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Selection of Combat Aircraft by Using Shannon Entropy and VIKOR Method

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ABSTRACT

The selection of military defense equipment, especially fighter aircraft, has a bearing on the readiness of the Indian Air Force to defend the country's independence. This study analyses a collection of alternative fighter aircraft that are linked to several choice factors using a multiple-criterion decision-making analysis technique. To handle such scenarios and make wise design judgements, a variety of criterion decision analysis techniques can be used. In this study, we assess fifth-generation fighter aircraft that incorporate significant 21st-century technological advancements. These aircraft represent the state-of-the-art in fleet planning operations to 2022. These are generally equipped with quick-moving airframes, highly integrated computer systems, superior avionics features, networking with other battlefield elements, situational awareness, command, control, and other communication capabilities. The study proposes a strategy for the selection of the fifth-generation combat aircraft for the National Air Force. Because of the problems, the Army needed an application that could assist with decision-making for combat selection systems. Solving the decision problem for evaluating fifteen military fighter alternatives in terms of nine decision criteria is the main objective of this work. We use the Shannon entropy and VIKOR model for the Air Force's fleet program to evaluate military fighter aircraft suitability. The entropy technique is used to compute the weight of the criteria, and then the VIKOR technique has been used to rank the fighter aircraft.

Keywords: Air force fleet planning; Military combat aircraft selection; MCDM; Shannon entropy; Vikor method; Normalisation

1. INTRODUCTION

The air transport industry has undergone significant progress because of the transfer of technologies utilised in armed aircraft to civil aviation. Furthermore, the number of aircraft and rivalry among corporations rose substantially because of the deregulation procedures that began in the US (United States) in 1978. To obtain a competitive edge, deregulation has also allowed airlines to embrace innovative business models. Airlines must choose amongst aircraft options to select the best-suited aircraft. In the 1950s, modern MCDM approaches that aid airline planners in selecting aircraft were invented by Koksalan[1], *et al.* Many approaches are utilised in the evaluation assessment, and multicriteria decision-making (MCDM) methodologies have provided airlines with suitable answers in aircraft selection Dozic[2], *et al.*

To analyse military aircraft selection challenges, the MCDM approach is developed. In decision-making analytical issues, the framework assists decision-makers in getting precise judgments. Decision-making methods of analysis may be divided into compensatory (Fuzzy systems, CP, TOPSIS, AHP, and VIKOR techniques) and non-compensatory (Fuzzy Systems, PROMETHEE, DEMETAL, ELECTRE) techniques[3-5].

For the Air Force fleet management, the decision-making process in a military combat aircraft selection must be based on a thorough and rigorous study to ensure a realistic and acceptable option. When employing the VIKOR technique to evaluate and rank alternatives, the objective weight of the criterion is determined using Shannon's Entropy weight methodology. The armed jet fighter choices are ranked using the weighted objective criteria.

According to the literature study, a variety of compensating MCDM approaches was utilised to tackle military combat aircraft selection difficulties. TOPSIS method was used to obtain a total performance score for every different to reach a good selection of aggregated the assessors' perspectives toward preference[6].

The military combat aircraft selection challenge includes evaluating a collection of alternative aircraft candidates using numerous criteria that are in conflict. These parameters and alternatives were determined by an analysis of relevant literature. Air Forces are critical to national security, from policy and strategy to capabilities and capacity. A real-life choice problem of relevance to the Spanish Air Force was solved by addressing the challenge of an army training jet using a mix of various criterion decision-making procedures and a fuzzy logic method. In the study of Sanchez et.al[7], to determine the criterion weights the AHP method was used, and the alternatives were evaluated using TOPSIS Technique. A set of choice criteria was used to choose the best military training aircraft.

An MCDM analysis assists a decision-maker by quantifying certain criteria depending on their value in the

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context of other objectives. This paper explains some of the most essential aspects of MCDM analysis, as well as the numerous algorithms that are accessible, and highlights their unique qualities in the context of military fighter aircraft evaluation. The MCDM analysis approach given here may be utilised to identify an appropriate solution to military combat aircraft analysis, and system design challenges that include many competing purposes. The weighted, normalised values are then utilised in the data and rank the order of choice options[8-14].

