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Selection of Twin Engine Multirole Fighter Aircraft Using Multiple Criteria Decision-Making Analysis (MCDMA)

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Abstract: This study aims to select a twin-engine multirole fighter employing multiple criterion decision-making analysis (MCDMA) technique. In this process, competing goals and objectives must be balanced, especially when it comes to the price of purchasing, maintaining, and updating the fleet. Deciding on the many possibilities accessible can be efficiently assisted by multiple criterion decision-making analysis methodologies. The subject-specific literature was consulted to develop the selection criteria, and the analysis technique is utilised to ascertain the optimal planning methodology for defence procurement and fleet upgrades in addition to which fighter aircraft should be purchased for the air defence force. The research project explores subject-specific literature in search of strong selection criteria, guaranteeing a thorough basis for assessment. The analysis technique used not only helps identify the best planning approach for defense acquisitions and fleet modernizations, but it also supports the critical choice of which fighter aircraft is best suited for the air defense force. This study adds to the strategic framework guiding defense procurement by highlighting the need for a comprehensive approach in selecting a twin-engine multirole fighter that aligns with a variety of operational requirements and budgetary considerations. It does this by combining literature insights with advanced decision-making methodologies. Overall, the aim is to make an informed and strategic decision that will benefit the air force in the long run. The purpose of this work is to provide a method for evaluating the fighter aircraft alternatives DassaultRafale, Eurofighter Typhoon, FA18 Super Hornet, Mig-35, Su-35, and F-15EX based on a technique for order preference by the resemblance to the ideal solution (TOPSIS).

Keywords: Fighter Aircraft, TOPSIS, MCDMA, Euclidean Distance, Entropy Index, Mean Index, Weighted Product Model, Weighted Sum Model

1. Introduction

A type of fighter plane known as a twin-engine fighter aircraft makes use of two engines for increased performance, dependability, and redundancy. These aircraft can fly at higher altitudes and speeds while towing heavier cargo than single-engine fighters. They are often bigger and heavier. They are suitable for long-range and air superiority missions. An actual instance was given to show the value of the suggested process for choosing combat aircraft. To rank the possibilities and determine the best option, the system considers several dimensions and aspects. To reach the required performance levels while developing new multirole fighter aircraft, ultracritical design criteria are required. Particularly in military stealth fighter aircraft, a variety of design indicators must be considered and optimised to encourage effective creation and achieve desired objectives.

Twin-engine fighter aircraft have some advantages over their single-engine counterparts, but they also have some disadvantages. They are typically more expensive to operate and maintain and require more runway space for take-off and landing. They also have a larger radar signature, making them easier to detect by enemy radar systems. In general, choosing a modern twin-engine fighter aircraft is an extremely difficult decision that is influenced by numerous economic, geopolitical, and technical limitations. The needs for strategic, tactical, operational, and dynamic defence must also be met by an air force. Hence, to choose a fighter aircraft under various, competing choice criteria, strategic planning is crucial.

TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) is a multiple criteria decision-making (MCDM) methods used to evaluate and rank a set of alternatives based on multiple criteria. It was developed by Hwang and Yoon in 1981 and has since become a widely used decision-making technique in various fields.

The purpose of this study is to find a solution to the Air Force's issue with aircraft selection. This entails replacing its ageing fleet, fulfilling needs to combat foes and terrorist operations, and considering diplomatic and financial limits. It is crucial to remember that a lot of criteria for making decisions have the difficult decision problem built right in. Among these options, we selected a twin-engine fighter aircraft for our comparative study of the two methods. There are two categories of qualities: cost-beneficial and non-beneficial, both of which contain all other attributes. This study yielded several rankings of fighter aircraft using various techniques. When faced with several choices and various conflicting (ie., "benefit" and "cost") and noncom mensurable decision criteria, the multiple criteria decision-making analysis (MCDMA) approach (ie., compensatory / no compensatory) is used to arrive at an optimal decision solution [1].

