Global Journal of Computer and Engineering Technology (GJCET)

Vol. 1, No. 1, January, 2021 ISSN: 2767-1933

# SELECTION OF FOREIGN PLAYERS IN T20 CRICKET LEAGUE USING MULTIPLE CRITERIA DECISION MAKING (MCDM) TECHNIQUES

Vineet Kumar Awasthi, Dr. C.V. Raman University, India (vineet99kumar@gmail.com)
Sanjay Kumar Singhai, Govt. Engineering College, India(ersanjaysinghai@gmail.com)

**ABSTRACT**

Cricket is most popular sport among every age group of people and T20 cricket is the new dimension added in international cricket. From all three formats T20 format is becoming popular. Every team in any T20 league want to selects the best foreign players in their squad to win the match. Team management and coach want to analyze the performance of players to select the best one. This research uses the application of Multi Criteria Decision Making (MCDM) techniques to rank the foreign players as per their performances. Analytical Hierarchy Process (AHP)and integrated method of AHP and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) named as AHP-TOPSIS methods are used for ranking of six foreign batsmen for the selection. The experimental results after applying AHP and AHP-TOPSIS methods reveals that batsmen C, F and A have achieved first, second and third rank respectively.

**Keywords:** Multi Criteria Decision Making (MCDM), Analytical Hierarchy Process (AHP), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method.

## 1. INTRODUCTION

T20 Cricket leagues are extremely popular in international label and widely seen throughout the world. International players from different countries participate in the tournament. Team members are selected on the basis of bidding to form a balanced team for the league. The selection of foreign players is the key in the playing eleven for every match because of the selection limits. Every team wants to identify best foreign players for their side to win T20 league. The section of foreign player is based on their overall record and current form. The values of multiple quantitative attributes are identified and used to evaluate the performance of foreign player. It is the responsibility of team management to smart enough to identify the best foreign players for their team. The ranking of foreign players can be the best solution of the selection problem. Day et al.(2011) have used different Multiple Criteria Decision Making (MCDM) technique to identify the bowling performances in IPL2008. Author used the application of Analytical Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method for ranking of all blowers to identify the performances of players in IPL2008. Another author (Zhongyou, 2012) used the application of TOPSIS method to identify Foreign Players in Chinese Basketball Association (CBA) Games. The proposed framework by the author helps to identify best foreign CBA players. Hota et al. (2015) have used AHP and integrated methods for selection of best stock index. Three years financial data of six stock indices of Bombay Stock Exchange (BSE) are used for ranking to identify the best stock index.

In this research work we have used MCDM techniques to solve the tedious selection process to form T20 team. The ranking of foreign batsmen was done using AHP and integrated AHP-TOPSIS. The main aim of this research work is to help the coach and team manager to identify and select the best batsman for their team. The hypothetical experimental data are used with different criterion related to batting statistics like inning, total run, batting average, No. of 30, No. of 50 etc.

## 2. RELATED WORK

MCDM techniques are used as potential tools for analyzing complex problems with the ability to judge different alternatives on various criterion for the selection of best or suitable alternative (Chauhan et. al., 2012; Zavadskas et al., 2014). MCDM analysis (Hota et al., 2016) has some unique characteristics like presence of conflicting criterion,

presence of different alternative and different unit of measurement among the criterion. MCDM techniques are basically structuring and solving decision and planning problem having different criterion that are conflicting in nature. Different authors have used MCDM techniques for the ranking of objects for decision making. MCDM has widely used with the data having different criterion that is conflicting in nature. MCDM method has an ability to effectively manage the importance of criterion and rank the objects for problem solving. Table 1 explains literatures that effectively reflect the importance of MCDM technique for problem solving of different problem domains.

