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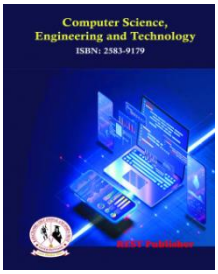

Optimizing Information System Selection: A Grey Relational Analysis (GRA) Approach

***Manjula Selvam, Sathiyaraj Chinnasamy, M. Ramachandran, Vidhya Prasanth**

REST Labs, Kaveripattinam, Krishnagiri, Tamil Nadu, India

*Corresponding Author Email: manjulaselvam2016@gmail.com

Abstract: *Information systems play a vital role in modern organizations, enabling efficient data management, streamlined processes, and informed decision-making. Selecting the right information system for an organization is crucial to ensure optimal functionality, productivity, and alignment with business goals. However, the process of information system selection can be complex and requires careful planning and evaluation. Information system selection involves identifying and assessing various software solutions or technology platforms that meet the organization's specific needs. This process typically begins with a thorough analysis of the organization's requirements, objectives, and existing infrastructure. It is essential to understand the unique challenges and opportunities within the organization to determine the most suitable information system. Here we use the method of Grey relational analysis or known as GRA method for the methodology used for the topic of information system selection.* Evaluation parameters taken as *Total costs, Implementation time, reliability, R&D capability and the capability, Organizational reputation. A1 has a GRG value of 0.457187 and is assigned the rank of 6. A2 has the highest GRG value of 0.714286 and is ranked 1. A3 has a GRG value of 0.510627 and is ranked 5. A4 has a GRG value of 0.437389 and is ranked 7, indicating the lowest position. A5 has a GRG value of 0.52234 and is ranked 3. A6 has a GRG value of 0.611111 and is ranked 2. A7 has a GRG value of 0.519814 and is ranked 4. A2 holds the rank of 1, and A4 obtains the lowest rank, which is 7. These rankings provide insight into the relative ordering of the information systems based on their performance or proximity to an ideal solution according to the GRA method.*

Keywords: *Total costs, Implementation time, reliability, R&D capability and the capability, Organizational reputation.*

1. INTRODUCTION

In order to maximise the company's net benefit, information system (IS) decision-making entails identifying a few different projects and distributing assets only among those initiatives, within the available resource limitations. The issues associated with selecting IS projects involve multiple criteria. Over the past few decades, numerous methodologies for choosing IS projects or developing research initiatives have been created and disclosed [1]. The importance of Information Systems (IS) initiatives as crucial business activities has been acknowledged and emphasised by many scholars and IS executives. The 'optimal' decision to choose a group of IS initiatives from among battling suggestions for projects is an important resource allocation choice that can commit an organisation to significant commitments over the course of time. The growth of procedures and models to select the most suitable array of IS projects, as well as better techniques for assessing the expenses and rewards of IS, have all been addressed in the body of literature due to the commercial significance of this topic. The IS project selection methods that have been suggested so far are useful, but their use is limited because they only take into account detached IS projects (2). Many businesses want to adopt computer systems because of their proven effectiveness in boosting productivity, boosting company efficiency, and increasing competitiveness. Examples include enterprise resource planning (ERP), manufacturing executive systems (MES), customer relationship management (CRM), and others. However, even though numerous surveys, like have confirmed the benefits and chances of these firm IT systems, numerous studies also reveal that projects involving information systems for companies frequently face substantial costs as well as elevated risks (3). The organisation will save more money through the use of a checkout terminal and sales database because the transactions will be processed more quickly and effectively. Finally, there is a technical interdependence created when the creation of an IS requires the expansion of another project that is associated. This category of the interconnection will also include projects that are

