \frac{1}{5}(V_{16} + V_{26} + V_{36} + V_{46} + V_{56}) = \frac{1}{5}(0.0559 + 0.0305 + 0 + 0.0592 + 0.0727) = \frac{1}{5}(0.2182) = 0.0436$$

$$GRG_7 = \frac{1}{5}(V_{17} + V_{27} + V_{37} + V_{47} + V_{57}) = \frac{1}{5}(0.1676 + 0.1524 + 0.0582 + 0 + 0.1090) = \frac{1}{5}(0.4873) = 0.0975$$

$$GRG_8 = \frac{1}{5}(V_{18} + V_{28} + V_{38} + V_{48} + V_{58}) = \frac{1}{5}(0.2235 + 0 + 0.1165 + 0.1776 + 0.0363) = \frac{1}{5}(0.5539) = 0.1108$$

The result of the gray relational coefficient value is the final result of the application of the GRA method in determining the display of employee employment contracts, based on the results of the gray relational coefficient value, alternative ratings will be made as shown in Figure 2.

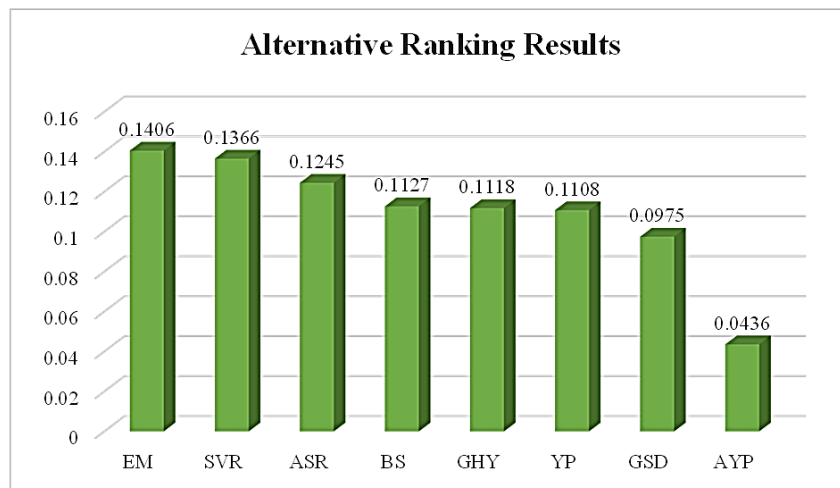


Figure 2. Alternative Ranking Result

The results of the alternative ranking of figure 2 show that the first rank with a GRA final value of 0.1406 was obtained by the EM alternative, the second place with a GRA final value of 0.1366 was obtained by the SVR alternative, the third place with a GRA final value of 0.1245 was obtained by the ASR alternative, the fourth place with a GRA final value of 0.1127 was obtained by the BS alternative, the fifth place with a GRA final value of 0.1118 was obtained by the GHY alternative, sixth place with a GRA final value of 0.1108 was obtained by alternative YP, seventh place with a final GRA value of 0.0975 was obtained by alternative GSD, and eighth place with a final GRA value of 0.0436 was obtained by alternative AYP.

3.3 Discussion

The LOPCOW (Logarithmic Percentage Change-Driven Objective Weighting) method is an interesting approach to comprehensively measure performance by considering logarithmic percentage changes of various performance indicators. This method makes it possible to identify the underlying performance trend and assign appropriate weight to each indicator based on its degree of change. The use of logarithmic percentages helps in capturing significant changes in performance, be it increases or decreases, without giving too much weight to small fluctuations. The LOPCOW method ensures that factors deemed more important or strategic to the organization are given appropriate emphasis. This assists management in gaining a more thorough understanding of the overall performance of the organization and facilitates more informed decision making. The LOPCOW method offers a systematic, data-driven approach to measuring performance more comprehensively, which can be used to assist organizations in evaluating their goal achievement, identifying areas for improvement, and directing resources effectively. The use of Grey Relational Analysis (GRA) in identifying employees who are most likely for contract renewal is a systematic and data-driven approach. Through the GRA analysis process, employee performance data is normalized and relational values between each employee and evaluation criteria are calculated, reflecting the degree of relative relationship. The GRA allows organizations to identify employees who are closest or have the highest relative relationship to the evaluation criteria, highlighting those with the best potential for contract renewal. With this approach, contract renewal decisions can be taken in a more objective and informed manner, helping organizations to retain and develop valuable talent and maximize overall company performance. Through the use of GRA, organizations can avoid decisions based on



subjective preferences or personal tendencies, as this method generates assessments based on objective data. In addition, GRA also makes it possible to capture complexity in employee performance data, especially in situations where the data is gray or uncertain.