**Table 1:** Related literatures

| S. No. | Year | Author | Title | Journal |
|---|---|---|---|---|
| 1 | 2020 | Lei, F. et al. | TOPSIS Method for Developing Supplier Selection with Probabilistic Linguistic Information | International Journal of Fuzzy Systems |
| 2 | 2020 | Dehdasht, G. et al. | A hybrid approach using entropy and TOPSIS to select key drivers for a successful and sustainable lean construction implementation. | PLoS ONE |
| 3 | 2020 | Majumder, P. et al. | Application of New TOPSIS Approach to Identify the Most Significant Risk Factor and Continuous Monitoring of Death of COVID-19 | Electronic Journal of General Medicine |
| 4 | 2020 | Janjua, S. et al. | Fuzzy AHP-TOPSIS multi-criteria decision analysis applied to the Indus Reservoir system in Pakistan . | Water Supply. |
| 5 | 2020 | Sarjono, H. et al. | Analytical Hierarchy Process (AHP) In Manufacturing And Non-Manufacturing Industries: A Systematic Literature Review. | Sys Rev Pharm |
| 6 | 2020 | Goswami S.S. et al. | Selecting the best mobile model by applying AHP-COPRAS and AHP-ARAS decision making methodology. | International Journal of Data and Network Science |
| 7 | 2020 | Han, Y., et al. | Application of AHP to Road Selection. | International journal of Geo-information. |
| 8 | 2020 | Wulan, H. et al. | Application of Analytical Hierarchy Process (AHP) in Determining Maritime Defense Strategy as a Follow- Up to Conflict in Natuna Sea. | International Journal of Advanced Science and Technology |
| 9 | 2015 | Krohling et al. | A-TOPSIS – An Approach Based on TOPSIS for Ranking Evolutionary Algorithms | Procedia Computer Science |
| 10 | 2017 | Elsayed, E.A. et al. | Evaluating Alternatives through the Application of TOPSIS Method with Entropy Weight | International Journal of Engineering Trends and Technology |

## 3. METHODOLOGY

MDCM techniques are ranked as based methods, generally used with data having multiple criterion that are equally important. MCDM techniques are very useful to manage the priority of criterion and ranking the objects. In this research work we have used AHP and integrated method of AHP-TOPSIS for ranking of batsman for selecting of T20 team. AHP and AHP-TOPSIS methods are discussed as followed:-

**3.1. AHP:** Satty (1980) has introduced most popular MCDM technique called AHP. It is a rank based method used for ranking of alternatives. The steps of AHP method are shown in Figure 1.