mandated by either internal or exterior requirements (4). The majority of organisations place a high value on data, and a growing number of contemporary organisations are depending on their information systems (IS) over day-to-day operations. Every modern organisation must regularly choose which data systems to implement. It is acknowledged that choosing the ideal system is a difficult task that could provide some competitive advantages (5). presented the process of planning for space in nations with complex managerial and legal systems by incorporating factors related to society, the economy, and the environment. presented a Geographic Information System (GIS) use to evaluate the availability of small hydroelectricity in a region of India by gathering available data on its location and output. Belmonte et (8). Planning for information systems (IS) are now essential to a company's success given the rapid advancement of technological innovation. Planning for IS has frequently been identified as the top priority in surveys to determine the most pressing problems affecting IS mangers (9). When information system (IS) initiatives are chosen from a list of potential rival projects, they are assessed using various criteria. Prior studies overlooked the interdependencies between IS projects, a crucial aspect of technological development. When choosing an IS project for an organisation, recognising and simulating these project interconnections can help organisations save money (10). Researchers recently suggested using the analytic hierarchy process (AHP) to create a system of priorities for the deliberate choice of information system (IS) assignments. This study clarified how AHP calculates a priority structure computationally and illustrated how this is used in the choosing of IS assignments (11). Leadership dissatisfaction with the selection process for proposed developing information systems projects is on the rise. The three main sources for trouble in project selection, according to the authors' informal polling of businesses and government agencies, are failure to fulfil decision-making criteria regularly, difficulty using personal selection criteria, and a frequent dearth of alternative suggestions for a specific application (12). Computerised maps may indicate unspoken connections between areas and clients or rivals. The geographic information system (GIS) is a collection of processes which offer data input, preservation and search, map ping, and analysis of space for both geographic and attribute information in order to assist with the organisational decision-making processes (13). All of the computerised information systems which can be utilised throughout an organisation are included in modern enterprise resource planning (ERP) systems. The central concept of ERP is utilising IT to develop the capacity for arranging and integrating resources across the entire organisation (14). Landfill siting choices clearly require consideration of a wide range of factors, and geographic information systems (GIS) are the best tool for such initial research given their capacity to handle sizable volumes of spatial data from various sources. Information is efficiently stored, retrieved, analysed, and displayed in accordance with defined by the user criteria (15). Implementing GIS in conjunction with other cutting-edge communication technologies related to travellers' systems allows for the visible propagation of information about fixed route amenities, such as offices, schools, healthcare facilities, puts of interest for tourists, etc.; planning of routes and geographic and attribute data concerning other modes of transportation within the towns, such as roadways, airports, underwater harbours, and passengers rail systems (16).

2. MATERIALS & METHODOLOGY

Grey relational analysis (GRA) is recommended as a tool to utilise a number of criteria achievement plan, which is employed for choosing remedies from a finite set of choices, in the context of fuzzy multiple factors model (26). In order to choose an ERP package, investigators have used a variety of methods. We believe that this study is the first that combines the IFS and GRA approaches to choosing an ERP system. (27), the proposed method is only used for personnel selection. GRA. Deng (1982) first put forth the concept of the grey system. By integrating all of the operational attributes that are taken into account for all possibilities into one value, GRA is able to solve the issues related to MCDM. As a result, the original issue is reduced to a taking decisions issue involving a single attribute. Consequently, options with (28). In the process of identifying the best option after DM evaluations, GRA benefits. The fuzzing steps of the procedure require assessment of DMs with hesitancy and uncertainty. The purpose of this study aims to propose a comprehensive MCDM approach that utilises IFS and GRA for the selection of green vendors in light of the data that was provided (29). The multi-attribute decision-making (MADM) approach is presented as a modified grey analysis of relationships. A new logarithmic standardisation method is used for data preparatory processing or normalisation to address the weakness of the GRA method indicated in Section 2. Each of the M-GRA steps for resolving problems involving multiple attributes during choice-making (30). The GRA can be used to resolve issues involving intricate connections between many possible solutions and characteristics. The GRA technique has been extensively used to address uncertainty issues arising from separate data and incomplete knowledge. The optimal accessibility network is obtained using the GRA method, and the proportional importance of the requirements for various services are determined using the AHP method (32).Through the optimisation of grey relational grades, grey relational analysis (GRA), which has been shown to be into effect for dealing about poor, unfinished; and uncertain facts, can be used to handle a variety of inexact shortcomings that includes a variety of requirements and goals (33).Grey Relational Analysis (GRA) is a subset of Grey Although it Theory, which is appropriate for complicated interactions between numerous variables and contributing factors in making choices. Although GRA has been successfully used in network

