

Multi Criteria Decision Making with the Help of Methods & Applications: An Overview

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Abstract— This article presents an overview of different selection techniques as per Multi criteria Decision making and their applications. Recent articles which are pertinent regarding MCDM are collected and analysed to find out which approach and areas is more common compare to the other applications.

Key words: MCDM; AHP; ANN; ANOVA; DEA; MOORA; TOPSIS

I. INTRODUCTION

Multiple criteria decision making (MCDM) refers to making decisions in the presence of multiple optimization, usually conflicting, criteria. Multi criteria decision making problems are common in the life of everyday. In personal context a house or a car buys may be characterized in terms of price, size, style, safety, comfort, etc. Although MCDM problems are widespread since as a discipline only has a relatively short history of about 30 years. The History of early development in Multiple Criteria Decision Making, presented by Stanley at the 21st International Conference on Multiple Criteria Decision Making held in Jyvaskyla, June 2011. The development of the MCDM discipline is closely related to the field of manufacturing industry, management, agriculture, logistics & computer technology.

In one hand, the rapid development of computer technology in recent years has made it possible to conduct systematic analysis of complex MCDM problems. On the other hand, the extensive use of manufacturing industry has generated a huge amount of information, which makes MCDM increasingly important and useful in supporting business decision making. In today's manufacturing world, quality is of swift importance. So in this paper, MCDM methods

II. WHAT IS MCDM METHOD?

MCDM is the well-known process that allows to make decision making when there exist several conflicting criteria. It is a branch of general category of Operational Research models which deals with decision problems under the presence of decision alternatives and decision criteria. This fabulous model is known as Multi Criteria Decision making

or MCDM. MCDM can be broadly classified into two classes, namely,

- Multi-Attribute Decision Making (MADM)
- Multi-Objective Decision Making (MODM)

Multi-criteria decision making is a useful tool of many engineering disciplines such as manufacturing, material selection, production, manufacturing resource planning, constructional, etc. and which is also useful for other departments like economical, logistics, management, military, aircraft, etc. problems specifically plays an important role in the fields of supplier selection, project evaluation, investment decision and so on. The following pros and cons of MCDM are given below-

A. Pros of Multi Criteria Decision Making

- 1) It can structure an assessment of a complex problem along both cognitive and normative dimensions, both of which are essential in evaluating ecosystem services.
- 2) It allows comparison of ecological objectives with socio-cultural and economic ones in a structured and shared framework.
- 3) It can facilitate multi-stake holder process.
- 4) It is easy to use compare to other methods.
- 5) It does not require any assumption that the criteria are proportionate.
- 6) The methods differ in their approach of selecting the best alternatives.
- 7) Some methods introduce additional parameters which affects the top ranked solution.

B. Cons of Multi Criteria Decision Making

- 1) It does not provide a clear method by which to assign weights.
- 2) It is potentially time consuming and technically complex.
- 3) It is difficult to find out the inter-comparison of case studies.

III. MCDM SURVEY & ITS APPLICATIONS

Following are the effective articles of multi criteria decision making (MCDM) methods which has been used to analyze the problem of various sectors and realized the area of specific to implement the optimization techniques-

Article Number	Methods	Authors	Applications	Specific area
1	TOPSIS method	Abhishake Chaudhary, Vijayaat Maan, and, Bharat Singh Chittoriyan.	Manufacturing	Selection of robot in welding technology.
2	Fuzzy AHP-CA	Bottani.E, and, Rizzi.A.	Manufacturing	Merchant selection.
3	MOORA method	Gadakh V.S	Manufacturing	Selection of best milling operation.