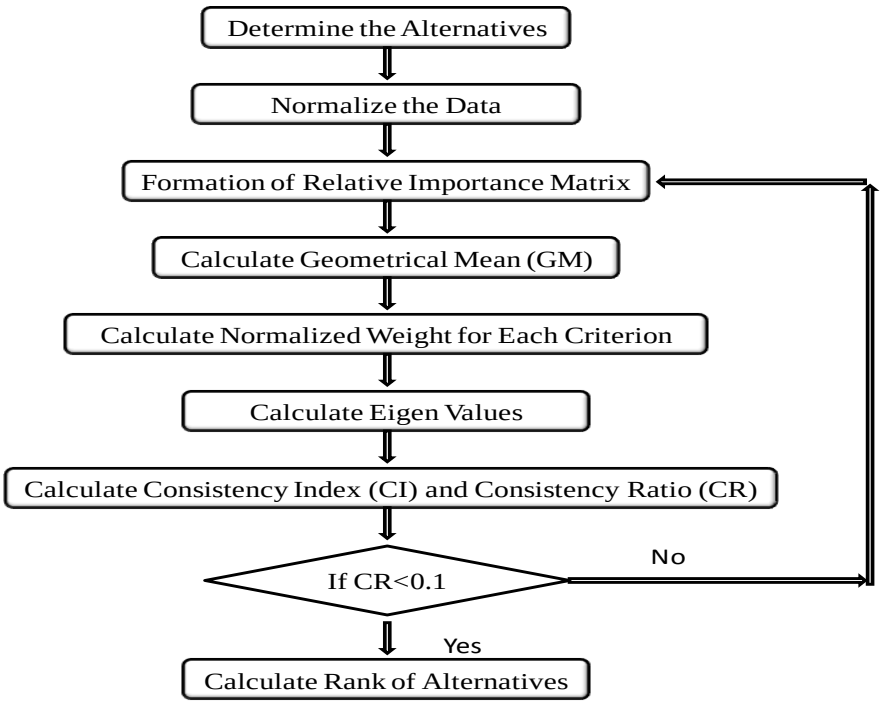


**Figure 1:** Workflow of AHP method

**Step 1:** Determine the objective with alternative and criterion.
**Step 2:** Normalized the objective data by using some normalized technique. One simple method is to select maximum value from each criterion and then divide it to all values of respective criterion.
**Step 3:** In next step a pair wise comparison matrix is constructed to calculate the criterion priority weights under specific constraints. It is a n*n matrix that is used to compare importance between n criterion. When one criteria compared with itself then the value assigned in matrix in 1. So the diagonal of matrix is always 1. If some value $b_{ij}$ has assigned for the comparison of two criterion $C_i$ and $C_j$ then the value of $b_{ji}$ will be the reciprocal of $b_{ij}$.
Final criterion weights are decided by-
(i) Calculate Geometrical Mean ($GM_j$) and Normalized Weight ($W_j$) using following formula:-

$$GM_j = \left[\prod_{i=1}^{n} b_{ij}\right]^{1/n} \quad (1)$$

$$\text{and } W_j = {GM_j}\Big/{\sum_{i=1}^{n} GM_j} \quad (2)$$

(ii) Then calculate the $E_1$ and $E_2$ where column matrix $E_1$ is obtained by adding the multiplication of criterion weights to $W_j$ and column matrix $E_2$ is obtained multiplying $E_1$ to $W_j$.
(iii) Calculate the maximum Eigen value $\lambda_{max}$ by taking the average of matrix $E_2$.
(iv)The value of Consistency Index (CI) is calculated using following equation-

$$CI = {(\lambda_{max} - n)}\Big/{(n-1)} \quad (3)$$

(v) Consider the pre specified value of Random Index (RI) that depends upon the no of alternatives. Calculate the consistency ratio (CR) by -

$$CR=CI/RI \quad (4)$$

The calculated value of $W_j$ is consistence if CR<0.1.

**Step 4:** At last the rank of alternative is decided by the final AHP weight that is obtained through summing the multiplication of alternative value and criterion weights.

**3.2 AHP-TOPSIS:** In this integrated method weights of criterion, calculated using AHP method are applied to TOPSIS method for raking of alternatives. TOPSIS is another popular rank based MCDM technique introduced by Hwang and Yoon (1981). The ranking of an alternative is depends upon the shortest and longest distance from best and worst solution respectively. The best solution and the worst solution are indicated by positive ideal solution and negative ideal solution respectively. An alternative is identified as the best with minimum distance with positive ideal solution and maximum distance with negative ideal solution. Working of AHP-TOPSIS method is shown in figure 2.

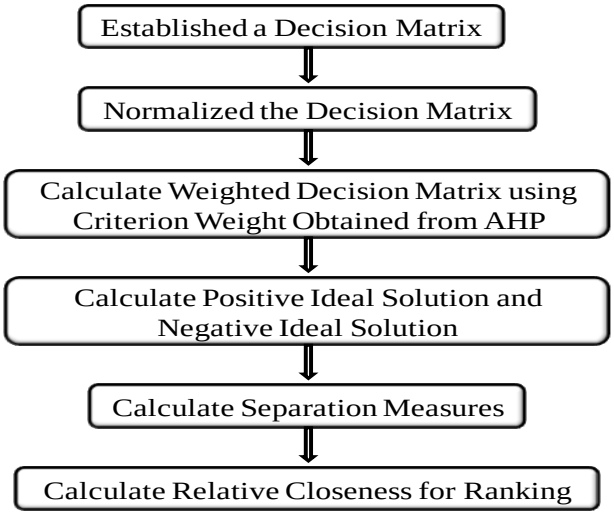


**Figure 2:** Workflow of AHP-TOPSIS method

The steps of AHP-TOPSIS method is described as follows:-

**Step 1:** Obtain matrix $T_{m*n}$ of m alternatives with n criterion.

**Step 2:** Some normalized techniques are used to calculate normalized data.

**Step 3:** Obtain the weighted decision matrix V by multiplying each column of R with the criterion weight obtained from AHP initially.

**Step 5:**Obtained the Positive ideal solution and Negative ideal solution that is the set of positive ideal value and negative ideal value of each criterion.