For the Taiwan Air Force, the TOPSIS application was taken into consideration when evaluating initial training aircraft in a fuzzy environment. The importance weights of the evaluation criteria were calculated using the fuzzy multiple criteria decision-making analysis approach, and the ratings of the candidate aircraft were combined. Combined the preferences of the assessors, and TOPSIS was used to get a clear overall performance rating for each option to reach a judgement [2].

The weights of the criteria were determined using the Analytic Hierarchy Process (AHP), and the alternatives were assessed using the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). A set of choice criteria were used to determine which military training aircraft was best [3].

With the help of the Analytic Hierarchy Process (AHP) and Cost Benefit Analysis, the problem of choosing military aircraft for the Pakistan Air Force was taken into consideration (CBA). Ten technical and financial parameters were used to compare six different aircraft [4].

Also, fleet planning is a mid and long-term strategic decision that has an impact on the financial health of airlines because it entails a sizeable capital expenditure with a long-term perspective. The airline's fleet planning process is a critical example of a multiple-criteria decision-making (MCDM) analysis that considers several important evaluation factors [5].

MCDMA issues and evaluation procedures frequently entail subjective judgements and produce data that is qualitatively imperfect. Decisions in mathematics, engineering, or management are frequently made using the data and information that is currently accessible, which is frequently ambiguous, imprecise, and unclear. One of these typical instances, which frequently requires some approach to deal with ambiguous facts and information, is the decision-making process in engineering schemes produced during the concept design phase. Designers frequently present a wide range of options throughout the design phase. Nonetheless, the subjective qualities of the choices are frequently ambiguous and must be assessed with insufficient information and judgement on the part of the decision maker [7].

DUD and Topsis approaches mentioned here can be utilized to help design an acceptable strategy for enhancing the performance of aircraft selection problems based on the efficacy of several types of metrics, with both theoretical and industrial management consequences. Comparing the success of other industries is another benefit of the process. The results of this study have considerable managerial implications for the industry. To increase the effectiveness of the aircraft selection process, management can acquire greater insights and recommendations for identifying various decisions regarding the improvement of operations and processes. It is a useful instrument for assessing, categorizing, contrasting, and ranking aircraft performance. Managers in the aviation industry will gain a better understanding of the changes they must make to their aircraft selection procedures if they wish to increase performance while taking changing market conditions into account. The MCDM research problem is to identify the appropriate aircraft types using both the entropic weight method (EWM) and Topsis, which should be selected for fleet optimization in a particular airline based on the precise criteria established by experts. In the relevant literature, choosing aircraft for airlines is a more common difficulty [8].

The process of multiple criteria decision-making analysis typically entails selecting one option from a range of choices. Making the decision that will produce the best results is what decides efficiency. The viable options chosen for goal attainment and evaluation are contrasted using criteria and taking attribute influence into account. Because they consider not just technical difficulties but also value judgements, assess alternatives to solve real problems, and exhibit a high level of interdisciplinary, MCDMA approaches are highly helpful in this context to support the decision-making process [9].

This paper focuses on the selection of the best military attack helicopter for the Armed Forces to enhance their reconnaissance and offensive combat capabilities in military operations. The study employs a multiple criteria decision analysis method combined with the variance weight procedure to rank and prioritize the nine military attack helicopter models based on strategic, tactical, and operational criteria. The selection of the military attack helicopter is crucial for ensuring the sovereignty and strategic interests of the country and supporting its foreign policy. The paper highlights the importance of the national defence strategy in guiding the strategic planning of the Armed Forces and the employment of Airpower. Among the analysed military attack helicopters, ATAK T629, Mi-28NE, Ka-52 Alligator, and AH-64E APACHE are identified as the top-performing options based on unweighted, mean-weighted, and variance-weighted evaluations in the multiple criteria decision-making analysis. The results provide transparency and simplicity to the decision-making process for the Armed Forces [10].

