ijecs open access www.ijecs.in
International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume – 5 Issue -03 March, 2016 Page No. 16004-16008

Multi Criteria Recommendation System for Material Management

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***Abstract*— Material management is related to planning, controlling and organizing the flow of material from availability to requirement. Mapping excess material in appropriate location considering multiple criteria is one of the administrative decision making task.**

Material utilization is a multi –criteria decision making problem consist of several conflicting criteria must verified before taking any decision. A systematic methodology is proposed in this paper based on TOPSIS and AHP method. This paper discusses about important mechanism that provide guideline to decision maker for material mobilization and material utilization using TOPSIS and AHP methods. The combination of TOPSIS and AHP provide faster, reliable and convenient way for decision maker evaluating the most important criteria. Using TOPSIS and AHP method, we can provide best tool for decision maker so that material management will achieve easily.

***Index Terms*— Material management, TOPSIS, AHP, Material mobilization, Multi criteria decision making.**

I. INTRODUCTION

Now days, E- Governance have played a very important role in government sector. The impact of Information technology has made everything simple, easy, reachable and flexible. Digitalization has been involved in many different sector as education, inventory, finance management and decision making. [1]

Main objective of material management system is planning, organizing and controlling material and avoid surplus stock, but sometimes surplus stock arises due to sudden change in requirement or change in specification. As rapidly change in technology, material specification and requirement is continuously vary. It is critical for any organization to avoid surplus material. Proper decision making is required to overcome surplus material problem. In this paper, we can try provide guideline for decision making with the help of TOPSIS and AHP method. This technique effectively used to overcome surplus material problem considering different conflicting criteria.

TOPSIS is multi criteria decision making method, calculate solution based on shortage distance from ideal solution and longest distance from worst solution. The Euclidean distance is used to calculate shortage and longest distance. TOSIS is method which can provide decision making with help of both negative and positive criteria. It is faster than AHP and one of the simple MCDM method. But, in TOPSIS very difficult to allocate weight and keep judgment of weight. [2]

The analytic hierarchy process is MCDM method which decomposed complex problem into smaller hierarchical statement. AHP matrix is calculated with help of alternatives with respective criteria. AHP is one of the complex method, it require more number of calculation as number of alternative and criteria increases. [3]

The proposed framework utilized advantages from TOPSIS method, to overcome TOPSIS weight issue we consider AHP and calculate weight for criteria. Proposed method is simple than AHP and require less calculation than AHP. It is simple method which provide reliable and fast result for multi criteria decision making problem. This project is developed to minimize gap between surplus material and requirement considering proposed framework in multi criteria decision making.

II. THEORETICAL BACKGROUND

This part describes some theoretical context which are related to this project.

MULTI CRITERIA DECISION MAKING

Over the years, decision making has increased popularity due to its uses in variety of domains. Multi criteria decision making used in financial, customer relationship management, housing evaluation, disaster management and food risk management. Multi criteria decision making consist of many methods like AHP, TOPSIS, ELECTRA and much more. Each methods having its own pros and cons, Sohail Asghar suggested that hybrid decision making system required, which can overcome complex problem by using multi criteria decision making [4].

ANALYTIC HIERARCHY PROCESS (AHP) METHOD

The Analytic Hierarchy Process has been developed by T. Saaty. It allows users to assess weight of multiple criteria in an intuitive manner [5]. Analytic Hierarchy Process allows a logical mixture of data, which could be qualitative, quantitative, experience, intuition and insight in its algorithmic framework. AHP is used in many field to make decision making, such as business, education, government, healthcare and industry [6]. One of the advantage of AHP is that it shows, how changes in priority of criteria at upper levels have a result on the priority of criteria at lower levels. It also provide stability and flexibility respecting changes within and additions to the hierarchy [7]. However, AHP has some week point like it's complexity for implementation. As number of hierarchy level increases, the number of pair comparison also increases, so it require more time and effort to build AHP model. Also, AHP method cannot guarantee the decisions as absolutely true [8].