The economic, environmental, and engineering efficiency aspects are used in decision studies for military aircraft selection challenges. The economic, environmental, and engineering efficiency aspects are used in decision studies for military aircraft selection challenges. This paper proposes an MCDM solution for the military fighter aircraft selection issue that leverages the data normalisation approach and facilitates a precise decision-making process.

The remainder of the article is composed as follows: The approach for the decision analysis issue is presented in section 2. The situation in the Air Force is applied using the MCDM model and recommended MCDM technique provides in section 3. The application of MCDM techniques in the decision-making process is discussed in section 4 along with its potential outcomes. Section 5 concludes with findings.

2. METHODOLOGY

In this section, two methods are proposed, the first is the Entropy method. And the second is the VIKOR method. Both methods are explained in detail below in the subsection.

2.1 Entropy Method

Entropy is one of the most appropriate ways of determining relative importance. Entropy weights are measurements of uncertainty in data constructed utilising probability distributions, and this availability of information in the feature values of the choices assesses every attribute's effectiveness in identifying variation in the information. When decision-makers disagree on weight values, this approach is employed to generate criteria weights. The entropy weight is a metric that represents many alternative solutions to specific criteria[15-16].

Shannon Entropy[17] was developed from the modelling technique, which represents the distribution of tips between sender and receiver[18-19]. These techniques' weights are also referred to as objective weights. It comprises the decision matrix's equalisation. The more significant a criterion is, the greater the value differences between alternatives when comparing them on the same basis. A criterion's influence on decision-making increases in direct proportion to how beneficial it is. A criterion is disabled during the assessment process, signifying that its weight will be zero if all the options score equally on it. The entropy approach includes the following phases.

Creating the Decision Matrix: A matrix containing all the alternatives in this step, and the criteria for the problem is created. The decision matrix is shown in Eqn. (1):

$$D = \begin{bmatrix} d_{11} & d_{12} & \dots & d_{1n} \\ d_{21} & d_{22} & \dots & d_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ d_{m1} & d_{m2} & \cdots & d_{mn} \end{bmatrix} \quad (1)$$

Normalizing the Decision Matrix: For Normalizing the decision matrix (1), first, calculate p_{ij} with the help of the subsequent Eqn.

$$p_{ij} = \frac{d_{ij}}{\sum_{i=1}^{m} d_{ij}} \quad (2)$$

In the above Eqn. (2), the notation i=1,2,…m (Row) denotes the alternatives, and the notation j=1,2,…n (Column) denotes the criteria, the normalised values represent by p_{ij} and d_{ij} represents the given utility values.

Calculation of Entropy: The entropy (e_j) value is calculated for each criterion.

$$e_j = \frac{-\sum_{i=1}^{m} p_{ij} log_2 p_{ij}}{log_2 m} \quad (3)$$

Where, $logm$ represent the entropy coefficient and e_j represent the entropy value.

Calculation of the Degree of Differentiation: The degree of differentiation of the entropy value (d_j), is calculated as follows:

$$f_j = 1 - e_j \quad (4)$$

Calculation of Entropy Weight: Lastly, use the following equation to get the weighted value (ω_j) of each criterion where $\sum_{i=1}^{n} \omega_j$ and $0 \le \omega_j \le 1$.

$$\omega_j = \frac{f_j}{\sum_{i=1}^{n} f_j} \quad (5)$$

2.2 VIKOR Method

VIKOR is another important multi-criterion decision-making method that was developed by Serafim Opeicovic and introduced VIKOR (Vlsekriterijumsko kompromisno Rongiranje) in 1998. VIKOR is an MCDM approach for dealing with decision-making issues. The approach was created to solve complex multi-criteria optimisation issues by providing compromise solutions. The term "compromise solution" refers to a mutually agreed-upon solution.

Whenever a decision-maker is unable to convey their desire for a compromise option, VIKOR is a useful decision-making approach. A multi-criterion ranking index from VIKOR is based on a metric for how near a solution is to the ideal one. When there are competing criteria, this strategy focuses on ranking and choosing from a group of choices. To help decision-makers minimize trade-offs and arrive at the optimal solution, ranking by VIKOR may be conducted with various values for weights of the criteria. This analysis looks at the influence of the weight criterion on the suggested compromise solution. The VIKOR approach can be recommended as the best suitable method for real-world selection and ranking in large-scale contexts. The VIKOR technique involves normalizing the decision matrix by using Eqn. (6) and calculating the utility measure (S_i) with the help of Eqns. (7), (8), as well as calculating the regret measure (R_i) with the help of Eqns. (9), and (10). The equation was then used to obtain the VIKOR index (11). Finally, a minimum value for an alternative is offered as the first rank, in other words, the minimum value and the number of additional possibilities depend on the value of Q_i for the best ranking[20-23].