One of the main advantages of the LOPCOW method is its ability to measure performance more comprehensively and objectively. Compared to traditional performance measurement methods that may only account for one or two performance indicators, LOPCOW considers various aspects of employee performance by accounting for logarithmic percentage changes of each indicator. With this approach, LOPCOW enables organizations to capture significant and relevant performance changes, both in increments and decreases, without giving too much weight to small fluctuations (Rong et al., 2024; Ulutaş et al., 2024). This allows management to gain a more holistic understanding of employee performance, identify areas that need improvement or improvement, as well as make more informed decisions in human resource management. In addition, using the LOPCOW approach, organizations can assign appropriate weight to each performance indicator based on its rate of change. Thus, indicators that are considered more important or strategic for the organization can be given greater emphasis in the overall performance appraisal. This helps in ensuring that performance appraisals reflect the priorities and strategic objectives of the organization more accurately. LOPCOW also provides flexibility in adjusting the weight of performance indicators according to the needs and preferences of the organization. Taking into account logarithmic percentage changes, an organization can adjust its relative weight dynamically depending on conditions or changes in the work environment or business strategy. Overall, the main advantage of the LOPCOW method is its ability to measure employee performance comprehensively, objectively, and dynamically, providing a more holistic view of individual contributions to organizational goals and enabling more informed decision-making in human resource management.

One of the main advantages of the GRA method is its ability to evaluate the relative relationship between a set of variables or criteria with reference variables in situations where data are gray or uncertain (Kannan & N.M.Sivaram, 2024; Yang et al., 2024). With this approach, GRA enables organizations to measure employee performance comprehensively and objectively, without getting bogged down in the limitations of incomplete or inaccurate data. In addition, the GRA provides an objective framework in decision making, minimizing the risk of subjective bias that can arise in performance appraisals. With the GRA method, organizations can identify employees who have the most potential for contract renewal more precisely, based on their level of relationship with predetermined evaluation criteria. This allows for more informed decision making, helping organizations to retain and develop valuable talent as well as maximizing overall company performance. In addition, GRA's advantage also lies in its ability to provide a more holistic view of individual performance in a broader context. By taking into account a variety of relevant factors and performance indicators, GRA allows managers to gain a deeper understanding of each employee's contribution to organizational goals. This allows for more informed and informed decision making in terms of career development, positioning, and rewards and recognition of good performance. Thus, GRA is not only a tool for performance appraisal, but also a means to motivate employees, increase talent retention, and create a more productive and fulfilling work environment.

The hybrid used of LOPCOW and GRA methods in the employee employment contract renewal process offers a structured and comprehensive approach. The LOPCOW method allows organizations to measure employee performance more holistically, taking into account logarithmic percentage changes of various performance indicators. Thus, this method helps identify underlying performance trends more precisely. Meanwhile, GRA allows organizations to evaluate the relative relationship between employees and established evaluation criteria, allowing to identify employees who are most likely for contract renewal based on their level of relationship with those criteria. The integration of these two methods allows for more informed and objective decision making, taking into account various aspects of employee performance comprehensively. Thus, the organization can ensure that contract renewal decisions are based on robust and relevant data, as well as provide fair opportunities for all employees to develop their careers according to their contribution to the organization. Through the integration of the Hybrid Method of LOPCOW and GRA, organizations can improve the decision-making process of employee contract renewal to be more effective and efficient. The Hybrid Integration of LOPCOW and GRA Methods in employee contract renewal decision making not only provides benefits in terms of effectiveness and efficiency of the decision-making process, but also helps in creating a more fair, transparent, and achievement-oriented work environment.

4. CONCLUSION

Hybrid Logarithmic Percentage Change-Driven Objective Weighting and Gray Relational Analysis (HLOPCOW-GRA) is an approach that combines two analysis methods, namely LOPCOW and GRA to improve accuracy and reliability in decision making. HLOPCOW-GRA provides an advantage in combining LOPCOW's advantage in handling dynamic data fluctuations with GRA's advantage in analyzing relative relationships between criteria, this approach allows decision makers to gain a deeper understanding of the factors that affect the final outcome. The hybrid used of LOPCOW and GRA methods in the employee employment contract renewal process offers a structured and comprehensive approach. The LOPCOW method allows organizations to measure employee performance more holistically, taking into account logarithmic percentage changes of various performance indicators. Thus, this method helps identify underlying performance trends more precisely. The results of alternative ranking showed that the first



place with a GRA final value of 0.1406 was obtained by EM alternatives, second place with a GRA final value of 0.1366 was obtained by SVR alternatives, third place with a GRA final value of 0.1366 was obtained by SVR alternatives, third place with a GRA final value of 0.1406 was obtained by EM alternatives. The final GRA value of 0.1245 obtained alternative ASR. The Hybrid Integration of LOPCOW and GRA Methods in employee contract renewal decision making not only provides benefits in terms of effectiveness and efficiency of the decision-making process, but also helps in creating a more fair, transparent, and achievement-oriented work environment.

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