selection processes through, rank the reverse phenomenon still affects it (35). Another GRA technique that draws attribute value data using PFN, unidentified attribute pounds' data, and builds a MADM approach to handle information conflict under PF conditions is presented. presented a longer version of the linguistic PF Topis methods before addressing the issues in a company's resource planning system. for choosing and evaluating sustainable suppliers (36). The procedure for choosing suppliers has been the subject of numerous attempts to use grey relational analysis (GRA), which relies on grey theory of systems. The disadvantage is that the GRA's choice of supplier's simulation only takes into account the whitening principles of the grey number. Dealing with the characteristics of quality is challenging (37). Two sections of the literature have been reviewed. The first review addresses the current models that can be used to choose a supplier. The second part discusses various MCDM programmes for AHP and GRA (38). The previously discussed fuzzy readily apparent MADM issues cannot be resolved using the traditional GRA methods because there is inadequate pounds' information. How to identify substantial items using data that is difficult to assign weight to and provided fuzzily easily understood (39). When performing an assessment of choosing suppliers, the GRA method is used to combine both quantitative and qualitative data while taking into account its "large-is-better" or "smaller-is-better" properties. It has been proposed for automatically performing the analysis of mathematics and get the results using an Excel programme called AHP-GRA model. Finally, a real-world example of a Taiwanese a notebook computer producer is given to highlight the viability of this integrated scheme (41). Grey relational analysis (GRA), which is a crucial component, can only reflect the trend that exists between a possible substitute and the perfect alternative. Several GRA steps have been amended altered to address this issue, including the normalised formula and the simultaneous consideration of both ideal and non-ideal alternatives (42). The study's enhanced GRA method is a potent tool for making decisions when dealing with unpredictability because it uses numbers that represent intervals. The fact that the enhanced GRA allows for distinct gathering and subsequent integration of expert opinions gives it an edge over other ways of making decisions. Comparatively to other models utilising, this makes our suggested model more flexible (46).

3. RESULTS & DISCUSSION

TABLE 1. Information System Selection

	Total costs	Implementation time	reliability	R&D capability and the capability	Organizational reputation
A1	120	40	82.5	182	25
A2	130	30	85.6	239	25
A3	95	35	80.9	147	21
A4	110	35	81.7	153	22
A5	120	45	82.3	177	28
A6	100	25	80.4	193	23
A7	98	30	81.2	162	20

The provided Table 1 contains information regarding the selection of various information systems. Each row corresponds to a specific system identified as A1, A2, A3, and so forth. The columns represent different factors or criteria used for evaluating these systems. The "Total costs" column indicates the overall expenses associated with implementing the information systems. The values in this column range from 95 to 130, with A3 being the least costly and A2 being the most expensive. The "Implementation time" column shows the estimated duration required to implement the systems. The values in this column range from 25 to 45, with A6 having the shortest implementation time and A5 having the longest. The "Reliability" column reflects the rating for the reliability of the information systems. The values in this column range from 80.4 to 85.6, with A6 being the least reliable and A2 being the most reliable. The column labeled "R&D capability and the capability" appears to have a typographical or formatting error, as it seems incomplete. It is possible that it was meant to indicate the research and development (R&D) capability and another capability of the information systems, although the specific values or meaning are unclear. Lastly, the "Organizational reputation" column denotes the reputation of the organizations associated with the information systems. The values in this column range from 20 to 28, with A7 having the lowest reputation and A5 having the highest. Overall, Table 1 provides a comparative overview of these evaluation criteria for the different information systems.

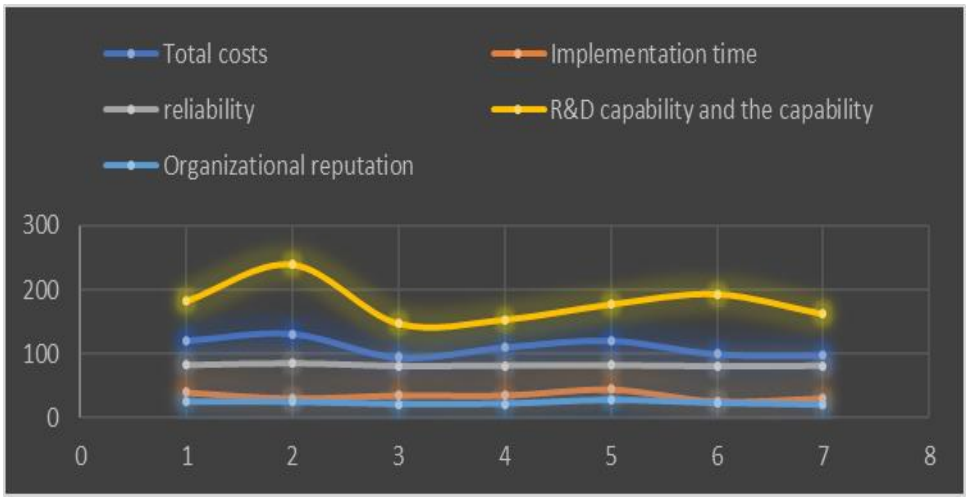

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TABLE 2. Normalized matrix

0.4038	0.3804	0.6250	0.2857	0.2500
1.0000	1.0000	0.6250	0.0000	0.7500
0.0962	0.0000	0.1250	1.0000	0.5000
0.2500	0.0652	0.2500	0.5714	0.5000
0.3654	0.3261	1.0000	0.2857	0.0000
0.0000	0.5000	0.3750	0.8571	1.0000
0.1538	0.1630	0.0000	0.9143	0.7500

