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Advanced Fuzzy-Based Decision-Making: The Linear Diophantine Fuzzy CODAS Method for Logistic Specialist Selection

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ABSTRACT

This study addresses the inherent uncertainty in human decision-making by leveraging fuzzy sets, which were introduced to better capture the imprecision associated with human thoughts and judgments. As an extension to traditional fuzzy sets, the Linear Diophantine Fuzzy Set (LDFS) was developed, offering a more flexible approach by relaxing existing limitations on grade values. The LDFS has found applications across various fields, demonstrating its versatility and effectiveness. In this study, we explore the application of the Linear Diophantine Fuzzy Set within the framework of the Combinative Distance-based Assessment (CODAS) method. The CODAS method stands out because it incorporates Euclidean and Taxicab distances. Decision-making should consider not only the direct distances between ideal solutions and alternatives but also the indirect distances. The foremost objective of this research is to propose a novel approach by integrating the CODAS method with the LDFS to address complex decision-making problems characterized by uncertainty and imprecision. To illustrate the practical utility of the proposed method, we apply it to a numerical example involving the selection of a logistics specialist, a critical decision in emergency logistics optimization. The research also includes a case study on a logistics specialist, highlighting the practical application of the methods discussed. Furthermore, this study provides a comprehensive sensitivity analysis of the parameters' weights to evaluate the robustness and reliability of the proposed method. The results highlight the effectiveness of the LDF CODAS method in making informed and reliable decisions under conditions of uncertainty, paving the way for future applications in other decision-making scenarios.

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1. Introduction

In an uncertain competitive landscape, businesses need to take strategic entrepreneurial measures to ensure their continued success, create lasting competitive benefits, and produce superior performance over the long term with an eye toward sustainability. According to this viewpoint, either a competitive advantage using the resource-based view or a breakthrough innovation demands the organization to build up a base on its human capital, which is defined as the accumulation of various knowledge, skills, and abilities gained through education, experience, and training of employees within an organization, to ensure the success in terms of performance with lowering costs or differentiating. Based on such a perspective, human resources management (HRM) functions in any type of organization and it is primarily concerned with the tasks of attracting, developing, motivating, and retaining a workforce with high performance, which is strongly associated with organizational success. According to this perspective, businesses are expected to develop practices that are in line with their business- and corporate-level strategies to attract, select, and hire the right person for the right job.

The study and expertise involved in managing and controlling the movement of energy, products, information, and associated resources are known as logistics. Currently, the term "logistic" refers to a broad range of activities, including the movement of raw materials from providers to producers and the ultimate shipping of completed products to end users. To confirm customer requirements, logistics is defined by the Council of Logistics Management (CLM) as the process of organizing, implementing, and managing the efficient, affordable flow and storage of raw materials, in-process inventory, finished goods, and related information from point of origin to point of consumption (Figure 1).
As it enables the transfer of products from suppliers to manufacturers, sellers or distributors, and

Fig. 1. Importance of logistics in business management

ultimately purchasers, logistics is a crucial component in the supply chain. Planning, executing, and overseeing many operations that guarantee the efficient operation of storage and transit of commodities from their point of origin to their destination are common tasks in logistics management. Managing logistics requires doing tasks including inventory control, raw material accumulation, supply and demand planning, and warehouse administration. As a result, it covers a wide range of supply chain procedures (Figure 2). Increasing client satisfaction and lowering overall operating costs are the two fundamental objectives of logistics management.

Likewise, it must be pointed out that it is exorbitant to change the wrong hiring choice due to the

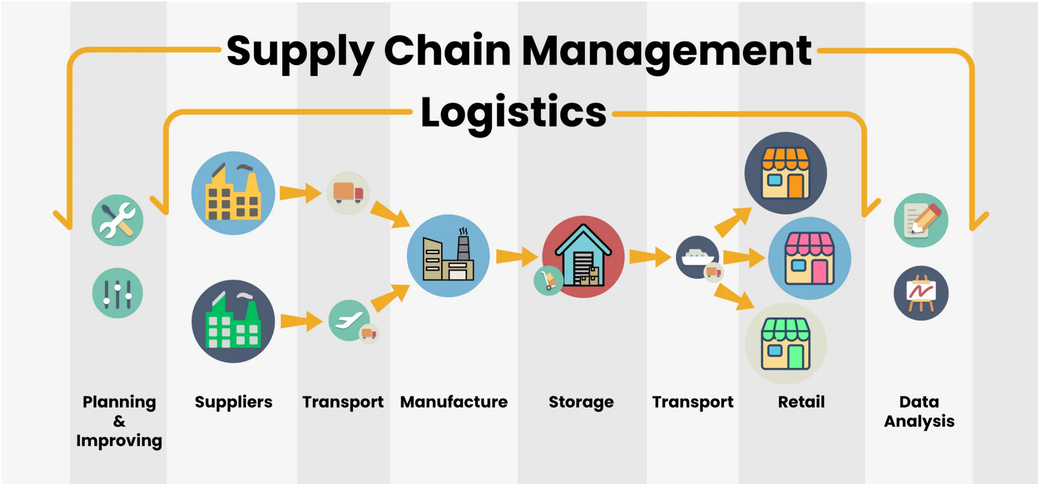

Fig. 2. Supply chain vs Logistics

time spent on, costs associated with hiring, training, monitoring, and terminating that person, as well as unnecessary financial and time-related losses from hiring a new one, as well as the indirect costs of loss in productivity, precision flexibility, quality of the product, and industrial accidents in an organization.

A managerial role known as a logistics expert is in charge of a company's warehousing, shipping, and receiving activities. Logistics experts manage the movement and storage of goods or commodities, which frequently entails office work and occasional manual labor. Logistics specialist, as expected, has also become a significant concern for logistics, since everything is done for people by people and generates a significant portion of the national economy as well as a catalyst for national competitiveness. This necessitates businesses to meet a steadily increasing demand for professionals with specialized knowledge and talent of more than 280 skills due to a complex, multidimensional, integrated, and international structure with various decision levels. Since the fact that there have been numerous changes in job requirements and the number of requirements for employment as a result of recent developments in the fields of globalization, information, and communication technologies, traditional methods of logistics expert selection have become more ineffective. HR managers are unable to select the best candidates, as the HR infrastructure in the field of logistics is insufficient.