To address the issue of choosing a freighter aircraft through multiple criterion decision analysis, the study suggests a technique termed entropic programming. The suggested strategy offers a thorough and well-structured framework for assessing and rating the best freighter aircraft alternatives. By an analysis of research data, the study defines decision criteria and aircraft options and then uses the mean weight methodology and standard deviation method to assign objective criteria weights. The results demonstrate that the entropic programming approach is a practical, efficient, and reliable solution for decision-making analysis issues when applied to real-world decision issues. According to the analysis, the Boeing B747-8F freighter is the top contender for fulfilling the requirements [14].

The use of various criterion decision-making analytic techniques to identify the best regional aircraft for aviation operators is covered in this study. The study uses a variety of decision-making techniques, such as preference analysis for the optimal reference solution, to assess nine regional aircraft models (PARIS). Several business tactics are used by the aviation sector to achieve a competitive edge, and operators must make strategic choices to create a successful business strategy by utilising a long-term fleet structure [21].

The proposed multiple-criteria decision-making analysis model is based on the integrated entropy index process and the additive multiple-criteria decision-making theory. Seven different models of fighter aircraft are compared using a variety of design criteria, and it is found that the suggested method is effective for selecting the best alternative. The study emphasises how important it is to consider uncertainty and weighting considerations while selecting a combat aircraft. It should be emphasised, nevertheless, that different methods for standardising data, weighing factors, and making decisions based on a variety of factors may lead to different results. The seventh alternative with the highest effectiveness is picked as the best choice since the decision analysis results are frequently consistent across many situations [22].

2. Methodology

A. Technique for Order Preference by Similarity to Ideal Solution (TOPSIS):

Multiple standards prioritizing or selecting an alternative from a set of accessible alternatives while considering numerous selection criteria is the process of decision-making. Evaluation (MCDMA) multiple criteria decision-making analysis problems are solved using the TOPSIS MCDMA model, a method for ordering preference by similarity to the ideal solution. It is predicated on the notion that the chosen alternative ought to be, on the positive side, the closest to the perfect solution and, on the negative side, the farthest from it.

Examples include the positive ideal solution, which optimizes functionality while minimizing expense, and the negative ideal solution, which maximizes cost while minimizing functionality. The best feasible values of the criteria make up the positive ideal solution, and the worst achievable values of the criteria make up the negative ideal solution. The performance evaluations and the weights of the criteria are specified in this manner as precise numbers or linguistic variables. The model's operational steps are as follows:

Step 1: Establish the decision matrix

$$X = \begin{pmatrix} x_1 \\ \vdots \\ x_i \end{pmatrix} \begin{pmatrix} g_1 & \cdots & g_j \\ x_{11} & & x_{1j} \\ \vdots & \ddots & \vdots \\ x_{i1} & \cdots & x_{ij} \end{pmatrix}$$

Where $X_i = (x_1, x_2, x_3, \ldots, x_i)$ denote the set of all the alternatives under evaluation. Assume that the preference of the alternatives $(x_1, x_2, x_3, \ldots, x_i)$ with respect to a single criterion g_j is completely known and measured explicitly.

Step 2: Normalize the decision matrix

$$n_{ij} = \frac{g_j(a_i)}{\sqrt{\sum_{i=1}^{I} g_j(a_i)^2}}$$

$\{i = 1, 2, \ldots, I\}$

$\{j = 1, 2, \ldots, J\}$

where g_j is the deterministic value of alternative *i* for criterion g_j. n_{ij} is the normalized criteria values of alternatives.

Step 3: By multiplying the normalised decision matrix by the related weights, one may calculate the weighted normalised decision matrix as follows:

$$u_{ij} = \omega_j n_{ij}$$

Where ω_j is the weight of the jth criterion g_j.

Step 4: Identify the positive ideal solution (a*) and negative ideal solution (a**)

$a^* = \{u_1^*, \ldots, u_n^*\} = \{(\max u_{ij} | j \in I), (\min u_{ij} | j \in I)\}$

$a^{**} = \{u_1^{**}, \ldots, u_n^{**}\} = \{(\min u_{ij} | j \in I), (\max u_{ij} | j \in I)\}$

Step 5: Calculate each alternative's Euclidean distance from the ideal solutions, both positive and negative.

$$D_i^* = \sqrt{\sum_{J=1}^{J} \left(U_j^* - U_{ij}\right)^2}$$

$$D_i^{**} = \sqrt{\sum_{J=1}^{J} \left(U_{ij} - U_j^{**}\right)^2}$$

Step 6: Compute the *i*th alternative's relative proximity coefficient to the ideal answer.

$$C_i = \frac{D_i^{**}}{D_i^{**} + D_i^*}$$

Step 7: Rank all alternatives based on ascending values of $C_i (0 \le C_i \le 1)$ and select the optimal one.