Table 2 displays a normalized matrix created using the Grey Relational Analysis (GRA) method. The matrix has seven rows and five columns. Each cell within the matrix contains a numeric value ranging from 0 to 1, indicating the level of relation or correlation between various elements. Rows correspond to the elements or alternatives under evaluation, while columns represent the criteria or factors used in the evaluation. The values in the matrix reflect the degree of similarity or proximity between the elements for each criterion. Higher values signify stronger correlations, whereas lower values indicate weaker correlations.

TABLE 3. Deviation sequence

0.5962	0.6196	0.3750	0.7143	0.7500
0.0000	0.0000	0.3750	1.0000	0.2500
0.9038	1.0000	0.8750	0.0000	0.5000
0.7500	0.9348	0.7500	0.4286	0.5000
0.6346	0.6739	0.0000	0.7143	1.0000
1.0000	0.5000	0.6250	0.1429	0.0000
0.8462	0.8370	1.0000	0.0857	0.2500

Table 3 displays a deviation sequence obtained through the application of the Grey Relational Analysis (GRA) method. Like Table 2, it comprises seven rows and five columns. Each cell in the table holds a numeric value ranging from 0 to 1. The deviation sequence reveals insights into the variances or disparities between elements

and criteria, utilizing the GRA methodology. It quantifies the relative closeness or resemblance between elements for each criterion. The values in the table gauge the extent of deviation or disparity between elements for each criterion, with higher values signifying more significant deviations and lower values indicating lesser deviations.

TABLE 4. Grey relation coefficient

0.4561	0.4466	0.5714	0.4118	0.4000
1.0000	1.0000	0.5714	0.3333	0.6667
0.3562	0.3333	0.3636	1.0000	0.5000
0.4000	0.3485	0.4000	0.5385	0.5000
0.4407	0.4259	1.0000	0.4118	0.3333
0.3333	0.5000	0.4444	0.7778	1.0000
0.3714	0.3740	0.3333	0.8537	0.6667

Table 4 displays a matrix of Grey Relation Coefficients. It has a structure of seven rows and five columns, with each cell holding a numeric value. The Grey Relation Coefficients are utilized within the Grey Relational Analysis (GRA) methodology to assess the extent of the relationship between elements and criteria. The values in the matrix serve as the Grey Relation Coefficients, indicating the degree of correlation or connection between elements and criteria. Higher values signify a more pronounced relationship, whereas lower values suggest a weaker relationship.

TABLE 5. Grey Relation Grade and rank

Information systems	GRG	Rank
A1	0.457187	6
A2	0.714286	1
A3	0.510627	5
A4	0.437389	7
A5	0.52234	3
A6	0.611111	2
A7	0.519814	4

Table 5 displays the Grey Relation Grade (GRG) values and ranks for different information systems. The table has two columns: "Information systems" and "GRG." In the "Information systems" column, various information systems are listed as A1, A2, A3, A4, A5, A6, and A7. The "GRG" column contains the corresponding GRG values, which indicate the relative performance or similarity of each information system according to the Grey Relational Analysis (GRA) method. The GRG values range from approximately 0.437389 to 0.714286. The "Rank" column represents the assigned ranks for each information system based on the GRA method. The ranks range from 1 to 7, reflecting the relative positions or orders of the information systems. A1 has a GRG value of 0.457187 and is assigned the rank of 6. A2 has the highest GRG value of 0.714286 and is ranked 1. A3 has a GRG value of 0.510627 and is ranked 5. A4 has a GRG value of 0.437389 and is ranked 7, indicating the lowest position. A5 has a GRG value of 0.52234 and is ranked 3. A6 has a GRG value of 0.611111 and is ranked 2. A7 has a GRG value of 0.519814 and is ranked 4. These GRG values and ranks provide insights into the relative performance and rankings of the information systems based on their resemblance to an ideal solution using the GRA method.