However, modern methods of multi-criteria decision-making (MCDM) models have emerged in response to the failure of existing methods to meet the needs and provide a less expensive, quicker, more accurate, and easier-to-use approach to any PS problem to find the best match candidate. With this in mind, the motive of this research is to appraise the criteria applied in many countries' logistics industry and present a trustworthy MCDM model to select and hire a "logistics specialist" in a logistics company through a real case, and to create a foundation for end-users to compare the relative weight of criteria across nations. An in-depth investigation of logistics specialist characteristics with various approaches in the literature has been conducted in a variety of scenarios and presented in Table 1.
The findings are anticipated to offer new perspectives and useful information to students, scholars who have studied logistics and the MCDM model, selection and recruitment agencies, candidates for the logistics profession, and managers of logistics companies

Table 1
Literature Review on Selection Charateristics

Position	Evaluation Approach	Selection Criteria
[1] System analysis engineer	Fuzzy TOPSIS	Emotional steadiness, oral communication skills, personality, past experience, self-confidence
[2] ICT project manager	Fuzzy linguistic evaluation approach	Education, experience, computer knowledge, foreign language, age, gender, labor shift and non-smoker
[3] System analysis	IFS TOPSIS	Leadership, motivation, work experience, proficiency, appearance, creativity, age and communication skills
[4] Sales manager	IF-TOPSIS	Oral communication skills, past experience, general aptitude, willingness, self-confidence and first impression
[5] Engineer	Fuzzy VIKOR	General and professional knowledge criteria
[6] Project manager	Fuzzy VIKOR	Site management capacity, technical level,level of leadership, personal qualities and contextual competencies
[7] Project manager	Fuzzy MCDM	Basic requirements, project management skills, management skills and interpersonal skills
[8] CIO	Fuzzy TOPSIS	Soft and technical skills
[9] Support Manager	Fuzzy TOPSIS	Creativity/innovation, problem-solving/decision making, conflict management/negotiation, empowerment/delegation, strategic planning, specific presentation skills,communication skills, team management, diversity management, self-management, and educational background
[10] HR manager	Fuzzy TOPSIS	Scientific, psychological, behavioral and apparent characteristics, functional characteristics and medical
[11] System analyst	Fuzzy TOPSIS	Emotional steadiness, oral communication skills, personality, past experience and self-confidence
[12] Personnel	Fuzzy TOPSIS	Science and education, behavior and appearance, personal psychological, functional activity and medical criteria

1.1 *Literature Review*

Human thinking and reasoning give rise to hazy human conceptions, which give rise to Zadeh's fuzzy set[13]. The topic of fuzzy sets is growing and has seen a lot of use lately, particularly in the logistics sector. This problem is demonstrated by its capacity to assist experts in selecting the optimum options for higher positions. Despite the overwhelming response, there are not enough members to handle every situation. Together with non-membership grades, Atannosov[14] created an intuitionistic fuzzy set (IFS). Then, Yager introduced the novel interpretation of Pythagorean fuzzy sets (PFS)[15] with q-rung orthopair fuzzy sets (q-ROFS)[16], as a generalization of IFSs. These widely available fuzzy sets cannot reflect some concerns and have certain restrictions on grade values.

The linear diophantine fuzzy set (LDFS) [17], the prototype of a novel and unique fuzzy concept, removes all of these restrictions as reference parameters exist. From the LDF environment perspective, Jeevitha *et al.*,[18] promoted and used the DEMATEL approach in the context of climate change. The linear diophantine multi-fuzzy aggregation operators are credited to Jeevitha *et al.*,[19] for their development and application to digital transformation. To choose the right Agri-Drone, Vimala *et* *al.*,built the complex LDF soft set [20]. Several Einstein aggregation techniques were applied to explore LDFS for MCDM problems in Aiyared Iampam[21]. These operators can extract rating data and identify the optimal choice. Subsequently, Saya Ayub[22] connected algebraic features with LDF relations through decision-making. Riaz *et al.*,[23] developed on LDFS by putting forth the idea of soft rough sets for application in material handling equipment. To choose third-party logistic service providers, Riaz *et al.*,[24] developed aggregation operators (AOs) that used linear Diophantine fuzzy numbers (LDFNs) in priority order. An application of Einstein prioritized linear Diophantine fuzzy AOs was proposed by Farid *et al.*,[25].

Riaz *et al.*,[26] recently created Frank AOs for linear Diophantine fuzzy numbers with interval values. Apart from delineating the characteristics and uses of LDFS, Vimala *et al.*,[27] also devised the MARCOS technique for LDFS. Using the LDF correlation coefficient, Jeevitha *et al.*,[28] described the LDFS clustering technique. Petchimuthu[29] attempted to address the supplier selection issue by utilizing IVLDF data and its AOs. Jeevitha and Vimala [30] implemented the multi-fuzzy soft set in LDFS and addressed its applicability in the tender selection process. Furthermore, the LDMFS similarity measure was introduced and utilized to choose the optimal replacement for the petrol[31]. Moreover, LDFS[32–34] implements the lattice structures in several studies with applications in the prediction of Myocardial Infarction and analysis of farming methods. Nithya *et al.*,[35] incorporated the theory of bipolar in LDFS and introduced Einstein aggregation operators for bipolar LDFS. Several authors have discussed various MCDM problems within the context of fuzzy theory.[36–38]

Ghorabaee *et al.*, [39] initially presented the CODAS technique to handle complicated MCDM issues. By contrasting its outcomes with those of other well-known MCDM techniques, the efficacy of CODAS was shown, indicating its appropriateness for addressing MCDM difficulties. Ghorabaee *et al.*, [40] created a hybrid model in a different study that combines fuzzy logic and the CODAS technique for multi-criteria group decision-making, especially when choosing the best suppliers. This improvement extended the CODAS technique by integrating language phrases with trapezoidal fuzzy numbers (TrFNs).

Panchal *et al.*, [41] presented an integrated MCDM strategy that uses a fuzzy version of CODAS and the fuzzy analytical hierarchy process (FAHP) to support maintenance decision-making in the process sector. The CODAS approach was used by Badi *et al.*, to choose suppliers for the steelmaking industry [42] and to choose locations for desalination plants [43]. To choose the optimal location for wave energy facilities, Boltürk [44] expanded the CODAS approach by putting forth a PF-CODAS version for supplier selection. Later, he and Kahraman [45] created an Interval-Valued IF CODAS. After comparing the outcomes with those from the conventional CODAS approach, a unique rating was produced. Peng and Garg [46] proposed the weighted distance-based approximation (WDBA), CODAS, and a new approach for constructing distance and similarity measures to handle interval-valued fuzzy soft decision-making problems. Mathew and Sahu [47] utilized newly developed CODAS, EDAS, WASPAS, and MOORA methods to solve two material handling equipment selection problems. Their rankings were then compared with other popular methods like TOPSIS and ELECTRE. Pamucar *et al.*, [48] introduced the Pairwise-CODAS model, altering the CODAS method with Linguistic Neutrosophic Numbers (LNN).

The interval-valued Atanassov IF CODAS method was introduced by Yeni and Ozcelik [49] as a solution to MCDM difficulties. The interval-valued neutrosophic CODAS approach for choosing the locations of wind energy plants was created by Karasan *et al.*, [50]. Ijadi Maghsoodi *et al.*, applied decision-making procedures, combining CODAS with the Best-Worst Method (BWM) for site selection [51] and the Step-Wise Weight Assessment Ratio Analysis (SWARA) method for material selection [52]. To show the superiority of the new approach, Seker [53] provided an updated integrated model based on CODAS and interval-valued intuitionistic trapezoidal fuzzy sets (IVITrFS). This model produced a different ranking. Peng *et al.*,[54] discussed the CODAS method for PFS in MCDM. Picture fuzzy extension of the CODAS method is emphasized in the context of ERP selection by H.Y. Aydogmus *et al.*, [55].

Several fuzzy number extensions have reportedly been combined with the CODAS approach under uncertainty, according to the literature. The focus of this work is on the linear Diophantine fuzzy extension of the CODAS approach, which has not yet been investigated in the literature.

1.2 *Contribution of this research*

The foremost contributions of this study are stated as follows:

1. This work presents a unique framework for decision-making by combining the Linear Diophantine Fuzzy Set (LDFS) with the CODAS approach.
2. It enhances conventional approaches by addressing intricate decision-making issues marked by uncertainty and imprecision.
3. A case study is provided that utilizes the suggested LDF CODAS method for emergency logistics optimization when choosing a logistics specialist.
4. To assess the method's robustness and dependability in practical situations, the study involves a thorough sensitivity analysis.
5. The study opens the door for additional LDF CODAS technique applications in a range of multi-criteria decision-making scenarios.

