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Multi Attribute Decision Making In Optimization of Corrugated Sheet Box Industry

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Abstract – *The aim of this research work paper is an optimization of corrugated sheet box industries by using 15 common attributes from three different industries by using MADM methods like AHP, TOPSIS & PROMETHREE so that we can find out best alternative. Systematic decision-making analysis can help decision maker to summarize and judge all information effectively and to define right question and to find out optimum and the most appropriate solution. Analytic hierarchy process(AHP) is a structured technique for organizing and analyzing the complex decisions. TOPSIS is also one of the MADM method, in this technique two artificial alternatives are hypothesized. Positive ideal alternative which corresponds to the maximum value and negative ideal alternative which corresponds to the minimum value. PROMETHREE offers complete ranking from the best alternative to the worst one. In this method pair of alternative is compared.*

From this investigation , it is found that ,these technique like AHP and PROMETHREE will not only help the researcher in providing the matter concerned but also helps to understand the optimization problem in better way with possible solution.

Keywords- *Multi Attribute decision Making, Analytic Hierarchy Process (AHP)*

INTRODUCTION

Multi-attribute decision making method, which was taking as the base for the decision making model, is one of the decision-making support methods. The MADM theory offers a formal base for the establishment of a model, in which the key criteria is interconnectedness of assessments according to the individual parameters that result in an integrated assessment.

Engineers are always making design decisions, whether it's the design of a thermal fin or the location of a new manufacturing plant. Poor decisions could result in the loss of money, resources, and time. Therefore, it is important that engineers make logical and well reasoned decisions. Systematic decision-making analysis can help decision maker to summarize and judge all information effectively and to define right question and to find out optimum and the most appropriate solution.

Analytic hierarchy process (AHP) is a structured technique for organizing and analyzing the complex decisions. TOPSIS is also one of the MADM methods, in this technique two artificial alternatives are hypothesized. Positive ideal alternative which corresponds to the maximum value and negative ideal alternative which corresponds to the minimum value. PROMETHREE offers complete ranking from the best alternative to the worst one. In this method pair of alternative is compared.

From this investigation, it is found that ,these technique like AHP and PROMETHREE will not only help the researcher in providing the matter concerned but also helps to understand the optimization problem in better way with possible solution. The purpose for using utility theory in decision making is to create a mathematical model to aid the process. It gives the decision maker the ability to quantify the desirability of certain alternatives. Utility theory is for design scenarios where uncertainty and risk are considered. The end result of using this method is a function which represents the designer's preferences, given a certain set of design attributes.

INDUSTRIAL SURVEY

Name of Industries are given below:

1] Sunpack Industries Private Ltd, N-45,MIDC, Amravati
2] Shrinath Packers Pvt. Ltd, C- 40, MIDC Badnera Road, Amravati
3] Mahalakxmi packers Private Ltd , MIDC , Amravati

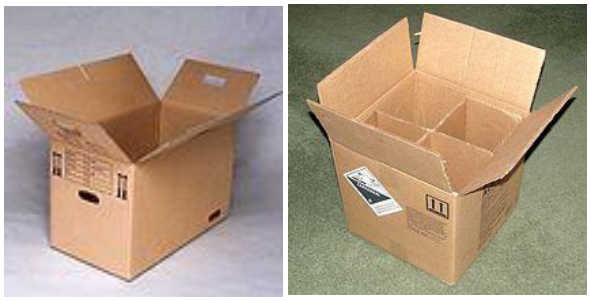

Fig 1-Packing Boxes

CORRUGATED SHEET BOX PRODUCTION PROCESS

There are mainly six workstation
1] Corrugation
2] Pasting
3] Printing
4] Creasing.
5] Slotting
6] Stitching & Punching

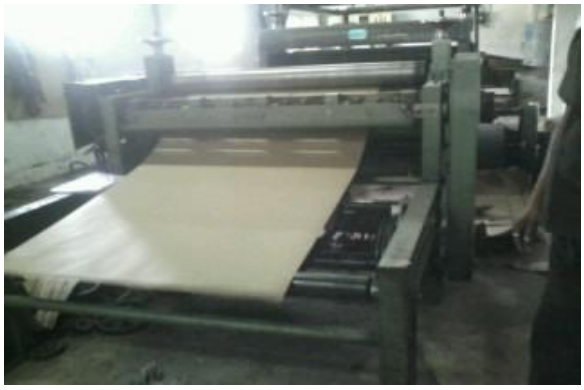

Fig2- Corrugation Process

It has 3 rolls & 1hp motor & gum pot. Rotate with high speed about 1000 rpm .then the gum is sticking with a roll. It carries 3 rolls & 1hp motor & gum pot