B. Euclidean Distance MCDMA Model:

The optimal solution is located by the Euclidean distance

MCDMA model in the feasible area of the n-dimensional space that is closest to the optimal point. The model's operational steps are as follows:

Step 1: Establish the decision matrix

$$X = \begin{pmatrix} x_1 \\ \vdots \\ x_i \end{pmatrix} \begin{pmatrix} g_1 & \cdots & g_j \\ x_{11} & & x_{1j} \\ \vdots & \ddots & \vdots \\ x_{i1} & \cdots & x_{ij} \end{pmatrix}$$

Where $X_i = (x_1, x_2, x_3, \ldots, x_i)$ denote the set of all the alternatives under evaluation. Assume that the preference of the alternatives $(x_1, x_2, x_3, \ldots, x_i)$ with respect to a single criterion g_j is completely known and measured explicitly.

Step 2: Normalize the decision matrix

$$n_{ij} = \frac{g_j(a_i)}{\sqrt{\sum_{i=1}^{I} g_j(a_i)^2}}$$

$\{i = 1, 2, \ldots, I\}$

$\{j = 1, 2, \ldots, J\}$

where g_j is the deterministic value of alternative *i* for criterion g_j. $n_{ij}$is the normalized criteria values of alternatives.

Step 3: By multiplying the normalised decision matrix by the related weights, one may calculate the weighted normalised decision matrix as follows:

$$u_{ij} = \omega_j n_{ij}$$

Where ω_j is the weight of the jth criteriong_j.

Step 4: Identify the positive ideal solution (a*) vector

$a^* = \{u_1^*, \ldots, u_n^*\} = \{(\max u_{ij} | j \in I), (\min u_{ij} | j \in I)\}$

Step 5: Calculate each alternative's Euclidean distance from the ideal solutions, both positive and negative.

$$D_i^* = \sqrt{\sum_{J=1}^{J} \left(U_j^* - U_{ij}\right)^2}$$

Step 6: Rank all alternatives based on ascending values of D_i $(0 \le D_i \le 1)$ and select the optimal one.

C. Weighted Sum Model (WSM) or Simple Additive Weighting (SAW):

An example of a mathematical model used in decision-making is the weighted sum model, which assesses the desirability of various possibilities based on a set of criteria.

The model entails giving each criterion a weight to indicate its relative importance to the decision-making process. Usually, the decision maker chooses the weights depending on his or her priorities and preferences.

Each choice is assessed after the weights have been given, taking into account how well it meets each condition. Each option for each criterion is often given a score or rating as part of this review, with higher values signifying greater performance.

Step 1: Establish the decision matrix

$$X = \begin{pmatrix} x_1 \\ \vdots \\ x_i \end{pmatrix} \begin{pmatrix} g_1 & \cdots & g_j \\ x_{11} & & x_{1j} \\ \vdots & \ddots & \vdots \\ x_{i1} & \cdots & x_{ij} \end{pmatrix}$$

Where $X_i = (x_1, x_2, x_3, \ldots, x_i)$ denote the set of all the alternatives under evaluation. Assume that the preference of the alternatives $(x_1, x_2, x_3, \ldots, x_i)$ with respect to a single criterion g_j is completely known and measured explicitly.