The research is arranged in the following manner: The Preliminaries are covered in Chapter 2, which lays the theoretical groundwork and methods that are crucial for interpreting the subsequent sections. In Chapter 3, the Linear Diophantine Fuzzy CODAS (LDF CODAS) method is presented, along with its theoretical improvements over previous methods and a description of its formulation. A case study on emergency logistics optimization using the suggested CODAS approach to choose the most qualified logistics expert is presented in Chapter 4. To assess the validity and dependability of the findings, a comprehensive sensitivity analysis is also included in this chapter. Chapter 5 concludes with a summary of the study's main conclusions, a discussion of its ramifications, and recommendations for future research directions.

2. Preliminaries

Definition 2.1. [13] The fuzzy set $\mathfrak{H}$ on Ω is symbolized in the form

$$\mathfrak{H} = \{(\mathfrak{p}_i, \mu(\mathfrak{p}_i))/\mathfrak{p}_i \in \Omega\}$$

where μ maps from $\Omega \to [0,1]$ and it represents the degrees of Membership Grade(MG) in Ω.

Definition 2.2. [17] A linear Diophantine fuzzy set $\mathfrak{J}$ on Ω is a structure symbolized as:

$$\mathfrak{J} = \{(\mathfrak{p}_i, \langle\mu(\mathfrak{p}_i), \nu(\mathfrak{p}_i)\rangle, \langle\alpha(\mathfrak{p}_i), \beta(\mathfrak{p}_i)\rangle) : \mathfrak{p}_i \in \Omega\}$$

where, $\mu(\mathfrak{p}_i), \nu(\mathfrak{p}_i), \alpha(\mathfrak{p}_i), \beta(\mathfrak{p}_i) \in [0, 1]$ are MG, NMG, and their RP respectively. It could satisfy the condition $0 \leq \alpha(\mathfrak{p}_i)\mu(\mathfrak{p}_i) + \beta(\mathfrak{p}_i)\nu(\mathfrak{p}_i) \leq 1$ for all $\mathfrak{p}_i \in \Omega$ with $0 \leq \alpha(\mathfrak{p}_i) + \beta(\mathfrak{p}_i) \leq 1$.

Definition 2.3. [17] Let $\mathfrak{L}_1 = (\mathfrak{p}_i, \langle\mu_{\mathfrak{L}_1}, \nu_{\mathfrak{L}_1}\rangle, \langle\alpha_{\mathfrak{L}_1}, \beta_{\mathfrak{L}_1}\rangle) : \mathfrak{p}_i \in \aleph$ and $\mathfrak{L}_2 = (\mathfrak{p}_i, \langle\mu_{\mathfrak{L}_2}, \nu_{\mathfrak{L}_2}\rangle, \langle\alpha_{\mathfrak{L}_2}, \beta_{\mathfrak{L}_2}\rangle) : \mathfrak{p}_i \in \Omega$ be the two LDFS over Ω. The arithmetic operations between $\mathfrak{L}_1$ and $\mathfrak{L}_2$ are summarized as follows:

1. $\mathfrak{L}_1 \cup \mathfrak{L}_2 = (\langle max\{\mu_{\mathfrak{L}_1}, \mu_{\mathfrak{L}_2}\}, min\{\nu_{\mathfrak{L}_1}, \nu_{\mathfrak{L}_2}\}\rangle, \langle max\{\alpha_{\mathfrak{L}_1}, \alpha_{\mathfrak{L}_2}\}, min\{\beta_{\mathfrak{L}_1}, \beta_{\mathfrak{L}_2}\rangle)$

2. $\mathfrak{L}_1 \cap \mathfrak{L}_2 = (\langle min\{\mu_{\mathfrak{L}_1}, \mu_{\mathfrak{L}_2}\}, max\{\nu_{\mathfrak{L}_1}, \nu_{\mathfrak{L}_2}\}\rangle, \langle min\{\alpha_{\mathfrak{L}_1}, \alpha_{\mathfrak{L}_2}\}, max\{\beta_{\mathfrak{L}_1}, \beta_{\mathfrak{L}_2}\rangle)$.

3. ${\mathfrak{L}_1}^c = (\langle \nu_{\mathfrak{L}_1}, \mu_{\mathfrak{L}_1}\rangle, \langle \beta_{\mathfrak{L}_1}, \alpha_{\mathfrak{L}_1}\rangle)$

4. $\mathfrak{L}_1 \oplus \mathfrak{L}_2 = (\langle \mu_{\mathfrak{L}_1} + \mu_{\mathfrak{L}_2} - \mu_{\mathfrak{L}_1}\mu_{\mathfrak{H}}, \nu_{\mathfrak{L}_1}\nu_{\mathfrak{L}_2}\rangle, \langle \alpha_{\mathfrak{L}_1} + \alpha_{\mathfrak{L}_2} - \alpha_{\mathfrak{L}_1}\alpha_{\mathfrak{H}}, \beta_{\mathfrak{L}_1}\beta_{\mathfrak{L}_2}\rangle)$

5. $\mathfrak{L}_1 \otimes \mathfrak{L}_2 = (\langle \mu_{\mathfrak{L}_1}\mu_{\mathfrak{L}_2}\rangle, \nu_{\mathfrak{L}_1} + \nu_{\mathfrak{L}_2} - \nu_{\mathfrak{L}_1}\nu_{\mathfrak{L}_2}, \langle \alpha_{\mathfrak{L}_1}\alpha_{\mathfrak{L}_2}, \beta_{\mathfrak{L}_1} + \beta_{\mathfrak{L}_2} - \beta_{\mathfrak{L}_1}\beta_{\mathfrak{L}_2}\rangle)$

6. $\Omega\mathfrak{L}_1 = (\langle 1 - (1 - \mu_{\mathfrak{L}_1}^{\Omega}), (\nu_{\mathfrak{L}_1})^{\Omega}\rangle, \langle 1 - (1 - \alpha_{\mathfrak{L}_1})^{\Omega}, (\beta_{\mathfrak{L}_1})^{\Omega}\rangle)$, where $\Omega \in \mathbb{R}^+ - 0$.

6. ${\mathfrak{L}_1}^{\Omega} = (\langle (\mu_{\mathfrak{L}_1})^{\Omega}, 1 - (1 - \nu_{\mathfrak{L}_1})^{\Omega}\rangle, \langle (\alpha_{\mathfrak{L}_1})^{\Omega}, 1 - (1 - \beta_{\mathfrak{L}_1})^{\Omega}\rangle)$

Definition 2.4. [17] The term $\langle \mu, \nu\rangle, \langle \alpha, \beta\rangle$ is said to be Linear Diophantine Fuzzy Number(LDFN), which satisfies the conditions $0 \leq \alpha\mu + \beta\nu \leq 1$ with $0 \leq \alpha + \beta \leq 1$.