**Step 6:** Then calculate separation measurers ($S^+$) and ($S^-$) that indicates the deviation from positive ideal solution ($A^+$) and negative ideal solution ($A^-$) respectively using following formula-

$$S_i^+ = \sqrt[2]{\sum_{j=1}^{n}(v_{ij} - v_j^*)^2} \qquad \text{i = 1....m.} \quad (5)$$

$$S_i^- = \sqrt[2]{\sum_{j=1}^{n}(v_{ij} - v_j^-)^2} \text{ i = 1....m.} \quad (6)$$

**Step 7:** Alternatives are ranked on the basis of relative closeness to the best ideal solution. The relative closeness is calculated using following formula:

$$RC_i^* = S_i/(S_i^* + S_i^-) \qquad \text{i = 1...m} \quad (7)$$

## 4. EXPERIMENTAL DATA

In order to analyze and use of MCDM techniques for selection of batsman for T20 matches, we have considered hypothetical data with anonymous names of the batsman as A,B,C,D,E and F with seven criterion as shown in Table 2.

**Table 2:** Criterion

| Id | Criteria | Description |
|---|---|---|
| $C_1$ | Matches | Total T20 matches played by a player |
| $C_2$ | Innings | Total innings a player comes for batting |
| $C_3$ | Total Runs | Total runs he scored in T20 innings |
| $C_4$ | Average | Average score in T20 innings |
| $C_5$ | Strike Rate | Runs scored in 100 bolls |
| $C_6$ | 30s | Number of times he scored 30 or more than 30 |
| $C_7$ | 50s | Number of times he scored 50 or more than 50 |

It is clear from the above Table that from all seven criterion, average and strike rate are equally important. A selection panel always looks for a batsman with high average run with good strike rate. Since criterion mentioned above may be conflicting due to competing nature of batsman and hence it is necessary to apply MCDM technique to take appropriate decision after getting rank through these techniques.

## 5. EXPERIMENTAL WORK

As stated in section 4, experimental work was done with six batsmen namely A, B, C, D, E and F as alternatives along with seven criterion namely Matches($C_1$), Innings($C_2$), Total Runs($C_3$), Average($C_4$), Strike Rate($C_5$), 30s($C_6$), 50s($C_7$). The batting records of six batsmen are presented in Table 3.The data is applied into AHP and AHP-TOPSIS methods for players ranking.

**Table 3:** T20 Batting records of foreign players

| Player Name | Matches | Innings | Runs | Average | Strike Rate | 30s | 50s |
|---|---|---|---|---|---|---|---|
| A | 45 | 39 | 1404 | 36 | 82 | 10 | 5 |
| B | 40 | 40 | 1320 | 33 | 90 | 11 | 4 |
| C | 37 | 35 | 1365 | 39 | 97 | 13 | 4 |
| D | 32 | 30 | 1200 | 40 | 88 | 12 | 3 |
| E | 41 | 40 | 1280 | 32 | 102 | 11 | 4 |
| F | 35 | 34 | 1224 | 36 | 101 | 12 | 5 |

### 5.1. Ranking of Players using AHP method:

Table 2 presents the value with seven criterion of all six batsmen that reflects the performance of all players in T20 matches. The data is normalized by using the method as per we mention above and presented in Table 4. The importance or priority of every criterion is calculated and justified in the same way as we mentioned in step 3 of AHP. Table 5 presents the pair wise comparison matrix constructed using Saaty's 9 point scale and based on the experience of experts. The diagonals of matrix are marked as 1 when criterion is compared with itself. Inning ($C_2$) is more important than the matches so the relative importance value of 2 ($A_{21}$) is assigned to innings ($C_2$) over matches ($C_1$). As the same other relative importance values are inserted on the basis of importance between different criterion. Geometrical Mean ($GM_j$) and Normalized Weight ($W_j$) are calculated using equation (1) and (2). The values of $\lambda_{max}$ , CI and CR are calculated using equation (3) and (4). The consistency and accuracy of weight assigned to criterion are depends upon the value of CR that must be less than 0.1. The calculated value CR is 0.076 this certifies that the weights assigned by the expert are consistent and accurate. The normalized weights of criterion are presented in Table 6. These criterion weights are used to calculate the final AHP weight and ranks of players are presented in Table 7.