Step 2: Categorization of attributes

1. Benefit
2. Cost

Step 3: Normalization of the decision matrix

$$\text{Benefit} = \frac{x_{ij}}{\text{Sum}(x_{ij})} = r_{ij}$$

$$\text{Cost} = \frac{\frac{1}{x_{ij}}}{\text{Sum}\left(\frac{1}{x_{ij}}\right)} = r_{ij}$$

Step 4: Using the weight calculation by entropy method and standard deviation method

Step 5: Calculating the global score for each alternative using

$$\nu(A_i) = \sum_{j=1}^{n} \omega_j r_{ij}$$

From this which value $\nu(A_i)$ is high that is the best option.

D. Weighted Product Model (WPM):

The decision-making model by multiplication in linking an attribute rating includes the Weighted Product (WP) technique. Weight for characteristics acts as a favourable ranking in the attribute rating and acts as a negative rank for the cost attribute in the multiplication procedure between attributes.

Step 1: Establish the decision matrix

$$X = \begin{pmatrix} x_1 \\ \vdots \\ x_i \end{pmatrix} \begin{pmatrix} g_1 & \cdots & g_j \\ x_{11} & & x_{1j} \\ \vdots & \ddots & \vdots \\ x_{i1} & \cdots & x_{ij} \end{pmatrix}$$

Where $X_i = (x_1, x_2, x_3, \ldots, x_i)$ denote the set of all the alternatives under evaluation. Assume that the preference of the alternatives $(x_1, x_2, x_3, \ldots, x_i)$ with respect to a single criterion g_j is completely known and measured explicitly.

Step 2: Categorization of attributes

1. Benefit
2. Cost

Step 3: Normalization of the decision matrix

$$\text{Benefit} = \frac{x_{ij}}{Sum(x_{ij})} = r_{ij}$$

$$\text{Cost} = \frac{\frac{1}{x_{ij}}}{Sum\left(\frac{1}{x_{ij}}\right)} = r_{ij}$$

Step 4: Using the weight calculation by entropy method and standard deviation method

Step 5: Calculating the global score for each alternative using

$$\nu(A_j) = \prod_{1}^{n} (r_{ij})^{\omega_j}$$

From this which value $\nu(A_i)$ is high that is the best option.

E. Techniques of Objective Weighting for Calculating Criterion Weights:

a. Entropy Index- Entropy pertains to the level of diversity within an attribute dataset in multiple criteria decision analysis. The weight of that attribute increases with the degree of diversity.

In other words, the stronger the discrimination strength of a characteristic in shifting ranks of alternatives, the less entropy within the data connected to the trait.

Entropy, which is related to the number of alternate outcomes for a physical system once all the information that can be observed at a macroscale has been recorded, is related to incomplete information. The following are the steps involved in the calculation of entropy weights.

Step 1: Normalizing the decision matrix

A given decision matrix should first be translated into a dimensionless space since measured data under various criteria can have different units or scales:

$$P_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}}$$

i = 1, 2, …, m

j = 1, …, n

where x_{ij} represents an ith alternative and the jth criterion in the decision matrix. The total number of options is m, while the number of criteria is n.

Step 2: Calculate the entropy (e_j) and the level of diversity in step two (d_j). It is possible to calculate the entropy inside the datasets of the normalised decision matrix for the jth criterion.

$$e_j = -\frac{1}{\ln(m)} \sum_{i=1} P_{ij} \ln p_{ij}$$

The degree of diversity (d_j) is then calculated as

$$d_j = 1 - e_j$$

Step 3: The objective weights are calculated (ω_j).

Finding the relative objective weight of each criterion by linearly normalisingd_j:

$$\omega_j = \frac{d_i}{\sum_{j=1}^{n} d_j}$$

$$\sum_{j=1}^{n} \omega_j = 1,\ \omega_j > 0,\ j = 1, \ldots, n$$

Where ω_j is the objective weight of the jth criterion which the entropy method assigns.

b. Mean Index

The Mean Index is a method used in Multiple Criteria Decision Analysis (MCDA) when there is minimal knowledge about the priorities of criteria and limited input from the decision maker. It is particularly useful when there is a lack of information or when the available information is not sufficient to make a decision.

$$\omega_j = \frac{1}{n},\ j = 1,2, \ldots, n$$

Where ω_j is the objective weight of attributes which the mean weight method assigns.