2.2.1 The Following Steps are Used in the VIKOR Technique

Step 1: Create the choice matrix according to (1)

Step 2: Create a normalised decision matrix by following steps

$$c_{ij} = \frac{d_{ij}}{\sqrt{\sum_{i=1}^{m}(d_{ij})^2}} \quad (6)$$

Step 3: Calculate the utility measure (S_i) for beneficial criteria using (7), and for non-beneficial criteria using (8). And regret measure (R_i) for beneficial criteria using (9), and for non-beneficial criteria using (10) as follows (7)

$$S_i = \sum_{i=1}^{m} \omega_j \left[\frac{(c_{ij})_{max} - (c_{ij})}{(a_{ij})_{max} - (a_{ij})_{min}}\right] \quad (8)$$

$$S_i = \sum_{i=1}^{m} \omega_j \left[\frac{(c_{ij}) - (c_{ij})_{min}}{(c_{ij})_{max} - (c)_{min}}\right] \quad (9)$$

$$R_i = max\left\{\omega_j \left[\frac{(c_{ij})_{max} - (c_{ij})}{(a_{ij})_{max} - (a_{ij})_{min}}\right]\right\} \quad (10)$$

$$R_i = max\left\{\omega_j \left[\frac{(c_{ij}) - (c_{ij})_{min}}{(c_{ij})_{max} - (c)_{min}}\right]\right\}$$

where criterion weight is denoted by (ω_j), and the relative importance is stated in the following Eqn.

Step 4: Compute the value of Q_i

$$Q_i = v \quad (11)$$

where,

$S_{+=(s_i)_{max}}$, $S_{-=(s_i)_{min}}$, $R_{+=(R_i)_{max}}$, $R_{-=(R_i)_{min}}$, and v signifies the maximum group utility or strategic weight of the criteria majority. In this study, $v = 0.5$. The value of this coefficient can be contained from 0 to 1.

Step 5: Ranking the alternatives: The smaller values of S_i, R_i and Q_i are provided to rank the best alternatives. The last phase then calculates the minimal VIKOR index based on the following conditions.

- Acceptable advantage: $Q(A^2)$-$Q(A^1) \geq DQ$ where, $DQ=1/(m-1)$, and $Q(A^2)$ is the alternative ranked second by Q; m represents the number of choices.
- Acceptable stability in decision-making: the best ranked by S or/and R must be provided with an alternative $Q(A^1)$.

If either criterion a or b is not met, a set of compromise options is provided, which includes the following:

- If condition b is met, then alternatives A^1 and A^2 are possible.
- If condition a is not met, alternative $A^1, A^2, \ldots A^m$ is used. For maximum n, A^m is defined by the relation $Q(A^m)$-$Q(A^1)<DQ$ which is "in closeness."

3. APPLICATION

The goal is to investigate and analyse potential alternatives of the fifth-generation combat military fighter jet options. Advanced military weaponry equipment can help countries increase their defensive capabilities and competencies. As a result, choosing the most suitable military weapon, particularly military combat aircraft is critical for fleet planning for Air Force. Consequently, picking the best option among a plethora of options is a difficult task for Air Force fleet planners. As a result, the major distinctive traits and assessment criteria of prospective combat aircraft for the combat helicopter's choice issue were determined. In this scenario, after determining the decision criteria, in the preliminary decision-making process, 15 fighter aircraft are shortlisted and considered suitable for the requirements which are as follows with their indication: T-7 Red Hawk (A-1), Chengdu J-20 (A-2), HAL AMCA (A-3), HAL Sukhoi PMF/FGFA (A-4), Qaher F-313 (A-5), KF-21 Boramae (A-6), F-22 Raptor (A-7), F-35 Lightning II (A-8), Mitsubishi F-X (A-9), Mitsubishi X-2 (A-10), Douglas YF-23 (A-11), Stavatti Javelin T-X (A-12), Sukhoi Su-75 (A-13), Sukhoi Su-57 (A-14) and TAI TF-X (A-15). We use the following decision criteria for the Military fighter aircraft selection.