**Table 4:** Normalized data

| Player Name | Matches | Innings | Runs | Average | Strike Rate | 30s | 50s |
|---|---|---|---|---|---|---|---|
| **A** | 1.00 | 0.89 | 0.89 | 0.90 | 0.80 | 0.77 | 0.71 |
| **B** | 0.89 | 0.91 | 0.83 | 0.83 | 0.88 | 0.85 | 0.57 |
| **C** | 0.82 | 0.80 | 0.86 | 0.98 | 0.95 | 1.00 | 0.57 |
| **D** | 0.71 | 0.68 | 0.76 | 1.00 | 0.86 | 0.92 | 0.43 |
| **E** | 0.91 | 0.91 | 0.81 | 0.80 | 1.00 | 0.85 | 0.57 |
| **F** | 0.78 | 0.77 | 0.77 | 0.90 | 0.99 | 0.92 | 0.71 |

**Table 5:** Pair wise Comparison matrix

| $A_{ij}$ | $C_1$ | $C_2$ | $C_3$ | $C_4$ | $C_5$ | $C_6$ | $C_7$ | GM | Relative Normalized Weight (W=A2) | E1(A3)= A1*A2 | E2= A3/A2 | $\lambda_{max}$ | CI | CR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $C_1$ | 1 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.56 | 0.07 | 0.54 | 7.55 | 7.62 | 0.10 | 0.076 |
| $C_2$ | 2 | 1 | 0.5 | 0.4 | 1 | 0.5 | 0.5 | 0.76 | 0.10 | 0.71 | 7.34 | | | |
| $C_3$ | 2 | 2 | 1 | 0.5 | 1 | 0.5 | 0.5 | 1.00 | 0.13 | 0.89 | 7.03 | | | |
| $C_4$ | 2 | 2.5 | 2 | 1 | 0.4 | 2.5 | 1 | 1.47 | 0.19 | 1.51 | 8.15 | | | |
| $C_5$ | 2 | 1 | 1 | 2.5 | 1 | 0.5 | 1 | 1.16 | 0.15 | 1.30 | 8.80 | | | |
| $C_6$ | 2 | 2 | 2 | 0.4 | 2 | 1 | 0.5 | 1.36 | 0.17 | 1.23 | 7.14 | | | |
| $C_7$ | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1.59 | 0.20 | 1.47 | 7.31 | | | |
| | | | | | | | | 7.91 | | | | | | |

**Table 6:** Final weight of criterion

| Criteria | $C_1$ | $C_2$ | $C_3$ | $C_4$ | $C_5$ | $C_6$ | $C_7$ |
|---|---|---|---|---|---|---|---|
| Normalized Weight | 0.07 | 0.10 | 0.13 | 0.19 | 0.15 | 0.17 | 0.20 |

**Table 7:** Players ranking using AHP method

| S. NO | Player Name | Final AHP Weight | Rank |
|---|---|---|---|
| 1 | A | 0.83 | 3rd |
| 2 | B | 0.80 | 5th |
| 3 | C | 0.85 | 1st |
| 4 | D | 0.77 | 6th |
| 5 | E | 0.81 | 4th |
| 6 | F | 0.84 | 2nd |

### 5.2 Ranking of Players using AHP-TOPSIS method:

The normalized experimental data of Table 3 is used for ranking using AHP-TOPSIS method. Initially the criterion weights of each criterion are inherited from Table 5 that are previous calculation using AHP method. The weighted decision matrix V are calculated and presented in Table 8. In which positive ideal solution (PIS) and negative ideal solution (NIS) are marked using bold and underline value respective. The separation measurers ($S^+$) and ($S^-$) are calculated using equation (5) and (6) and presented in Table 9. Finally, the rank of the alternatives is decided on the basis of Relative Closeness (RC) that is calculated using equation (7), presented in Table 10.