3. Application

In this section, Entropy Index (EI), Mean Index (MI) are taken into consideration to conduct the sensitivity analysis in order to show the applicability of the multiple criteria decision analysis technique on the problem of selecting Twin engine fighter aircraft.

Higher values are preferred for eight choice features (g1, g2, g3, g4, g5, g6, g7 and g8) that are useful criteria.

The decision problem chooses the best alternative from the alternatives that were chosen after taking these evaluation factors into account. The following selection factors should be considered while purchasing Twin engine fighter aircraft. Maximum speed (Mach number), service ceiling (km), combat range (km), maximum take-off weight (kg), manoeuvrability (linguistic variable (high-low)), Maximum Payload, Ferry range (km), Price are all listed in the graphs below. It is seen to be best to choose the best for a country's protection. Table 1 lists the definitions of the deciding criteria for fighter aircraft.

Table 1. *Definition of Decision Criteria.*

Decision Criteria	Definition
Price (g1)	The price that must be paid to purchase a particular good.
Maximum Take-off Weight (MTOW) (g2)	The maximum weight that can be attempted to takeoff due to structural or other limitations is known as the maximum take-off weight (MTOW) in kilogrammes.
Maximum Pay Load (g3)	The maximum payload of a fighter aircraft varies depending on its specific design and mission requirements.
Maximum Speed (g4)	Maximum speed is the Mach number at which an aircraft can operate.
Combat Range (g5)	The maximum distance an aircraft can travel from its base along a specific course with a typical load and return without refuelling is known as the combat range (km). The combat range is never as far as the maximum range.
Ferry Range (g6)	Ferry range is the furthest distance that an aeroplane can go while ferrying. This often refers to the maximum gasoline load, with the option of additional fuel tanks and minimal equipment.
Service Celling (g7)	The service ceiling (km) is the highest altitude that a specific type of aircraft can maintain while climbing at a particular pace.
Manoeuvrability (g8)	A military fighter aircraft's manoeuvrability is its capacity to alter its speed and direction of flight.

Table 2. *Decision Matrix of the Fighter Aircraft Selection Problem [25].*

Fighter Aircraft / Criteria	Aircraft Price (g_1)	Maximum Take-off Weight (g_2)(kg)	Maximum Payload (g_3) (kg)	Maximum Speed (g_4) (Mach)	Combat Range (g_5) (km)	Ferry Range (g_6) (km)	Service Ceiling (g_7) (m)	Manoeuvrability (g_8)
DassaultRafale	130	24500	14200	1.8	1850	3700	15835	9.3
Eurofighter Typhoon	175	23500	12500	2.35	1389	3790	19812	9.5
FA18 Super Hornet	80	23541	13108	1.8	740	3300	15000	7.8
Mig-35	55	24500	3500	2.25	1000	3000	16000	9.6
Su-35	75	34500	15500	2.25	1600	4500	18000	9.99
F-15E	135	30844	18143	2.5	1965	5600	20000	8.2

The objective weights of the decision criteria with respect to each related performance measurement were calculated by each weighting approach and the obtained results are illustrated in Table 3 to use in the MCDMA technique steps.

Table 3. *Objective Weights of Criteria.*

Method	g_1	g_2	g_3	g_4	g_5	g_6	g_7	g_8
EntropyIndex (EI)	0.29	0.05	0.31	0.03	0.20	0.09	0.02	0.02
Mean Index	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125

Following the application of the suggested approach to the problem of choosing a fighter aircraft, Tables 4-Table 7 present the final ranking outcomes obtained using the multiple criteria decision-making analysis technique with the TOPSIS MCDMA model, Euclidean Distance MCDMA model, Weight sum model, and Weight product model, as well as the two weighting methods.

The rankings of the alternatives when the suggested approach and the weights produced using various weight determination methods are applied are likewise reflected in Tables 4-Tables 7's ranking findings.