3.1 Military Combat Aircraft Decision Criteria Description

The literature research yielded a list of 9 primary decision criteria, which are defined in Table 1 with their measuring units such as Length (C-1), Width (C-2), Hight (C-3), Empty Weight (C-4), MTOW (C-5), Max Speed (C-6), Ceiling (C-7), Range (C-8), and Rate of climb (C-9).

3.2 Utilising the MCDM Approach to Selecting the Best Military Combat Aircraft

The MCDM approach was used to select military combat

Table 1. Criteria description for military combat aircraft

Decision criteria	Indicator	Criteria description
Length	C-1	This indicates the length of the Aircraft in a meter.
Width	C-2	This indicates the width of the Aircraft in a meter.
Hight	C-3	This indicates the height of the Aircraft in a meter.
Empty weight	C-4	This indicates the empty weight of the Aircraft in kilograms.
MTOW	C-5	This indicates the maximum takeoff weight of Aircraft in kilograms.
Max speed	C-6	This indicates the maximum speed of the Aircraft in km/h.
Ceiling	C-7	This indicates a measurement of the height of the base of the lowest clouds in a meter.
Range	C-8	This is the greatest distance an airplane may fly in kilometers between takeoff and landing.
Rate of climb	C-9	This represents an aircraft's vertical speed, which is the favorable or unfavorable rate of altitude change in time in minutes.

Table 2. Initial decision matrix

Criteria → Aircraft ↓	C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9
A-1	14.15	10.00	4.00	3250	5500	1300	15240	1840	10211
A-2	23.00	15.00	5.00	17600	77162	1305	18000	3400	18288
A-3	13.20	8.20	4.40	22700	36000	2205	15250	1000	13716
A-4	22.60	14.20	5.90	18500	26000	2400	20000	5500	21031
A-5	15.50	8.00	4.08	9700	9000	1500	15000	2000	7620
A-6	16.80	11.20	4.80	10000	23000	2500	19800	3800	18288
A-7	18.92	13.56	5.02	14514	24947	2574	15240	3218	21000
A-8	15.37	10.65	5.28	13155	31800	1930	15240	2220	12190
A-9	19.81	13.87	5.00	14000	25500	2350	20000	3000	13868
A-10	14.20	9.10	4.50	8900	13000	2570	15250	750	13716
A-11	20.60	13.30	4.30	13100	23330	2335	19800	4500	18000
A-12	14.00	10.00	4.00	3200	5000	1200	15000	1750	10058
A-13	15.00	10.00	5.00	16400	23400	1300	18000	4000	21336
A-14	22.00	14.20	6.05	18500	37000	2600	20000	5000	361
A-15	19.00	13.50	5.00	14150	27215	2400	20000	3200	15240

Table 3. Normalisation of the decision matrix

Criteria → Aircraft ↓	C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9
A-1	0.204	0.217	0.213	0.059	0.046	0.160	0.224	0.144	0.172
A-2	0.331	0.326	0.266	0.320	0.646	0.161	0.264	0.265	0.307
A-3	0.190	0.178	0.234	0.413	0.302	0.271	0.224	0.078	0.230
A-4	0.326	0.309	0.313	0.336	0.218	0.295	0.293	0.429	0.353
A-5	0.223	0.174	0.217	0.176	0.075	0.185	0.220	0.156	0.128
A-6	0.242	0.243	0.255	0.182	0.193	0.308	0.291	0.297	0.307
A-7	0.273	0.295	0.267	0.264	0.209	0.317	0.224	0.251	0.353
A-8	0.221	0.231	0.281	0.239	0.266	0.237	0.224	0.173	0.205
A-9	0.285	0.301	0.266	0.255	0.214	0.289	0.293	0.234	0.233
A-10	0.205	0.198	0.239	0.162	0.109	0.316	0.224	0.059	0.230
A-11	0.297	0.289	0.228	0.238	0.195	0.287	0.291	0.351	0.302
A-12	0.202	0.217	0.213	0.058	0.042	0.148	0.220	0.137	0.169
A-13	0.216	0.217	0.266	0.298	0.196	0.160	0.264	0.312	0.358
A-14	0.317	0.309	0.321	0.336	0.310	0.320	0.293	0.390	0.006
A-15	0.274	0.293	0.266	0.257	0.228	0.295	0.293	0.250	0.256
Maximum value	**0.331**	**0.326**	**0.321**	**0.413**	**0.646**	**0.320**	**0.293**	**0.429**	**0.358**
Minimum value	**0.190**	**0.174**	**0.213**	**0.058**	**0.042**	**0.148**	**0.220**	**0.059**	**0.006**
Entropy e_j	**0.994**	**0.993**	**0.997**	**0.966**	**0.930**	**0.987**	**0.997**	**0.959**	**0.963**
Weight ω_j	**0.030**	**0.034**	**0.013**	**0.159**	**0.325**	**0.062**	**0.014**	**0.190**	**0.173**