4	AHP method	Sanjay Kumar, Neeraj Parashar, and, Dr. Abid Haleem	Management	Selection of vendor for SSI, MSI, LSI.
5	AHP method	S.H.Tang, N.Hakim, W.Khaksar, M.K.A. Ariffin, S.Sulaiman, and, P.S. Pah	Management	Supplier selection to the procedure of optimization of AHP.
6	Fuzzy AHP method	Buyukuzkan.G, Feyzioglu.O, and, Nebol. E.	Logistics	Planned alliance partner selection.
7	Fuzzy MCDM, Vikor method	Buyukuzkan.G, and, Ruan.D.	Management	Evaluation of ERP software products.
8	ANN method	Efendigil.T, Onut. S, and, Kongar. E.	Management	Third party logistics provider selection.
9	Fuzzy AHP method	Lee. A.H.I, Chen. W. C, and, Chang. C. J.	Manufacturing	Department of IT performance evaluation.
10	Fuzzy logic MCDM	Harish Kumar Sharma	Manufacturing	Vendor selection for manufacturing systems.
11	MOORA method	Gorener.A, Diecher.H, and, Hacioğlu.U	Management	Selection of BBL centre.
12	MOORA method	Brauers .W.K.M, Zavadskas.E.K, Turskis.Z, and, Vilutiene	Management	Performance evaluate of contractor's ranking.
13	MOORA method	Gadakh.V.S, Shinde.V.B, and, Khemna.N.S	Manufacturing	Welding process parameters.
14	Fuzzy MOORA	Mandel.U.K, and, Sarkar.B	Manufacturing	Selection of best IMS.
15	MOORA method	Chakravorty.S	Manufacturing	Decision making in manufacturing.
16	MOORA method	Karande.P, and, Chakravorty.S	Manufacturing	Material selection.
17	MOORA Fuzzy algorithm	Ozcelik.G, Aydogan.E.K, and, Gencer.C	Education	Special education.
18	Fuzzy AHP method	Cheng.A.C, Chen.C, and, Chen.C.Y	Management	Comparison on skills forecasting method.
19	AHP and GA method	Lin.C.C, Wang.W.C, and, Yu.W.D	Construction	Best value bid.
20	AHP method	Hua.Z, Gong.B, and, Xu. A	Management	Parking of car supplier selection.
21	TOPSIS method	Vimal.J, Chaturverdi. V, and, Dubey.A.K	Manufacturing	Supplier selection in manufacturing industry.
22	TOPSIS method	Thomaidis.F, Konidari.P, and, Mavrakis.D	Management	Ranking selection.
23	AHP method	Dagdeviren.M	Manufacturing	Decision making in equipment selection.

24	DEA method	Karsak.E.E	Manufacturing	Flexible manufacturing system selection.
25	AHP and TOPSIS	Kuo.Y Yang.T, Cho.C, and, Tseng.Y.C	Manufacturing	Despatch problems.
26	AHP method	Lamelas.M.T, Marioni.O, Hoppe.A, and, Riva.J.D.L	Management	Defining of criteria weights.
27	AHP method	Wong.J, Li.H, and, Lai.J	Construction	Intellectual building systems.
28	AHP method	Melon.M.G, Beltran.P.A, and, Cruz.M.C.G	Education	Project judgement on evaluation.
29	DEA method	Meng.W, Zhang.D, Qi.L, and, Liu.W	Education	Basic research evaluation.
30	Fuzzy ANP method	Wu.C.R, Lin.C.T, and, Chen.H.C	Construction	Location choice for the purpose of construction.
31	TOPSIS method	H.S. Byun, and, K.H.Lee,	Manufacturing	Rapid prototyping process selection.
32	TOPSIS method	Srikrishna S, Sreenivasulu Reddy.A, and, Vani.S	Management	New car selection.
33	AHP and TOPSIS method	Jayaram.C.Sasi, and, Dr.Abhijeet.K.Digalwar	Management	Supplier selection between two countries.
34	AHP and TOPSIS method	Behar Sennaroglu, and Seda Sen	Management	Supplier selection.
35	MOORA method	Shankar Chakravorty	Manufacturing	Application in manufacturing environment.
36	AHP method	Doraid Dalalah, Faris-Al-Oqla, and, Mohammad Hayajneh	Manufacturing	Selection of cranes operation.
37	AHP method	Skibniewski.M. J, and, Chan. L. C	Construction	Evaluation of advanced construction technology.
38	MOORA method	Joseph Achebo, and, William Ejenavi Odinikuku	Manufacturing	Optimization of gas GMAW process.
39	ANOVA method	M.Kaladhar, k.Venkata Subbaiah, and, Ch.Srinivasa Rao	Manufacturing	Optimization of turning.
40	MOORA method	El-Santawy. M.F, and, Ahmed. A.N,	Education	Analysis of project selection of Life science.