Table 4. *Ranking Order of the Fighter Aircraft TOPSIS MCDMA Model.*

Fighter Aircraft	EI	Mean
DassaultRafale	4	3
Eurofighter Typhoon	6	6
FA18 Super Hornet	3	4
Mig-35	5	5
Su-35	1	1
F-15E	2	2

Table 5. *Ranking Order of the Fighter Aircraft Euclidean Distance MCDMA Model.*

Fighter Aircraft	EI	Mean
DassaultRafale	4	3
Eurofighter Typhoon	6	6
FA18 Super Hornet	3	4
Mig-35	5	5
Su-35	1	1
F-15E	2	2

Table 6. *Ranking Order of the Fighter AircraftWeighted Product Model (WPM).*

Fighter Aircraft	EI	Mean
DassaultRafale	4	3
Eurofighter Typhoon	6	6
FA18 Super Hornet	3	4
Mig-35	5	5
Su-35	1	1
F-15E	2	2

Table 7. *Ranking Order of the Fighter AircraftWeightedSum Model (WSM).*

Fighter Aircraft	EI	Mean
DassaultRafale	4	3
Eurofighter Typhoon	6	6
FA18 Super Hornet	3	4
Mig-35	5	5
Su-35	1	1
F-15E	2	2

In terms of sensitivity analysis, it is observed that the ranking results from the TOPSIS MCDMA (Multiple Criteria Decision-Making Analysis) Model (Table 4) and the Euclidean Distance MCDMA Model (Table 5) were the same. This similarity in ranking results can be attributed to the utilization of similar distance algorithms in both models. It is noteworthy that alternativewhen EI used Eurofighter Typhoon and when mean used Su-35, obtained the worst ranking order among the multirole fighter aircraft set. Overall, sensitivity analysis helps us understand the impact of different decision-making models and algorithms on the ranking outcomes. It provides valuable insights into the robustness and consistency the ranking results, allowing decision-makers to make of more informed choices in selecting the most appropriate twin-engine multirole fighter aircraft. The ranking results from Additive MCDMA Model (Table 6), and Multiplicative MCDMA Model (Table 7) were the same as the TOPSIS MCDMA Model (Table 4), and Euclidean Distance MCDMA Model (Table 5). From this research paper, we find that when EI weightage is used Su-35 is best and when Mean weight is used then Su-35 is best.

4. Conclusion

The scientific method of converting data into insights to help make better judgements in operations research is known as multiple criteria decision-making analysis. In this study, the finest fighter aircraft for the Air Force was chosen from a range of options using a thorough MCDMA approach.

Eight decision criteria were identified by the literature review to assess fighter aircraft, and two objective weighting techniques were applied throughout the decision-making process to obtain the final objective weight values for the criteria. The trustworthy MCDMA method was then used to determine the fighter aircraft's final rankings regarding the criteria.

The Su-35 and F-15E were determined to be the most suitable solutions by thedecision-making analysis process, according to the study's conclusions. As a result, the Su-35 score first rank when using Entropy weightage and Mean weighatge might be viewed as ideal fighter aircraft since itsatisfies both the technological and operational needs of the Air Force. The MCDMA model was provided in this study to compare the effectiveness of six alternatives under eight choice criteria. The ranking order of alternatives and comparison from this method.

An actual instance involving the selection of a fighter aircraft is provided to demonstrate the suggested methodology. The ranking outcomes demonstrate the method's efficacy. The MCDMA model has a dependable calculation process, which reduces the computational weight and encourages researchers from all fields of study to use it. It is crucial to remember that the MCDMA model is a tried-and-true and dependable procedure. The issue can be resolved using other MCDMA techniques for future research, and the results can be contrasted. This MCDMA study may serve as a guide for upcoming investigations on the different types of fighter aircraft with different attributes.

Credit Authorship Contribution Statements

HimanshuBhatra: Conceptualization, Methodology, Data extraction &curation, Formal Analysis, Writing-Original draft preparation and Project administration, Sanjeev Mishra: Data extraction &curation, Visualization, Reviewing, editing and Project administration.

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Conflict of Interest

The authors declare that they have no conflict of interest. The authors alone are responsible for the content and writing of the paper.

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