Definition 2.5. [17] Let $\mathfrak{G}$ = $(\langle \mu_{\mathfrak{G}}, \nu_{\mathfrak{G}}\rangle, \langle \alpha_{\mathfrak{G}}, \beta_{\mathfrak{G}}\rangle)$ be a LDFN over Ω. Then the score functionΨ of LDFN is characterized as

$$\Psi(\mathfrak{G}) = \frac{1}{2}[(\mu_{\mathfrak{G}} - \nu_{\mathfrak{G}}) + (\alpha_{\mathfrak{G}} - \beta_{\mathfrak{G}})]$$

3. A Proposed LDF-CODAS Technique

The Algorithmic process of our proposed LDF-CODAS was listed below.
Step 1: Assemble the LDF decision matrix $\mathfrak{Y}$.

$$\mathfrak{Y} = \begin{bmatrix} \mathfrak{l}_{11} & \mathfrak{l}_{12} & \dots & \mathfrak{l}_{1m} \\ \mathfrak{l}_{21} & \mathfrak{l}_{22} & \dots & \mathfrak{l}_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ \mathfrak{l}_{n1} & \mathfrak{l}_{n2} & \dots & \mathfrak{l}_{nm} \end{bmatrix}$$

where l_{rs} is a LDFN for the criteria s (s $\in \mathbb{N}$) by the alternative r (r $\in \mathbb{N}$).
Step 2: Normalise the decision matrix as $\mathfrak{N}$ = $[n_{rs}]$, where,

$$\mathfrak{N} = n_{rs} = \begin{cases} \frac{\mathfrak{l}_{rs}}{\max \mathfrak{l}_{rs}} & s \in \ Benifit\ type \\ \frac{\min \mathfrak{l}_{rs}}{\mathfrak{l}_{rs}} & s \in \ Cost\ type \end{cases} \tag{1}$$

Step 3: Compute the weighted normalized matrix

$$\mathfrak{X} = [x_{rs}], \tag{2}$$

$$x_{rs} = \omega_s \times n_{rs}. \tag{3}$$

where, ω_s is a weight for each criteria and $\omega \in [0,1]$ such that $\sum_s \omega_s = 1.$
Step 4: Evaluate the negative ideal solution NIS such that

$$NIS = [h_s^-]_{1\times m},\ where\ h_s^- = min x_{rs} \tag{4}$$

Step 5: Enumerate the Euclidean and Taxicab distance as follows:

$$\mathfrak{E}_r = \sqrt{\sum_{s=1}^{m}(x_{rs} - h_s^-)^2} \tag{5}$$

$$= \sqrt{\frac{1}{4}\sum_{s=1}^{m}\left[(\mu_{rs} - \mu_s^-)^2 + (\nu_{rs} - \nu_s^-)^2 + (\alpha_{rs} - \alpha_s^-)^2 + (\beta_{rs} - \beta_s^-)^2\right]} \tag{6}$$

$$\mathfrak{T}_r = \sqrt{\sum_{s=1}^{m}|x_{rs} - h_s^-|} \tag{7}$$

$$= \sqrt{\frac{1}{4}\sum_{s=1}^{m}\left[|\mu_{rs} - \mu_s^-| + |\nu_{rs} - \nu_s^-| + |\alpha_{rs} - \alpha_s^-| + |\beta_{rs} - \beta_s^-|\right]} \tag{8}$$

Step 6: Compute the Relative Assessment Matrix(RAM)

$$\mathfrak{D} = [d_{rs}] \tag{9}$$

$d_{rk} = (\mathfrak{E}_r - \mathfrak{E}_k) + (\phi(\mathfrak{E}_r - \mathfrak{E}_k) \times (\mathfrak{T}_r - \mathfrak{T}_k))$
where ϕ, which is indicated in the following, is the threshold function to determine whether the Euclidean distances of two distinct alternatives are equivalent.

$$\phi(z) = \begin{cases} 1 & if\ |z| \geq \gamma \\ 0 & if\ |z| < \gamma \end{cases} \tag{10}$$

The threshold parameter γ in the function above can be chosen and set by a DM or expert. γ lies in the range of 0.01 to 0.05. When the difference between two alternatives based on Euclidean distances exceeds the provided limit, it will keep calculating the taxi-cab distance of the two options. We choose γ =0.03 for the following computations in this study.
Step 7: Determine the evaluation score Δ for each alternative r,

$$\Delta_r = \sum_{k=1}^{n} d_{rk} \tag{11}$$

Step 8: Rank the alternatives based on evaluation score values in descending order.
The diagrammatic representation of the algorithmic process is shown in Figure 3.

4. Optimization of Emergency Logistics: A Case study

Emergency logistics is the process of planning, organizing, and carrying out the movement and distribution of products, services, and resources during and after emergencies or catastrophes. The

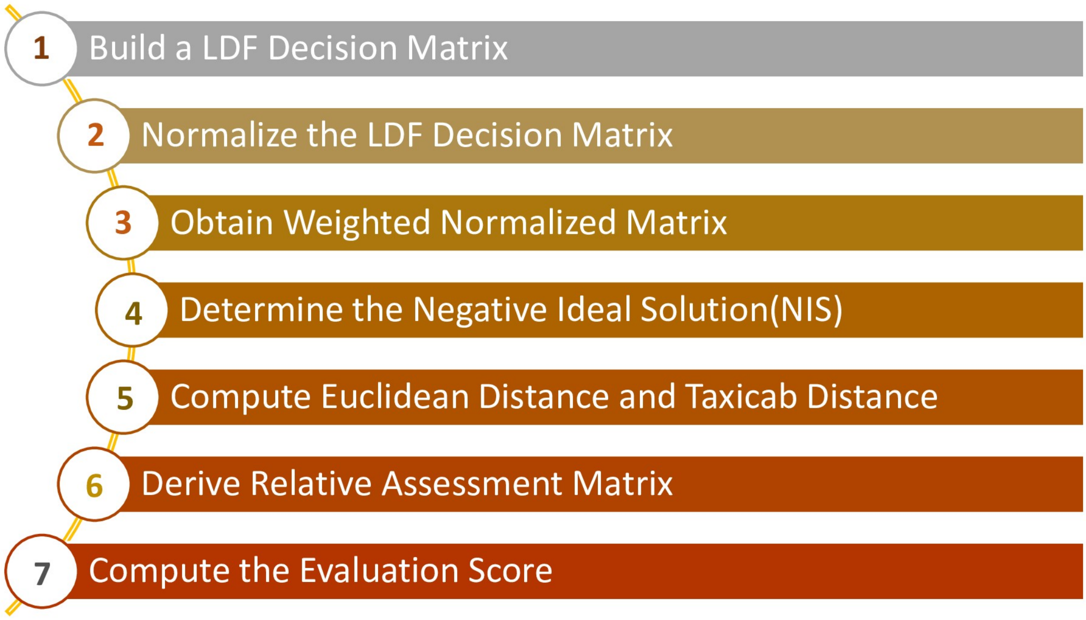

Fig. 3. LDF-CODAS Algorithmic Flow

fundamental purpose of emergency logistics is to guarantee that critical supplies, help, and relief materials reach affected areas and populations as soon as possible and in the most efficient manner possible. Disaster management and humanitarian response activities rely heavily on emergency logistics. Emergency logistics entails the planning, organization, and execution of the supply chain to ensure that crucial supplies such as food, water, medical equipment, shelter, and staff arrive in disaster-stricken areas as soon as possible. To guarantee a seamless response, it requires precise coordination among numerous parties, including government agencies, non-governmental organizations, and international groups. Transportation, warehousing, information systems, and communication networks must be managed effectively to reduce the impact of disasters, save lives, and aid in the recovery process. Emergency logistics, in essence, acts as the backbone of humanitarian relief efforts, giving timely aid to those in need at their most vulnerable times.