jets: For Air Force fleet planning following the establishment of 9 choice criteria, alternative aircraft issues were explored, and the initial decision procedure selected 15 appropriate armed combat aircraft, as shown in Table 2. In this study, we took 5th generation fighter aircraft and the data taken from military factory[24] with maximum optimisation.

Firstly, normalise the decision matrix and calculate the entropy value of each data and then obtain the criteria weights using the Shannon Entropy technique in the proposed model, the weight of criteria is illustrated in Fig. 1. The entropy and weight of decision criteria were calculated by equations (3), (4), and (5) which are represented in the last two rows in Table 3. Also, the normalizing value calculated by using (6)

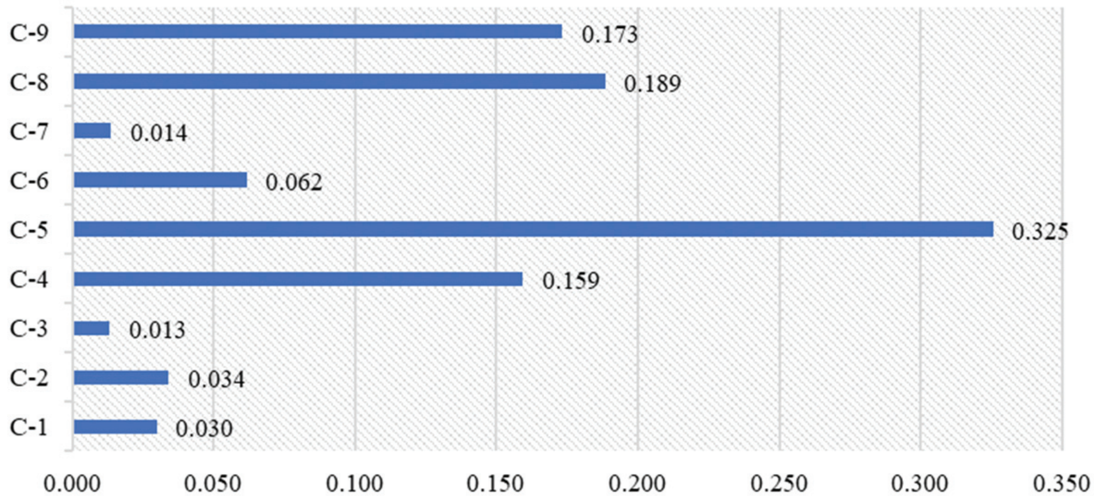

Figure 1. Entropy criterion weight.

Table 4. Calculation of S_i, R_i, Q_i and rank of alternative aircraft.

Alternative	S_i	R_i	Q_i	Rank
A-1	0.855	0.323	0.985	14
A-2	0.220	0.083	0.000	1
A-3	0.532	0.186	0.452	4
A-4	0.283	0.231	0.353	2
A-5	0.798	0.307	0.909	13
A-6	0.491	0.244	0.542	11
A-7	0.436	0.236	0.481	5
A-8	0.581	0.205	0.529	10
A-9	0.498	0.233	0.524	9
A-10	0.734	0.289	0.822	12
A-11	0.428	0.243	0.490	7
A-12	0.868	0.325	1.000	15
A-13	0.472	0.243	0.523	8
A-14	0.416	0.181	0.353	3
A-15	0.472	0.225	0.488	6

as well as the Maximum and Minimum Normalised values is presented. For selecting the best military combat aircraft using the MCDM method, the evaluation of the initial decision matrix has been done and is solved analytically by VIKOR and Entropy techniques and it is found that the ranking score of aircraft lies between 0 to 1.