FIGURE 2. Gray Relation Grade

Figure 2 presents the Grey Relation Grade (GRG) values assigned to various information systems. The GRG values in Figure 2 reflect the evaluation of each information system's relative performance and similarity using the Grey Relational Analysis (GRA) method. The range of GRG values extends from approximately 0.437389 to 0.714286. Typically, higher GRG values indicate better performance or a closer resemblance to the ideal solution within the GRA analysis context.

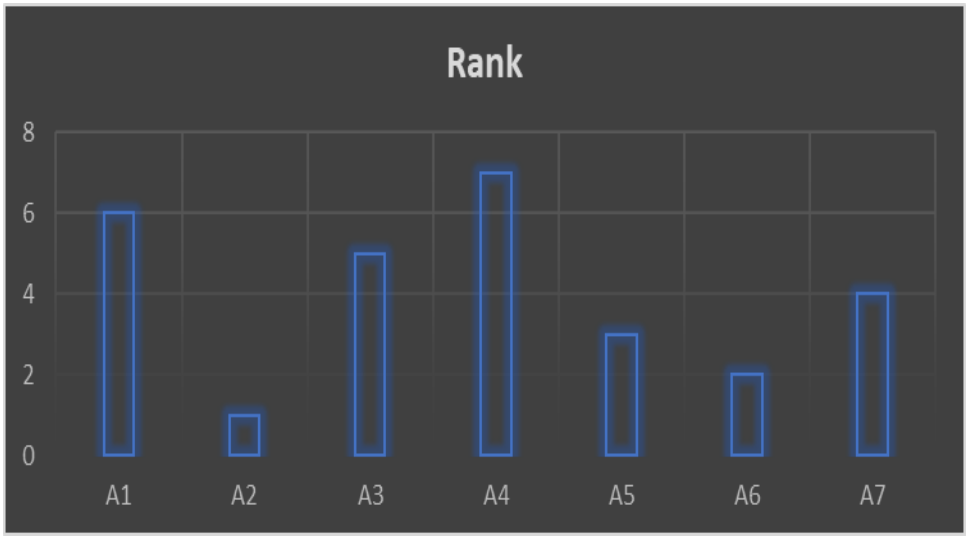

FIGURE 3. Ranks

Figure 3 displays the rankings assigned to different information systems using the GRA method. The rankings span from 1 to 7, representing the relative positions or orders of the information systems. In this figure, A2 attains the highest rank, which is 1, indicating its superior position. A6 secures the rank of 2, while A5 receives the rank of 3. A7 is assigned the rank of 4, and A3 follows with the rank of 5. A1 holds the rank of 6, and A4 obtains the lowest rank, which is 7. These rankings provide insight into the relative ordering of the information systems based on their performance or proximity to an ideal solution according to the GRA method.

4. CONCLUSION

The conclusion of an information system selection process will depend on the specific circumstances and objectives of the organization. However, here are some general points that could be included in a conclusion: Evaluation of Requirements: Summarize the key requirements identified during the selection process. This includes functional requirements (e.g., features, capabilities) and non-functional requirements (e.g., scalability, security). Vendor Assessment: Provide an overview of the vendors evaluated during the selection process. Highlight the strengths and weaknesses of each vendor, considering factors such as product fit, vendor reputation, customer support, and cost. System Selection: Clearly state the chosen information system based on the evaluation criteria. Explain why the selected system best meets the organization's requirements and goals. Benefits and Risks: Outline the potential benefits of implementing the selected information system. This could include improved efficiency, better decision-making, increased productivity, or cost savings. Additionally, discuss any potential risks or challenges associated with the implementation, such as compatibility issues or user resistance. Implementation Plan: Describe the next steps for implementing the chosen system. This may involve developing a detailed project plan, assigning responsibilities, setting timelines, and securing necessary resources. Cost Analysis: Provide a cost analysis that includes the initial investment, ongoing maintenance fees, and any additional expenses related to customization, training, or integration with existing systems. Assess the return on investment (ROI) and the anticipated payback period. Change Management: Highlight the importance of change management in successfully implementing the new information system. Emphasize the need for effective communication, training, and stakeholder engagement to minimize resistance and maximize user adoption. Future Considerations: Discuss any future considerations or recommendations for the organization. This could include potential system upgrades, integration with other systems, or the need for ongoing support and maintenance. Remember, the conclusion should provide a concise summary of the information system selection process, the chosen system, and the anticipated benefits and risks. It should leave the reader with a clear understanding of the rationale behind the selection and the path forward for implementation.

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