4.1 *Role of Logistics Specialist*

A logistics specialist's role in emergency logistics is critical for ensuring that resources and relief arrive in disaster-affected areas quickly and efficiently. Their knowledge of supply chain management, coordination, and adaptation is critical for saving lives and assisting communities in recovering from disasters. Also, a logistics specialist is critical in optimizing emergency logistics, which entails making the supply chain and resource management more efficient, cost-effective, and responsive during an emergency. Here are some major ways that a logistics specialist can help to improve emergency logistics:

1. Preparedness Planning: Logistics specialists work ahead of time to build thorough emergency response plans and tactics. This includes identifying potential risks, developing supply chain protocols, and developing contingency plans to enable a quick and effective response during a disaster.

2. Resource Allocation: They analyze historical data and utilize predictive modeling to identify the best resource allocation based on predicted demands during a crisis. This aids in ensuring that the appropriate resources are deployed to the appropriate locations at the appropriate time.

3. Supplier ties: It is critical to develop strong ties with dependable suppliers. To maintain a consistent flow of necessary commodities during catastrophes, logistics specialists negotiate contracts and form partnerships with suppliers.

4. Inventory Management: It is critical to keep an adequate supply of emergency supplies on hand. Inventory management strategies are used by logistics specialists to track stock levels and refill supplies as needed, minimizing shortages and surpluses.

5. technological Integration: To streamline logistics operations, they use technological solutions such as GPS tracking, real-time monitoring, and inventory management software. This enables better supply chain awareness and faster decision-making.

6. Transportation Efficiency: Logistics professionals optimize transportation routes and modes to reduce delivery times and costs. They may also plan for resource pre-positioning in crucial locations to allow speedy reaction.

7. Communication and Coordination: Effective communication and coordination with other stakeholders, such as government agencies, non-governmental organizations, and local governments, is crucial for optimizing logistics. They establish communication protocols to promote seamless information sharing and collaboration.

8. Data Analytics: Using data analytics, logistics specialists analyze and interpret real-time data to make informed decisions about resource allocation and distribution. This includes tracking demand patterns, transportation bottlenecks, and resource utilization.

9. Cost Control: Managing expenses efficiently is an important part of optimizing emergency logistics. Logistics specialists look for ways to cut costs while maintaining response quality and effectiveness. 10. They organize training sessions and disaster drills for logistical teams and responders to improve their skills and preparedness. Regular exercises aid in the identification of opportunities for improvement in logistics procedures.

10. Ongoing Improvement: Following each emergency response, logistics specialists undertake post-operation evaluations and debriefings. These evaluations' findings are utilized to modify and improve future emergency logistics strategies and procedures.

11. Risk Mitigation: It is critical to identify potential risks and weaknesses in the supply chain. Logistics professionals devise risk-mitigation techniques in response to obstacles such as road closures, natural disasters, and security concerns.

Logistics specialists contribute to a more efficient and effective response to catastrophes and emergencies by optimizing emergency logistics. Their knowledge of supply chain management, data analysis, and strategic planning is critical in saving lives and minimizing the impact of disasters on affected populations.

4.2 The need for Logistics Specialist

The selection of a logistics professional becomes essential for organizations, particularly in today's complicated and changing business climate. A logistics specialist has a plethora of experience in supply chain management, transportation, and distribution, allowing firms to effectively traverse the complexities of modern logistics. Their contribution is critical in optimizing operations, lowering costs, and assuring the efficient movement of goods and resources. Organizations can profit from improved productivity, better resource allocation, and increased customer satisfaction by making the right choice. Furthermore, a qualified logistics specialist can help organizations weather unanticipated interruptions and adapt to changing market conditions, contributing to supply chain resilience. Finally, hiring a logistics specialist is a strategic decision with far-reaching consequences for an organization's competitiveness, profitability, and ability to satisfy the demands of a dynamic global marketplace.

In the modern workplace, the need to hire a logistics specialist cannot be subtle. A logistics specialist brings specialized knowledge and abilities to the table. Logistics is the backbone of supply chain management. They may assist organizations in managing complicated challenges by optimizing operations, lowering costs, and increasing efficiency throughout the supply chain. Choosing the correct logistics specialist is critical in a globalized world where supply chains span countries and industries. They maintain regulatory compliance, effectively manage risks and respond quickly to disturbances or emergencies. Organizations that choose a logistics specialist strategically can not only improve their competitiveness and customer happiness but also establish resilience in their supply chains, allowing them to prosper in an ever-changing business climate.

4.3 Selection Criteria for Logistic Specialist

Based on the preceding case study, we developed five primary selection criteria for logistics specialists. These five criteria are as follows:

Transportation: Specialists in logistics are in charge of organizing and controlling cargo transportation. They must be able to identify the most effective and affordable means of transferring things by comprehending the many transportation options available. Additionally, they must be aware of the requirements of their clients and each step in the shipping procedure. In logistics, the four main means of transportation are by air, road, sea, and train. Depending on what is being shipped, where it is coming from, and where it is going, a different approach is employed. There could be a need for many approaches. And a logistics specialist should be aware of these all.

Technical: Technology is transforming the workplace, and the logistics industry is a prime example. In this industry, implementing new technology and automation is extremely important as businesses strive to remain competitive. This offers individuals fantastic chances to develop their skill sets over time. In order to monitor and manage the supply chain, inventory, transportation, movement of goods, customer database, customer behavior, and warehouse utilization, logistics leverages digital technologies significantly. Professionals in this field are skilled in carrying out routine activities if they possess basic IT abilities. For instance, businesses might engage personnel skilled in the use of spreadsheets for scheduling. Professionals should also become acquainted with the applications used by companies to manage their logistics procedures.

Decision-making: Making the greatest decisions for the client, team, and business requires the use of decision-making approaches and tactics. They may turn to you for leadership and rely on you to make crucial decisions in the production process. In the event of a supply chain emergency, specialists can also apply decision-making techniques to reach speedy conclusions. It's essential to establish and adhere to a precise decision-making process if you want to demonstrate that you can solve problems effectively and rapidly adjust to new scenarios. Professionals in logistics frequently manage extremely strategic choices, such as whether it is better to store something or make it to order. Other choices can deal with inventory deployment logic or inventory centralization.

Documentation: Any logistics specialist needs to be able to write appropriately, simply, and clearly. Effective writing abilities are required to interact with clients, suppliers, and other supply chain participants. Writing proposals, reports, and other documents that are precise, organized, and error-free is a skill required of logistics specialists.

Organization: Planning, carrying out, and managing an organization's effective use of its resources are all aspects of the organization. To ensure that resources are used effectively and efficiently, logistics specialists must be well-organized. As logistics specialists are in charge of making sure that resources and supplies are available when and where they are needed, planning is an essential skill for them. In order to be certain everything works appropriately, it is necessary to be able to plan ahead, anticipate needs, and create strategies. Having organizational structures that enable them to manage and monitor supply chain operations is crucial for logistics professionals. These people can manage distribution, plan product production, and meet deadlines by having good organizational skills. Strong organizational abilities are important in this profession because an ineffective organization can result in higher costs and dissatisfied customers.