Technical Data:-

Size Motor Weight Aprox Floor Space
(Inches) (H.P) (Kilo Gram)
55 1/2 500 6'*3'
65 1/2 600 7'*3'
75 1/2 700 8'*3'
85 1/2 800 9'*3'

A precision grinded roll, the glue is applied to the tips of the corrugated surface of the sheet. The pressure on sheet & control of gum is adjustable from single side. All gears and v belts are covered for safety.

METHOLOGY

Multi Attribute Decision Making (MADM)

MADM methods, on the other hand, are generally discrete, with a limited number of predetermined alternatives. MADM is an approach employed to solve problems involving selection from among a finite number of alternatives. An MADM method specifies how attribute information is to be processed in order to arrive at a choice. MADM methods require both inter- and intra-attribute comparisons, and involve appropriate explicit takeoffs.

PARTS OF MADM METHOD

Each decision table (also called decision matrix) in MADM methods has four main parts, namely:
(a) Alternatives,
(b) Attributes,
(c) Weight or relative importance of each attribute
(d) Measures of performance of alternatives with respect to the attributes.

Given the decision table information and a decision-making method, the task of the decision maker is to find the best alternative and/or to rank the entire set of alternatives. It may be added here that all the elements in the decision table must be normalized to the same units, so that all possible attributes in the decision problem can be considered.

Decision table in MADM methods

Alternatives	Attributes					
	B_1 (w_1)	B_2 (w_2)	B_3 (w_3)	- (-)	- (-)	B_M (w_M)
A_1	m_{11}	m_{12}	m_{13}	-	-	m_{1M}
A_2	m_{21}	m_{22}	m_{23}	-	-	m_{2M}
A_3	m_{31}	m_{32}	m_{33}	-	-	m_{3M}
-	-	-	-	-	-	-
-	-	-	-	-	-	-
A_N	m_{N1}	m_{N2}	m_{N3}	-	-	m_{NM}

The decision table shows

Alternatives, Ai (for i = 1, 2, ….. , N),

Attributes, Bj (for j = 1, 2, ….. , M),

Weights of attributes, wj (for j=1, 2, ….., M) and

The measures of performance of alternatives, mij (for i= 1, 2… N; j=1, 2… M).

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SELECTION OF AN ATTRIBUTE

Table:- 1 shows attributes and their alternatives

Sr. No.	Attributes	Industry 1	Industry 2	Industry 3
1	Production capacity/month	60 tonne	40 tonne	50 tonne
2	Material requirement	63 tonne	42 tonne	52 tonne
3	Number of Machines	6	6	6
4	Cycle time/day	10 hrs	12 hrs	10 hrs
5	Manpower requirement	15	12	12
6	Production / year	720 tonne	480 tonne	600 tonne
7	Types of sheet	3	1	2
8	Capital investment	39.48 lakh	16.64 lakh	21.28 lakh
9	Area of Industry	11000 sq.ft	10000 sq.ft	10000 sq.ft
10	Transportation cost	60000 rs	40000 rs	50000 rs
11	Container capacity	32.43 cu.ft	30.23 cu.ft	34.83 cu.ft
12	Wages & salaries	135000 rs	108000 rs	108000 rs
13	Wastage	3%	2%	2%
14	Net profit	15%	10%	15%
15	Power requirement	20 hp	22 hp	20 hp

APPLIED METHODS

1] Analytic Hierarchy Process (AHP)

2] Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) Method

3] Preference Ranking Organization Method for Enrichment And Evaluation (PROMETHEE)

CALCULATIONS

Table:- 2 Information regarding the Attribute is as follows

Preference scale	Numerical value
Very strong	1
Strong importance	2
Absolute strong	3
Between strong &very strong	4
Between strong &absolute strong	5