After calculating the weight of the criteria by entropy technique, the utility Measure (S_i) for beneficial criteria has been calculated by (7) and for non-beneficial criteria calculated by (8). As well as the regret measure (R_i) for beneficial criteria is calculated by (9) and for non-beneficial criteria is calculated by (10). Finally, the value of (Q_i) has been Computed by (11) and the rank of alternative combat aircraft is given, the calculated value is provided in the last column of Table 4 and with data illustration shown in Fig. 2.

Table 4 depicts the MCDM benefit aggregation and alternative aircraft critical assessment, which show that the Chengdu J-20 is the best military aircraft for the Armed Forces. Based on technical qualities, economic, and performance aspects, the Chengdu J-20 Fighter is scientifically analysed and first ranked. Table 4 provides a clear picture of the best aircraft

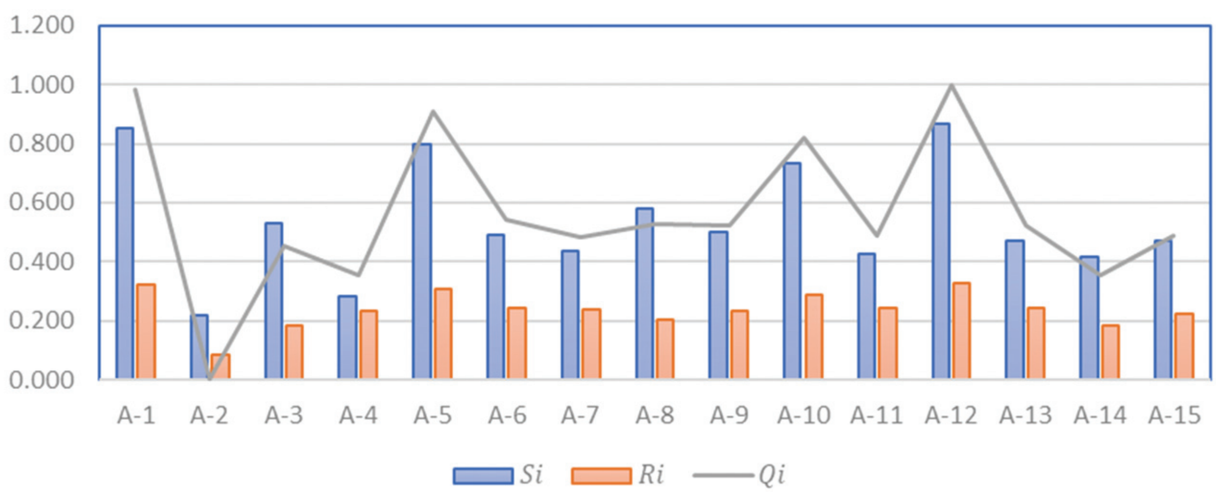

Figure 2. Data illustration of obtaining the result.