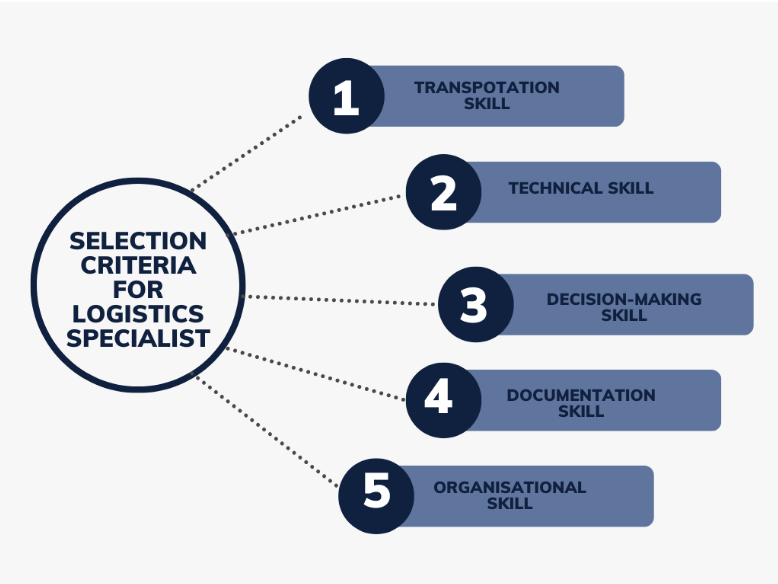

Fig. 4. Selection criteria of Logistics Specialist

4.4 *Mathematical Computation of proposed approach*

A Logistics company wants to take over an open job for the position of 'Logistic Specialist', who will be in charge of overseeing everyday operations. Following a pre-elimination in a pool of prospects, seven candidates are examined to hire a logistics specialist. They are reviewed by a group of experts as the HR manager, the Logistics Manager, the Vice president, and the Logistics Professional. The candidates are inspected based on their management skills, knowledge, and experience level using the following selection criteria: Transportation, Technical, Decision-making, Documentation, and Organization.

4.4.1 *Description of the Problem*

The five candidates are taken as a set of alternatives $\{\mathfrak{P}^{(1)}, \mathfrak{P}^{(2)}, \mathfrak{P}^{(3)}, \mathfrak{P}^{(4)}, \mathfrak{P}^{(5)}, \mathfrak{P}^{(6)}, \mathfrak{P}^{(7)}\}$. The selection criteria Figure 4 are taken as a parameter set $\{$ $\mathfrak{c}_1$(Transportation), $\mathfrak{c}_2$(Technical), $\mathfrak{c}_3$(Decision-making), $\mathfrak{c}_4$(Documentation), $\mathfrak{c}_5$(Organization)$\}$.

4.4.2 *Decision-making Process*

1. The LDF decision matrix is constructed as below;

$$
Y = \begin{bmatrix}
\langle 0.56, 0.42\rangle, & \langle 0.45, 0.65\rangle, & \langle 0.73, 0.24\rangle, & \langle 0.49, 0.53\rangle, & \langle 0.61, 0.34\rangle, \\
\langle 0.70, 0.25\rangle & \langle 0.79, 0.20\rangle & \langle 0.90, 0.07\rangle & \langle 0.76, 0.23\rangle & \langle 0.74, 0.16\rangle \\
\langle 0.72, 0.24\rangle, & \langle 0.51, 0.49\rangle, & \langle 0.80, 0.26\rangle, & \langle 0.54, 0.56\rangle, & \langle 0.83, 0.13\rangle, \\
\langle 0.84, 0.12\rangle & \langle 0.78, 0.21\rangle & \langle 0.83, 0.12\rangle & \langle 0.72, 0.13\rangle & \langle 0.91, 0.06\rangle \\
\langle 0.86, 0.15\rangle, & \langle 0.43, 0.71\rangle & \langle 0.66, 0.41\rangle, & \langle 0.62, 0.40\rangle, & \langle 0.73, 0.25\rangle, \\
\langle 0.79, 0.12\rangle & \langle 0.91, 0.06\rangle & \langle 0.79, 0.22\rangle & \langle 0.57, 0.41\rangle & \langle 0.84, 0.13\rangle \\
\langle 0.71, 0.32\rangle, & \langle 0.54, 0.41\rangle, & \langle 0.83, 0.19\rangle, & \langle 0.75, 0.20\rangle, & \langle 0.86, 0.12\rangle, \\
\langle 0.80, 0.16\rangle & \langle 0.71, 0.26\rangle & \langle 0.86, 0.11 & \langle 0.83, 0.10\rangle & \langle 0.86, 0.12\rangle \\
\langle 0.64, 0.43\rangle, & \langle 0.63, 0.26\rangle, & \langle 0.81, 0.26\rangle, & \langle 0.64, 0.73\rangle, & \langle 0.72, 0.17, \\
\langle 0.72, 0.26\rangle & \langle 0.82, 0.17\rangle & \langle 0.64, 0.31\rangle & \langle 0.84, 0.12\rangle & \langle 0.65, 0.13\rangle \\
\langle 0.54, 0.49\rangle, & \langle 0.72, 0.27\rangle, & \langle 0.65, 0.26\rangle, & \langle 0.86, 0.19\rangle, & \langle 0.54, 0.46\rangle, \\
\langle 0.76, 0.23\rangle & \langle 0.84, 0.15\rangle & \langle 0.86, 0.11\rangle & \langle 0.90, 0.06\rangle & \langle 0.77, 0.12\rangle \\
\langle 0.79, 0.21\rangle, & \langle 0.69, 0.20\rangle, & \langle 0.74, 0.13\rangle, & \langle 0.74, 0.31\rangle, & \langle 0.92, 0.19\rangle, \\
\langle 0.69, 0.30\rangle & \langle 0.76, 0.11\rangle & \langle 0.90, 0.06\rangle & \langle 0.83, 0.16\rangle & \langle 0.84, 0.12\rangle
\end{bmatrix}
$$