TOPSIS

TOPSIS consider Euclidean distance to get best alternatives, this method select alternatives using shortest Euclidean distance from best solution and farthest from negative solution [9]. The decision matrix examine both subjective and objective elements. Each criterion in the TOPSIS method is conclude to take either monotonically decreasing or increasing utility [10]. It has simple process which takes input as any number of criteria and attributes. It is easy to use and programmable. Attribute defines number of steps required to developed TOPSIS model. It has been used in business and marketing, supply chain management, design engineering and manufacturing system [11]. The biggest disadvantage of system is, TOPSIS not consider uncertainty in weights. Thus some time its produce unreliable result [9].

MATERIAL MANAGEMENT

The objective of material management is to mapping excess material in appropriate location considering multiple criteria. It is much more similar approach like supply chain management system. Ghodsypour and O'Brien (1998) present integration of linear programming and AHP to consider both tangible and intangible factors to select the best suppliers. They consider multiple sourcing problem, with multiple criteria and capacity [12]. Karpak and Kasuganti (1999) have proposed visual interactive goal Programming for supplier selection process [13]. Liu et al. (2000) proposed data envelopment analysis (DEA) to compare the performance rating of different supplier for best selection [14].Chaudhry et al. (1991) have present integer goal programming allocating order quantities among suppliers [15]. Kumar et al. (2002) have used fuzzy integer goal programming for supplier selection [16]. Chan et al. (2007) used an AHP to determine the optimal supplier. His project consider 14 criteria to choose best suppliers [17]. Wadhwa and Ravindran (2007) used a 3 objectives, for supplier selection methodology, such as price, rejects and lead time. All of these objective functions are minimization [18]. Similarly, Vahdani et al. (2008) also praduced a three step methodology considered balancing and ranking [19]. Chiou et al. (2005) presented a fuzzy hierarchical analytic process to determine the weights of criteria [20]. Aditya Hosanagara Kumaraswamy et al. (2011) used An Integrated QFD and TOPSIS Methodology for Supplier Selection [21]. Mohuya B. Kar et al. (2014) used fuzzy TOPSIS method for suppler selection. He construct a fuzzy based decision network for TOPSIS method considering global risk criteria and alternatives [22].

III. PROPOSED METHOD

This methodology for material donor selection using TOPSIS Method consists of following Step:-

- Identify the criteria to be used in the model;
- By using expert views weighing the criteria;
- Integration of AHP to obtain preferences weight for criteria
- Evaluation of alternatives with TOPSIS and determination of the final mark.

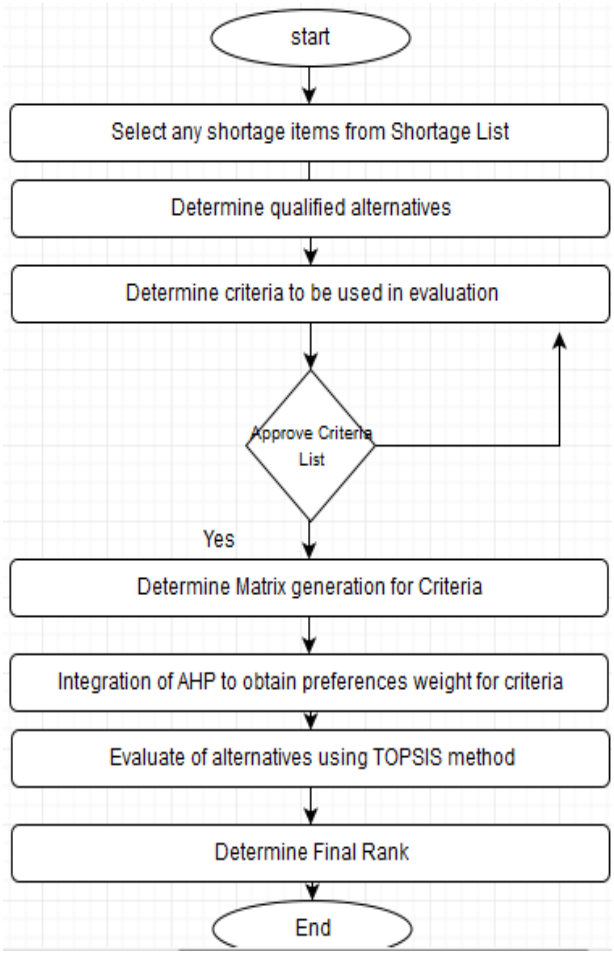

Figure 1: Flow Chart

IV. PROBLEM STATEMENT

Decision making Systems (DSS) are computer-based systems supporting decision making activities. DMS collect knowledge coming from several domain such as decision theory, artificial intelligence, database research, mathematical models and so on. Multiple Criteria Decision Making (MCDM) is a one of