Table 1: MCDM Approaches & its Applications

IV. TYPES OF MCDM METHODS & ITS APPLICATIONS

In this case study, we found that the method of MCDM has been useful in the several fields like manufacturing, management, construction, education and logistics which is mention detailed in the following table

Methods	Number of articles
AHP	18
ANN	1
ANOVA	1
DEA	2
MOORA	11
TOPSIS	8

Table 2: Techniques of MCDM

In the above table, we have find out that the majority of MCDM techniques are in Analytical Hierarchical Process (AHP). In the manufacturing areas, most articles of MCDM are used for selection, performance, ranking, and evaluation of manufacturing systems whereas, in the areas of management most articles are based on selection.

Figure shows that the percentage of articles published which are applied to the various techniques deals with the process of MCDM methods

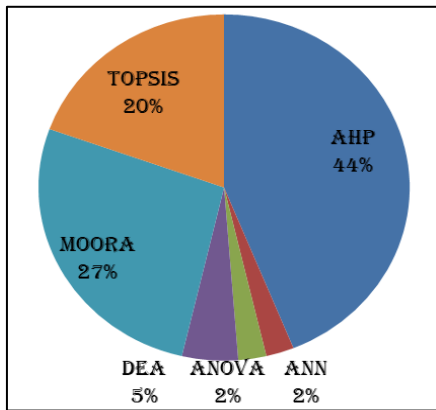


Fig. 1: Percentage of Techniques

Application	Number of articles
Construction	4
Education	4
Logistics	1
Management	14
Manufacturing	17

Table 3: Application Areas of MCDM

In the above table, we have examined that the majority of MCDM applications are in manufacturing and management. In the manufacturing areas, most articles of MCDM are used for selection, performance, ranking, and evaluation of manufacturing systems whereas, in the areas of management most articles are based on selection.

Figure shows that the percentage of articles published which are applied to the various sections of application deals with the process of MCDM methods

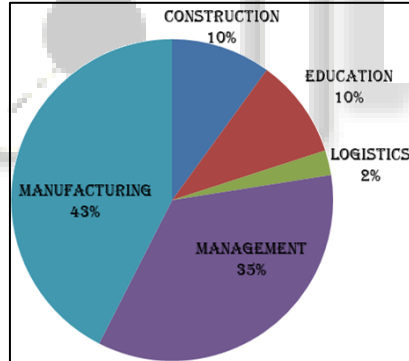


Fig. 2: Percentage of Application

V. OBSERVATIONS

Figure 2 shows that the percentage of MCDM methods which are applied to the respective. On the other hand, figure 3 shows that the percentage of articles approach to the respective sectors with the help of MCDM techniques. Among these articles, we found 16 articles using AHP, 9 articles using MOORA, 9 articles using TOPSIS, 2 articles using DEA and 2 articles using ANN knowledge based. On the above two tables, manufacturing sector is used the highest percentage to apply the procedure of multi criteria decision making and AHP has been found the most well-liked technique used in multi criteria decision making method as per the number of articles published.

VI. CONCLUSION

In this article, an attempt has been made to review and analyze different multi-criteria decision making techniques. The article things to see different areas of application where multi criteria decision making techniques are inserted. Table 2 and Table 3 shows different techniques of multi criteria decision making and areas of application respectively. Although, the searching for the paramount technique of multi criteria decision making may never end. Research in this area is most significant and precious.

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