2. Since all the criteria are of the same type, there is no need for normalization.

3. The weighted decision matrix is computed by utilizing the formula [Eq. (2)] as follows:

$$
X = \begin{bmatrix}
\langle 0.1514, 0.8407\rangle, & \langle 0.0858, 0.9374\rangle, & \langle 0.1783, 0.8073\rangle, & \langle 0.1829, 0.8266\rangle, & \langle 0.1717, 0.8060\rangle, \\
\langle 0.2140, 0.7579\rangle & \langle 0.2087, 0.7855\rangle & \langle 0.2921, 0.6711\rangle & \langle 0.3483, 0.6435\rangle & \langle 0.2362, 0.6931\rangle \\
\langle 0.2248, 0.7517\rangle, & \langle 0.1015, 0.8985\rangle, & \langle 0.2145, 0.8170\rangle, & \langle 0.2078, 0.8403\rangle, & \langle 0.2984, 0.6649\rangle, \\
\langle 0.3069, 0.6544\rangle & \langle 0.2032, 0.7913\rangle & \langle 0.2334, 0.7276\rangle & \langle 0.3174, 0.5422\rangle & \langle 0.3822, 0.5697\rangle \\
\langle 0.3251, 0.6843\rangle, & \langle 0.0808, 0.9499\rangle, & \langle 0.1494, 0.8748\rangle, & \langle 0.2519, 0.7597\rangle, & \langle 0.2304, 0.7579\rangle, \\
\langle 0.2681, 0.6544\rangle & \langle 0.3032, 6557\rangle & \langle 0.2087, 0.7968\rangle & \langle 0.2237, 0.7653\rangle & \langle 0.3069, 0.6649\rangle \\
\langle 0.2193, 0.7962\rangle, & \langle 0.1100, 0.8748\rangle, & \langle 0.2334, 0.7795\rangle, & \langle 0.3402, 0.6170\rangle, & \langle 0.1848, 0.7579\rangle, \\
\langle 0.2752, 0.6931\rangle & \langle 0.1695, 0.8170\rangle & \langle 0.2554, 0.7181\rangle & \langle 0.4123, 0.5012\rangle & \langle 0.3251, 0.6544\rangle \\
\langle 0.1848, 0.8447\rangle, & \langle 0.1385, 0.8217\rangle, & \langle 0.2205, 0.8170\rangle, & \langle 0.2640, 0.9099\rangle, & \langle 0.2248, 0.7016\rangle, \\
\langle 0.2248, 0.7638\rangle & \langle 0.2268, 0.7666\rangle & \langle 0.1421, 0.8389\rangle & \langle 0.4229, 0.5294\rangle & \langle 0.1759, 0.6649\rangle \\
\langle 0.1438, 0.8670\rangle, & \langle 0.1738, 0.8217\rangle, & \langle 0.1457, 0.8170\rangle, & \langle 0.4456, 0.6076\rangle, & \langle 0.1438, 0.8562\rangle, \\
\langle 0.2483, 0.7453\rangle & \langle 0.2403, 0.7523\rangle & \langle 0.2554, 0.7181\rangle & \langle 0.4988, 0.4300\rangle & \langle 0.2547, 0.6544\rangle \\
\langle 0.2681, 0.7319\rangle, & \langle 0.1611, 0.7855\rangle, & \langle 0.1830, 0.7364\rangle, & \langle 0.3324, 0.7037\rangle, & \langle 0.3966, 0.7174\rangle, \\
\langle 0.2088, 0.7860\rangle & \langle 0.1927, 0.7181\rangle & \langle 0.2921, 0.6557\rangle & \langle 0.4123, 0.5771\rangle & \langle 0.3069, 0.6544\rangle
\end{bmatrix}
$$

4. To find the NIS, we have to find the minimum value for each column 's'. The minimum value is computed based on score function of LDFN. For criteria $\mathfrak{c}_1$, the minimum value is $\langle 0.1514, 0.8407\rangle$,

$\langle 0.2140, 0.7579\rangle$. Thus the NIS is derived

$$NIS = \begin{bmatrix} \langle 0.1514, 0.8407\rangle, & \langle 0.0858, 0.9374\rangle, & \langle 0.1494, 0.8748\rangle, & \langle 0.2519, 0.7597\rangle, & \langle 0.1438, 0.8562\rangle, \\ \langle 0.2140, 0.7579\rangle & \langle 0.2087, 0.7855\rangle & \langle 0.2087, 0.7968\rangle & \langle 0.2237, 0.7653\rangle & \langle 0.2547, 0.6544\rangle \end{bmatrix}$$

5. The Euclidean distance $\mathfrak{E}_i$ and Taxicab distance $\mathfrak{T}_i$ is enumerated by using the formula Eq. (6), Eq. (8). The values are given in Table 2.

Table 2
Euclidean distance $\mathfrak{E}_i$ and Taxicab distance $\mathfrak{T}_i$

Alternatives	$\mathfrak{E}_i$	$\mathfrak{T}_i$
$\mathfrak{P}^{(1)}$	0.1350	0.8232
$\mathfrak{P}^{(2)}$	0.2227	1.6410
$\mathfrak{P}^{(3)}$	0.1690	0.9770
$\mathfrak{P}^{(4)}$	0.2213	1.5940
$\mathfrak{P}^{(5)}$	0.2161	1.4106
$\mathfrak{P}^{(6)}$	0.2673	1.4923
$\mathfrak{P}^{(7)}$	0.2615	1.9229

6. The RAM $\mathfrak{D}$ is calculated by using the Eq. (9), Eq. (10). The threshold value Θ is taken as 0.03.

$$\mathfrak{D} = \begin{bmatrix} 0.0000 & -0.9055 & 0.1198 & -0.8571 & -0.6685 & -0.8014 & -1.2262 \\ 0.9055 & 0.0000 & -0.6104 & 0.0484 & 0.2370 & 0.1041 & -0.3207 \\ 0.1877 & -0.7178 & 0.0000 & -0.6694 & -0.4808 & -0.6137 & -1.0385 \\ 0.8571 & -0.0484 & -0.5647 & 0.0000 & 0.1886 & 0.0557 & -0.3691 \\ 0.6685 & -0.2370 & -0.3865 & -0.1886 & 0.0000 & -0.1329 & -0.5577 \\ 0.8014 & -0.1041 & -0.4170 & -0.0557 & 0.1329 & 0.0000 & -0.4248 \\ 1.2262 & 0.3207 & -0.8534 & 0.3691 & 0.5577 & 0.4248 & 0.0000 \end{bmatrix}$$

7. The Evaluation Scores of each alternative are computed by utilizing the formula Eq. (11).

$$\Delta_1 = -4.3387 : \Delta_2 = 0.3639 : \Delta_3 = -3.3323 :$$
$$\Delta_4 = 0.1190 : \Delta_5 = -0.8344 : \Delta_6 = -0.0670 :$$
$$\Delta_7 = 2.0448$$

8. The rank of alternatives is $\mathfrak{P}^{(7)} > \mathfrak{P}^{(2)} > \mathfrak{P}^{(4)} > \mathfrak{P}^{(6)} > \mathfrak{P}^{(5)} > \mathfrak{P}^{(3)} > \mathfrak{P}^{(1)}$

Thus, the candidate $\mathfrak{P}^{(7)}$ is the most suitable for the position logistic specialist.

4.5 Sensitivity analysis

A sensitivity analysis of the weight assigned to each of the five criteria was done for this section.The criteria $\mathfrak{c}_4$ were deemed to be the most desirable in the suggested study. The results of changing the highest preference are examined in multiple scenarios.
Case 1: The higher preference is given to the criteria $\mathfrak{c}_5$. ω = (0.2, 0.15, 0.15, 0.2, 0.3). The RAM and

the final evaluation score are as follows.

$$\mathfrak{D} = \begin{bmatrix} 0.1869 & -0.7186 & -0.0212 & -0.6702 & -0.4816 & -0.6145 & -1.0393 \\ 1.3962 & 0.4907 & -0.9342 & 0.5391 & 0.7277 & 0.5948 & 0.1700 \\ 0.9560 & 0.0505 & -0.6294 & 0.0989 & 0.2875 & 0.1546 & -0.2702 \\ 0.8384 & -0.0671 & -0.5690 & -0.0187 & 0.1699 & 0.0370 & -0.3878 \\ 0.7802 & -0.1253 & -0.4778 & -0.0769 & 0.1117 & -0.0212 & -0.4460 \\ 0.5749 & -0.3306 & -0.3539 & -0.2822 & -0.0936 & -0.2265 & -0.6513 \\ 1.4372 & 0.5317 & -0.9752 & 0.5801 & 0.7687 & 0.6358 & 0.2110 \end{bmatrix}$$