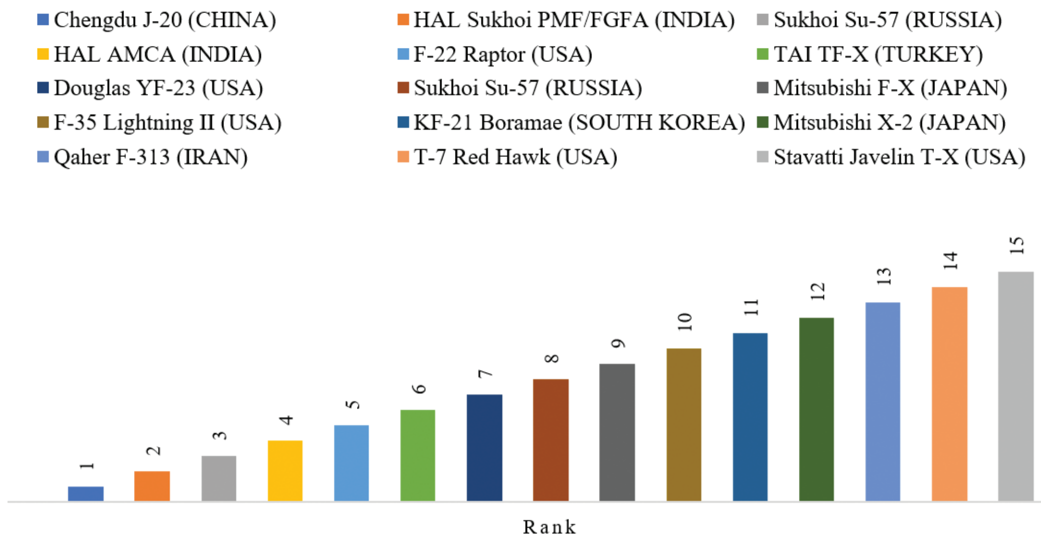

Figure 3. Ranking of the alternative fighter aircraft.

choice resulting from this analysis, as well as a graphical representation of alternative fighter aircraft by manufacturer country, ranked from highest to lowest, as provided in Fig. 3.

3.3 Air Force Fleet Planning

Acquisitions of air defence systems for Army Aviation fleet planning are extended budgeted expenditures for governments that are dependent on the country's geopolitical situations as well as military policy and strategy. Because the acquisition or development of military combat aircraft necessitates significant defence expenditure, it necessitates a thorough assessment process and the selection of suitable jets. To achieve optimal choices in the framework of financial and environmental issues connected with air defence acquisition, the ratio among needs with restrictions must be handled.

The MCDM model is a generally utilised strategy in situations where a ranking must be produced from a set of alternatives. Because there is no unanimous consensus about how to complete the standardisation stage, a difference in how information is standardised might result in alternative scores consequently.

Furthermore, there is no way of knowing which rankings are "correct" and which are not based on various factors. The MDCM method is robust to ranking reversals because it still produces the same results for selecting the best option. Theoretically, it is demonstrated that the MDCM criterion VIKOR and Entropy approach is entirely satisfied with the level of the ranking tests done.

4. RESULT AND DISCUSSION

The procurement of tactical combat aircraft for the Armed Forces was likely to experience a wide address in this study. Various factors in the procurement of a military combat aircraft, as well as the economic situation and technological qualities, were investigated and assessed using several conflicting decision criteria. The findings of the MCDM technique for military combat aircraft selection suggested that the Chengdu J-20 aircraft was the optimum answer to fleet planning for the Air Force.

Since complicated decision systems are highly unsustainable, it allows for the invention of multiple situations, which can result in different scores, and more debate may be necessary to establish a conclusion. The findings are regarded to be robust if the ranking does not fluctuate. In this study, an MCDM technique was used to choose the best military combat aircraft for the Air Force among a variety of options. The MCDM approach has an advantage over other strategies since it aggregates the benefit and cost criteria, resulting in a more consistent outcome. For the selection of fighter aircraft, nine decision criteria were identified, in terms of decision criteria to derive the final ranking by using the VIKOR method and to obtain the weighted values of the criteria of military combat aircraft by using the Shannon Entropy weight method. The proposed approach produced accurate findings. As a consequence of the decision-making process, the Chengdu J-20 was chosen as the best-suited alternative, with the HAL Sukhoi PMF/FGFA the second-ranking and the Sukhoi Su-57 achieving the third ranking in the armed combat aircraft choice challenge. As a result, the Chengdu J-20 is a suitable military combat aircraft because it fits technical standards, fiscal limits, and strategic real-world situations.

The following includes spectrum experts which give the inputs in terms of their qualifications concerning experience on fighter aircraft in the future, as follows:

- This is a reference to military jets that meet the standard specifications for supersonic maximum speed, stealth technology, and fully integrated systems. The J-20 marks the first aircraft from China that meets these requirements, and it might be an asset for both the navy and the air force
- Even in areas with little communication support, the planned HAL Sukhoi PMF/FGFA will have outstanding armored warfare, high tactical capabilities, and group action capacity. The aircraft will have cutting-edge capabilities for increased stealth, network-centric warfare, supersonic travel, and datalink
- The Su-57 is a multirole fighter equipped with stealth, integrated avionics, super maneuverability, super cruise, and a significant internal payload capacity. It is effective

in aerial warfare as well as ground and sea strike

- AMCA will be a single-seat, twin-engine aircraft. While the Mark 2 will eventually receive upgrades to 6th generation technology, the AMCA Mark 1 will include 5.5 generation technologies. The AMCA is made to perform a number of duties, such as ground attacks, air superiority, and the disabling of opposing air defences.