the method used to find best alternatives for DMS from multiple conflicting criteria. MCDM techniques are able to solve complex problems characterized by different objectives. MCDM problems are mostly used in real life applications within several domain: for example when buying a house or a car multiple criteria, such as size, price, consumptions, and style need to be taken into consideration. MCDM is used can be found in the finance, business and industrial contexts.

TOPSIS and AHP are two MCDM methods, each one have pros and cons. TOPSIS used any number of attributes and criteria, less comparison and easy to implement. But allocating directly weightage to criteria is difficult and provide unreliable result. AHP is flexible and scalable method but hard to implement. This project implemented TOPSIS method and instead of assigning directly weightage to criteria, combine AHP method and then calculate weight for criteria. The main objective of this project is to investigate a new approach based on TOPSIS and AHP that can provide more accurate decision making in multi criteria environment.

The aim of this project is developed a methodology for managing surplus material to required location in Directorate of Vocational Educational and Training. This paper has developed for selection of material donor by using combination of TOPSIS and AHP method. For this selection three different criteria are taking into account and weightage of criteria is calculate using AHP method. On this basis of criteria weightage, we produce rank of every donor with help of TOPSIS method.

V. IMPLEMENTATION

V.I Selection of alternatives

In first step, identify list of institute having excess martial related to shortage. In this process we choose any institute and then select shortage machine in respected institute. For example Institute code 0001 require machine code 1000 then all institute having machine code 1000 from excess list are listed.

V.II Identify the criteria to be used in the model

In the second step, with the help of going over expert we try to recognize variables and effective criteria in excess material selection and the criteria which will be used their revaluation is extracted then the list of appropriate institute are find.to perform this task choose following three criteria.

1. Scheme under institute are working.
2. Distance between two institutes.
3. Working condition of Excess material.

V.III AHP method for weighing the criteria

After identification of criteria and approved through decision maker, create criteria table

	Case_Id	Case_1	Case_2	Case_3
1	1	1	3	5
2	2	0.333333333333333	1	3
3	3	0.2	0.333333333333333	1

Figure 2: Criteria table

Figure 2 indicate criteria matrix, perform AHP method on criteria table and calculate rank with weightage for each criteria. Figure 3 indicate ranks for each criteria.

	Criteria_id	Score
1	1	0.633345720302242
2	2	0.26049795615013
3	3	0.106156323547628

Figure 3: Criteria with their weightage

V.IV Evaluation of alternatives with TOPSIS

In last stage, ranks are determined using TOPSIS Method. TOPSIS method consist of six activities is listed below.

ACTIVITY- 1

Establish a decision matrix for the ranking. The structure of the matrix can be expressed as follows:

B1 B2 …… Bn

D = A1 P11 P12..... P1n …. ……An Pm1 Pm2 …… Pmn (1)

Where Ai denotes the alternatives i, i = 1…., m;

Bj represents jth attribute or criterion, j = 1…., n, related to ith alternative; Pij is a crisp value indicating the performance rating of each alternative Ai with respect to each criterion Bj.

Decision matrix is based on following pointer system.

- **Criteria 1**

For criteria 1 create matrix which indicate pointer system. Maximum 9 and minimum 1

	General	Tribal Ashram Shala	SCP	Minority	Adivasi
General	9	7	6	5	4
Tribal Ashram Shala	4	9	7	6	5
SCP	4	5	9	7	6
Minority	4	5	6	9	7
Adivasi	4	5	6	7	9

Figure 4: Criteria 1

This figure indicate weightage for criteria 1. If shortage material from general institute and alternative are also general institute then it get 9 point and so on.