$\Delta_1 = -3.3587, \Delta_2 = 2.9844, \Delta_3 = 0.6478, \Delta_4 = 0.0029, \Delta_5 = -0.2556, \Delta_6 = -1.3634, \Delta_7 = 3.1894$

Thus, the rank of alternatives is $\mathfrak{P}^{(7)} > \mathfrak{P}^{(2)} > \mathfrak{P}^{(3)} > \mathfrak{P}^{(4)} > \mathfrak{P}^{(5)} > \mathfrak{P}^{(6)} > \mathfrak{P}^{(1)}$

Case 2: The higher preference is given to the criteria $\mathfrak{c}_1$. ω = (0.3, 0.15, 0.15, 0.2, 0.2). The RAM and the final evaluation score are as follows.

$$\mathfrak{D} = \begin{bmatrix} 0.2497 & -0.6558 & -0.0970 & -0.6074 & -0.4188 & -0.5517 & -0.9765 \\ 1.2877 & 0.3822 & -0.8932 & 0.4306 & 0.6192 & 0.4863 & 0.0615 \\ 1.0537 & 0.1482 & -0.6502 & 0.1966 & 0.3852 & 0.2523 & -0.1725 \\ 0.8162 & -0.0893 & -0.5466 & -0.0409 & 0.1477 & 0.0148 & -0.4100 \\ 0.8114 & -0.0941 & -0.5630 & -0.0457 & 0.1429 & 0.0100 & -0.4148 \\ 0.4772 & -0.4283 & -0.2573 & -0.3799 & -0.1913 & -0.3242 & -0.7490 \\ 1.2338 & 0.3283 & -0.8505 & 0.3767 & 0.5653 & 0.4324 & 0.0076 \end{bmatrix}$$

$\Delta_1 = -3.0573, \Delta_2 = 2.3741, \Delta_3 = 1.2132, \Delta_4 = -0.1082, \Delta_5 = -0.1531, \Delta_6 = -1.8531, \Delta_7 = 2.0935$

Thus, the rank of alternatives is $\mathfrak{P}^{(2)} > \mathfrak{P}^{(7)} > \mathfrak{P}^{(3)} > \mathfrak{P}^{(5)} > \mathfrak{P}^{(4)} > \mathfrak{P}^{(6)} > \mathfrak{P}^{(1)}$

Case 3: The higher preference is given to the criteria $\mathfrak{c}_2$. ω = (0.2, 0.3, 0.15, 0.15, 0.2). The RAM and the final evaluation score are as follows.

$$\mathfrak{D} = \begin{bmatrix} 0.5186 & -0.3869 & -0.2847 & -0.3385 & -0.1499 & -0.2828 & -0.7076 \\ 1.3587 & 0.4532 & -1.0031 & 0.5016 & 0.6902 & 0.5573 & 0.1325 \\ 1.2873 & 0.3818 & -0.8347 & 0.4302 & 0.6188 & 0.4859 & 0.0611 \\ 0.6471 & -0.2584 & -0.4336 & -0.2100 & -0.0214 & -0.1543 & -0.5791 \\ 1.1017 & 0.1962 & -0.7216 & 0.2446 & 0.4332 & 0.3003 & -0.1245 \\ 0.6870 & -0.2185 & -0.3398 & -0.1701 & 0.0185 & -0.1144 & -0.5392 \\ 1.5646 & 0.6591 & -1.0748 & 0.7075 & 0.8961 & 0.7632 & 0.3384 \end{bmatrix}$$

$\Delta_1 = -1.6320, \Delta_2 = 2.6905, \Delta_3 = 2.4302, \Delta_4 = -1.0098, \Delta_5 = 1.4299, \Delta_6 = -0.6766, \Delta_7 = 3.8542$

Thus, the rank of alternatives is $\mathfrak{P}^{(7)} > \mathfrak{P}^{(2)} > \mathfrak{P}^{(3)} > \mathfrak{P}^{(5)} > \mathfrak{P}^{(6)} > \mathfrak{P}^{(4)} > \mathfrak{P}^{(1)}$

Case 4: The higher preference is given to the criteria $\mathfrak{c}_3$. ω = (0.2, 0.15, 0.3, 0.15, 0.2). The RAM and the final evaluation score are as follows.

$$\mathfrak{D} = \begin{bmatrix} 0.8765 & -0.0290 & -0.4445 & 0.0194 & 0.2080 & 0.0751 & -0.3497 \\ 1.6211 & 0.7156 & -1.1573 & 0.7640 & 0.9526 & 0.8197 & 0.3949 \\ 1.2729 & 0.3674 & -0.9282 & 0.4158 & 0.6044 & 0.4715 & 0.0467 \\ 1.1362 & 0.2307 & -0.7192 & 0.2791 & 0.4677 & 0.3348 & -0.0900 \\ 0.8086 & -0.0969 & -0.4905 & -0.0485 & 0.1401 & 0.0072 & -0.4176 \\ 0.6808 & -0.2247 & -0.3462 & -0.1763 & 0.0123 & -0.1206 & -0.5454 \\ 1.7516 & 0.8461 & -1.1809 & 0.8945 & 1.0831 & 0.9502 & 0.5254 \end{bmatrix}$$

$\Delta_1 = 0.3556, \Delta_2 = 4.1107, \Delta_3 = 2.2508, \Delta_4 = 1.6393, \Delta_5 = -0.0977, \Delta_6 = -0.7200, \Delta_7 = 4.8698$

Thus, the rank of alternatives is $\mathfrak{P}^{(7)} > \mathfrak{P}^{(2)} > \mathfrak{P}^{(3)} > \mathfrak{P}^{(4)} > \mathfrak{P}^{(1)} > \mathfrak{P}^{(5)} > \mathfrak{P}^{(6)}$.

It is evident from the findings that the suggested method is sensitive to the criteria weights. The order's rank also slightly varies as we adjust the weight preferences.

5. Conclusion

This work presents a novel way to address decision-making difficulties under uncertainty by effectively integrating the CODAS method with the LDFS. The LDF offers a broad range of grade values, making this method suitable for all types of data sets. In this study, we identify the best logistics specialist using the CODAS method, which excels by incorporating two distance measures, leading to more accurate results. With its adaptable framework that manages imprecision and ambiguity, the LDF CODAS technique greatly improves decision-making—a critical feature for intricate situations. Its real-world impact is demonstrated by its practical implementation in the process of choosing a logistics specialist, which enhances operational decision-making and efficiency. Furthermore, the scalability of the system implies that it has the potential to be applied more widely across many industries, providing a trustworthy instrument for future decision-making difficulties. The sensitivity study supports the LDF CODAS method's robustness by demonstrating its ability to tolerate changes in input parameters without compromising consistent results. This work expands the use of fuzzy sets in decision-making and presents a potent tool for further investigation and real-world applications in domains that need complex decision-making in the face of uncertainty. The knowledge gathered from this study can be used in various fields, promoting additional investigation and improvement of fuzzy-based decision-making models. As our theory offers numerous advantages, it also has certain limitations. When the reference parameter values add up to more than one, our proposed theory is unable to manage the situation. Also, while dealing with large amounts of data, the computation of the proposed model could be laborious. In the future, several MCDM methods such as PROMTHEE, EDAS, and VIKOR, TODIM, DEMATEL approaches will be employed in various fields such as medicine, agriculture, economics, and society.

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Conflicts of Interest

The authors declare no conflicts of interest.

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