Planning the fleet and choosing the right aircraft must be a priority for airlines. Airlines may increase their revenues while reducing costs by selecting the appropriate aircraft. The choice of aircraft utilizing contemporary MCDM techniques offers airlines a suitable answer to this issue. This is done in a variety of ways, and for airline firms, it is strategically important. Hence, to achieve a market-leading position and improve long-term benefits, airline enterprises should take into account the findings of incorporating scientific methodologies for appropriate aircraft selection. These methods allow airlines to choose the right aircraft for their operations and needs as well as also taking positional accuracy, environmental effect, and economic performance into account. The model's criteria and sub-criteria may also be changed to accommodate different aircraft sizes and kinds. Together with narrow and broad-body commercial aircraft, these types can be used to choose freight, training, and military training aircraft. As a result, by employing this entropy and VIKOR methods, foot planners may add additional characteristics and evaluate the aircraft according to their preferences. Also, it is essential that decision-makers in the aviation business, a highly unpredictable and fiercely competitive market, make the right decisions. In addition to the process of choosing an aircraft, in the future, the suggested technique may be used for risk analysis, airline service quality evaluation, route selection, network design, and project planning. In addition to giving decision-makers a single point of contact, fifth-generation aircraft are the future combined force because of their operational use as sustained force multipliers, proved competence as an advanced airborne echelon, and vital contribution to strategic deterrents.

5. CONCLUSIONS

The choice of armed combat aircraft is a critical and difficult decision-making procedure that must be considered for optimal choice solutions. The study of military combat aircraft fleet modelling begins with the selection of accessible options and decision criteria. Aircraft that can better meet the demands of the Air Force can be considered an alternative aircraft. A survey of the literature determines the decision criteria for assessing aircraft type options, which are primarily based on technological, dimensional properties, operational, strategic, and economic concerns. In the decision procedure, the approach of analysing military combat aircraft alternatives based on decision criteria is critical. Because both feature an efficient and effective technique, it assents for the observation of the best options utilizing evaluation methods that can be simply assessed with an easy-to-grasp and implement MCDM method. The key contribution of the Shannon entropy and VIKOR model is that it may be used as a reference in future decision-making analysis research aimed at establishing the effectiveness selection problem of the armed combat aircraft.

It is crucial to assess the available options for aircraft and choose the best one for defence systems. For the long-term competitive strategies of the defence systems, selecting the right aircraft is crucial, and doing so can provide an advantage over the competitors. Therefore, a practical and long-term strategy for choosing aircraft should be developed by defence systems. Given the methodology and approach employed to structure this study, it is anticipated to provide significant contributions to the defence systems' decision-making on the best aircraft. Additionally, the procedures and techniques may be modified for usage in various industries. It is advised that moving forward, selection studies be conducted using the procedures and techniques employed in this study. Therefore, the best strategy for choosing and ranking in actual large-scale settings was proposed to be VIKOR and the entropy method.

In this study, the finest military fighter aircraft for the Air Force was chosen from a range of alternatives using the VIKOR MCDM approach. As the benefit and cost criteria are multiplicatively aggregated and the outcome is more consistent, the VIKOR MCDM method provides benefits over other approaches. During the decision-making process, the entropy weight technique was used to determine the weight values of the nine decision criteria, and the VIKOR MCDM method was utilised to determine the final ranking of military fighter aircraft about the decision criteria.

5.1 Novelty

Multi-criteria decision-making techniques have been shown in the literature to be of use for a wide range of issues and situations. Many of these approaches have been seen to co-exist when solving a problem. There has been a lot of research on the factors to consider when choosing fighter aircraft, how to evaluate their performance, or which aircraft is the best among the aircraft already in use. But for the fifth-generation aircraft, there are no research has been done so far. This study was conducted to fill this deficiency. To bridge this gap, the best fighters on the market will be selected using VIKOR technology, which is entropy-based. After the criteria were established, the criteria weights were calculated using the entropy approach. One of the most popular and simple methods for determining the importance of a criterion is the entropy technique.

Finally, the conclusions of this study and the application of the MCDM approach as a decision support system when dealing with choice difficulties should be thoroughly understood.

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