Table:-3 Relative Importance is as follows

Sr. No.	Attributes	Preference scale
1	Production capacity/month	1
2	Material requirement	2
3	Number of machines	5
4	Cycle time/day	3
5	Manpower requirement	0.5
6	Production / year	1
7	Types of sheet	5
8	capital investment	2
9	Area of Industries	0.5
10	Transportation cost	0.5
11	Container capacity	3
12	Wages & salaries	4
13	Wastage (In terms of paper)	2
14	Net profit	1
15	Power consumption	4

CALCULATIONS FOR AHP METHOD

Table 4- Pair Wise Comparison Matrix

Industry	Consistency Index	Score
1	3.413-2/3	o.471
2	4.306-2/3	0.768
3	4.786-2/3	0.928

Table 5- Weights of Attributes

Sr. No.	Row sum	Row sum*1/15	Weights
1	34.5	2.3	0.083
2	17.25	1.15	0.041
3	6.9	0.46	0.016
4	10.45	0.696	0.027
5	69	4.6	0.165
6	34.5	2.3	0.082
7	6.9	0.46	0.016
8	17.25	1.15	0.041
9	69	4.5	0.165
10	69	4.5	0.165
11	10.45	0.696	0.027
12	8.625	0.575	0.020
13	17.25	1.15	0.041
14	34.5	2.3	0.082
15	8.625	0.575 =27.612	0.020

Table 6- Composite Performance Score

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1	2	5	3	0.5	1	5	2	0.5	0.5	3	4	2	1	4
2	0.5	1	2.5	1.5	0.25	0.5	2.5	1	0.25	0.25	1.5	2	1	0.5	2
3	0.2	0.4	1	0.6	0.1	0.2	1	0.4	0.1	0.1	0.6	0.8	0.4	0.2	0.8
4	0.33	0.66	0.67	1	0.16	0.33	1.67	0.66	0.16	0.16	1	1.33	0.66	0.33	1.33
5	2	4	10	6	1	2	10	4	1	1	6	8	4	2	8
6	1	2	5	3	0.5	1	5	2	0.5	0.5	3	4	2	1	4
7	0.2	0.4	1	0.6	0.1	0.2	1	0.4	0.1	0.1	0.6	0.8	0.4	0.2	0.8
8	0.5	1	2.5	1.5	0.25	0.5	2.5	1	0.25	0.25	1.5	2	1	0.5	2
9	2	4	10	6	1	2	10	4	1	1	6	8	4	2	8
10	2	4	10	6	1	2	10	4	1	1	6	8	4	2	8
11	0.33	0.66	0.67	1	0.16	0.33	1.67	0.66	0.16	0.16	1	1.33	0.66	0.33	1.33
12	0.25	0.5	1.25	0.75	0.125	0.25	1.25	0.5	0.125	0.125	0.75	1	0.5	0.25	1
13	0.5	1	2.5	1.5	0.25	0.5	2.5	1	0.25	0.25	1.5	2	1	0.5	2
14	1	2	5	3	0.5	1	5	2	0.5	0.5	3	4	2	1	4
15	0.25	0.5	1.25	0.75	0.125	0.25	1.25	0.5	0.125	0.125	0.75	1	0.5	0.25	1

Table 7- Decision Matrix Table

Sr. No.	Attributes	Industry 1	Industry 2	Industry 3
1	Production capacity/month	60 tonne	40 tonne	50 tonne
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Table 8- Ranking of an Industry By AHP method

	Industry Ranking
Industry 3	0.928
Industry 2	0.768
Industry 1	0.471

Table 9- Ranking of an Industry by TOPSIS Method

Industry 2	0.086
Industry 3	0.21
Industry 1	0.10

Table:-10 Ranking of Industry by PROMETHREE Method

Industry2	0.731
Industry3	0.721
Industry1	-0.98

RESULT AND CONCLUSION

[1] From these three result of ranking table in calculation we can say that …
Industry2 > Industry 3 >Industry1 and CR of Industry 2 is more close to 1 than other two Industries, therefore Industry 2 is best.

[2] By using one of the MADM method like AHP and PROMETHREE, we can find out best optimal solution by comparing the values of each of industry.

[3] With this analysis we can find out which MADM is more effective for different set of problem. So here, two techniques such as AHP and PROMETHREE are more effective than TOPSIS.

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