| **Table 8:** Weighted matrix (V) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Player Name** | **Matches** | **Innings** | **Runs** | **Average** | **Strike Rate** | **30s** | **50s** |
| **A** | **0.071** | 0.086 | **0.112** | 0.167 | 0.118 | 0.133 | 0.143 |
| **B** | 0.063 | 0.088 | 0.105 | 0.153 | 0.130 | 0.146 | 0.115 |
| **C** | 0.058 | 0.077 | 0.109 | 0.181 | 0.140 | **0.172** | 0.115 |
| **D** | 0.050 | 0.066 | 0.096 | **0.186** | 0.127 | 0.159 | 0.086 |
| **E** | 0.065 | **0.088** | 0.102 | 0.148 | **0.147** | 0.146 | 0.115 |
| **F** | 0.055 | 0.075 | 0.098 | 0.167 | 0.146 | 0.159 | **0.143** |

| **Table 9:** Separation Measurers | | | | | | |
|---|---|---|---|---|---|---|
| | A | B | C | D | E | F |
| Si* | 0.07 | 0.09 | 0.11 | 0.19 | 0.15 | 0.17 |
| Si- | 0.05 | 0.07 | 0.10 | 0.15 | 0.12 | 0.13 |

| **Table 10:** Players raking using AHP-TOPSIS | | | |
|---|---|---|---|
| S. No | Player Name | Relative Closeness | Rank |
| 1 | A | 0.57 | 3rd |
| 2 | B | 0.10 | 6th |
| 3 | C | 0.70 | 1st |
| 4 | D | 0.40 | 5th |
| 5 | E | 0.49 | 4th |
| 6 | F | 0.68 | 2nd |

## 6. COMPARATIVE ANALYSIS

The comparative analysis of results using AHP and AHP-TOPSIS methods are presented in Table 11. It is clear from figure 3 that all the methods are producing same rank except 5th and 6ththat are interchanged. Player C is identified as the best T20 player using both the methods.

| **Table 11:** Comparative rank | | |
|---|---|---|
| Player Name | AHP Based Ranking | AHP-TOPSIS Based Ranking |
| A | 3rd | 3rd |
| B | 5th | 6th |
| C | 1st | 1st |
| D | 6th | 5th |
| E | 4th | 4th |
| F | 2nd | 2nd |

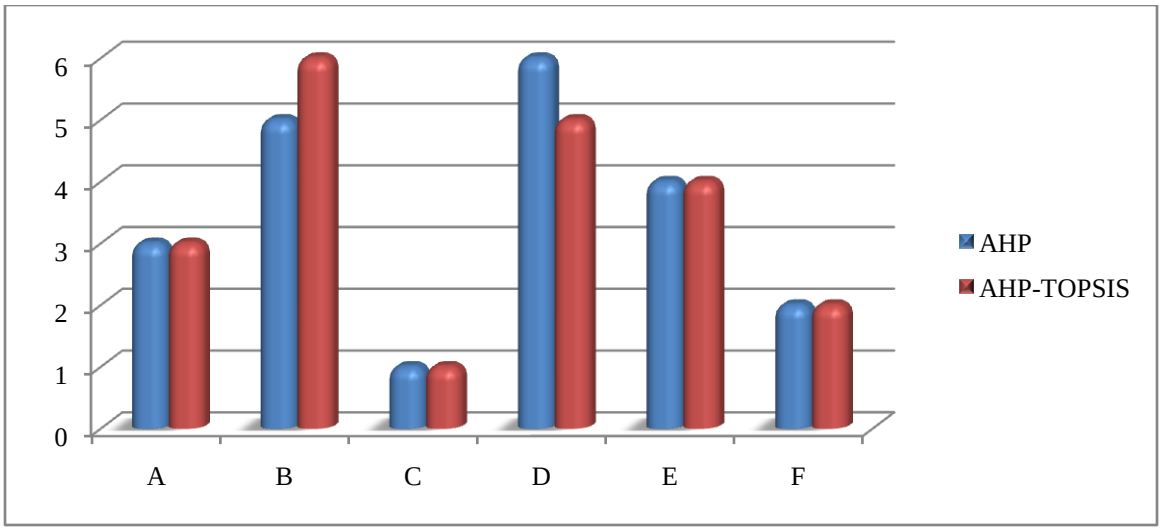


**Figure 3:** Ranking of foreign players using AHP and AHP-TOPSIS

## 7. CONCLUSION

Selection of best foreign player for T20 team is very tedious task for team selectors. The selection process of players may be based on some cricketing statistical indicators, but it becomes more difficult when these indicators are equally important. MCDM techniques provide the alternative solution for this type of specific problem by managing the importance of these indicators. This research work is used the application of AHP and AHP-TOPSIS method for ranking of six foreign batsmen (A,B,C,D,E and F) with seven statistical indicators named as matches, innings, total run, average, strike rate, 30s and 50s. Experimental result shows that foreign batsmen C, F and A have achieved first, second and third rank respectively.