- **Criteria 2**

Weightage for criteria 2 is calculated based on geographical distance. If alternative and require institute both from same taluka then 9 points else if both institute not in same taluka but in same district then 7 point. If not in district but within region then 5 point and out of region then 1 point.

- **Criteria 3**

Weightage for criteria 2 is calculated based on working condition. If excess material in working condition than 9 if minor fault then 7, major fault then 5 if proposed to write off then 3 and write off then 1

Using above three criteria decision matrix is calculated.

	id	Institutecode	Case1	Case2	Case3
1	1	0145	9	1	153
2	2	0232	4	5	45
3	3	0250	4	1	63
4	4	0669	9	1	18

Figure 5: Decision matrix

ACTIVITY - 2
Once decision matrix is calculate, normalized decision matrix Q= [Sij].
The normalized value Sij is calculated as;
Sij = -Pij / √ Σjn= 1 Pij2 i = 1 ……n; j= 1…..m (2)

ACTIVITY-3
Weighted normalized decision matrix is calculate by multiplying normalized decision matrix obtain from activity 2 and associated weightage from 5.5.3
The weighted normalized value Vij is calculated as:
Vij = Wij.Sij , j=1…….n; i= 1 ……m; (3)

Where wj represents the weight of the jth attribute or criterion.

	id	Case1	Case2	Case3
1	1	0.40924415440496	0.0492294863581323	0.0942023547121185
2	2	0.181886290846649	0.246147431790662	0.027706574915329
3	3	0.181886290846649	0.0492294863581323	0.0387892048814606
4	4	0.40924415440496	0.0492294863581323	0.0110826299661316

Figure 6: Weighted normalized decision matrix

Figure 6 indicate weighted normalized decision matrix for four alternatives obtain from activity 3

ACTIVITY- 4
After calculating weighted normalized decision matrix, determine maximum and minimum value for each criteria.
Determine the PIS and NIS, respectively:
V+ = {v1+ …….. vn+}
= {(Max vij I j c J), (Min vij I j € J')}
V- = {v1-…….. vn-}
= {(Min vij I j € J), (Max vij I j € J')}

	id	C1	C2	C3
1	1	0.40924415440496	0.246147431790662	0.0942023547121185

Figure 7: Maximum value for each criteria.

	id	C1	C2	C3
1	1	0.181886290846649	0.0492294863581323	0.0110826299661316

Figure 8: Minimum value for each criteria

ACTIVITY-5
TOPSIS method is based on Euclidean distance. Separation measure is calculate by using m-dimensional Euclidean distance.
The separation measure Ei+ of each alternative from the maximum value is given as:

Ei+ = √ Σjn =1 (Vij – Vj+) 2, i = 1…….m (4)

Similarly the separation measure Ei- of each alternative from the minimum is as follows:

Ei- = √ Σjn =1 (Vij – Vj-) 2, i = 1…….m (5)

ACTIVITY-6
Once m-dimensional Euclidean distance calculated, relative closeness to the ideal solution is calculate and rank the alternatives in descending order.
The relative closeness of the alternative Ai with respect to maximum V+ can be expressed as:
Hi* = Ei- / Ei+ + Ei- (6)
Where the index value of Hi* lies between 0 and 1. The lowest the index value, the better the performance of the alternatives.

	id	Institutecode	Case1	Case2	Case3
1	1	0145	9	1	153
2	2	0232	4	5	45
3	3	0250	4	1	63
4	4	0669	9	1	18

	id	value
1	1	0.448567066181213
2	4	0.48456579834112
3	2	0.545182917400856
4	3	0.916933735393836

Figure 9: Decision Matrix and Ranking

Thereafter, the relative closeness coefficients are determined, and selected alternatives are ranked. Figure 5.5.4.6 indicate rank for each institute. List of alternatives and their rank is vary depending upon selection of shortage institute and respected machine.

VI. CONCLUSION & FUTURE WORK

The aim of this research paper is to create multi criteria decision making, with help of TOIPSIS and AHP. This model present MCDM for evaluation of material mobilization. The main advantage of this method is simple and effective. This method avoid uncertainty in weight and enhance perfection of ranking.

The present model consider three criteria, in future more no of criteria require to consider. Above model also consider for supplier selection.

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