## REFERENCES

Chauhan, A., & Vaish, R. (2012). Magnetic material selection using multiple attribute decision making approach. *Materials & Design*, 36, 1–5.

Dehdasht G, Ferwati MS, Zin RM, Abidin NZ (2020). A hybrid approach using entropy and TOPSIS to select key drivers for a successful and sustainable lean construction implementation. *PLoS ONE* 15(2), 1-32.

Dey, P.K. and Roy, B.C. (2011). A MCDM approach for evaluating bowlers performance in IPL. *Journal of Emerging Trends in Computing and Information Sciences*. 2(11),563-573.

Elsayed, E.A., Dawood, A.K.S. and Karthikeyan, R. (2017). Evaluating Alternatives through the Application of Topsis Method with Entropy Weight. *International Journal of Engineering Trends and Technology (IJETT)*, 46(2),60-66.

Garg, H., Keikha,A. and Nehi H.M. (2020). Multiple-Attribute Decision-Making Problem Using TOPSIS and Choquet Integral with Hesitant Fuzzy Number Information .*Mathematical Problems in Engineering*. 1-12.

Goswami S.S. andMitra S.(2020). Selecting the best mobile model by applying AHP-COPRAS and AHP-ARAS decision making methodology. *International Journal of Data and Network Science.* 4:27–42

Hota, H.S., Awasthi, V.K. and Singhai S.K. (\2016), Application of TOPSIS Method For Stock Index Ranking. Journal of Global Information Technology. 11 (1), 37-43.

Han, Y.,Wang, Z., Lu X. and Hu, B.(2020). Application of AHP to Road Selection. *International journal of Geo-information*. 9,1-21.

Hwang, C. L., and Yoon, K. S. , (1981) ,Multiple attribute decision making: Methods and Applications , *Berlin, Springer-Verlag.*

Hota, H.S., Awasthi, V.K. and Singhai S.K. (2015), Comparative Analysis of AHP and Its Integrated Techniques Applied for Stock Index Ranking. Proceedings of ICACNI 2016, Advances *in Intelligent System and Computing, Springer*. 2,127-134.

Janjua, S. and Hassan, I. (2020). Fuzzy AHP-TOPSIS multi-criteria decision analysis applied to the Indus Reservoir system in Pakistan .*Water Supply*. 20 (5), 1933–1949.

Krohling, R.A. an Pacheco, A.G.C.(2015). A-TOSIS –AN Approach Based on TOPSIS for Ranking Evolutionary Algorithms. *Procedia Computer System*, 15, 208-317.

Lei, F., Wei, G. Gao, H. Wu, J. and Wei, C. (2020). TOPSIS method for developing Supplier Selection with Probabilistic Linguistic Information. *International Journal of Fuzzy System.* 22,749-759.

Majumder, P., Biswas, P. , Majumder, S. (2020). Application of New TOPSIS Approach to Identify the Most Significant Risk Factor and Continuous Monitoring of Death of COVID-19. *Electronic Journal of General Medicine.* 17(6),2516-3507.

Sarjono, H., Seik ,O., Defan, J. and Simamora, B.H. (2020). Analytical Hierarchy Process (Ahp) In Manufacturing And Non-Manufacturing Industries: A Systematic Literature Review. *Sys Rev Pharm*,11(11),158-170

Saaty, T.L., (1980). The Analytic Hierarchy Process. *McGraw-Hill*, New York.

Wulan, H., Martharaharja J.A., Sutrasna Y. and Sugi A. (2020).Application of Analytical Hierarchy Process (AHP) in Determining Maritime Defense Strategy as a Follow- Up to Conflict in Natuna Sea. *International Journaof Advanced Science and Technology* . 29(3),382-394.

Zavadskas, E. K., Turskis, Z., &Kildienė, S. (2014). State of art surveys of overviews on MCDM/MADM methods. *Technological and Economic Development of Economy*, 20, 165–179.

Zhongyou, X. ( 2012 ).Study on the Application of TOPSIS Method to the Introduction of Foreign Players in CBA Games. *Physics Procedia*. 33:2034 – 2039.