CRITERIA SELECTION OF SUPPLIER BY IMPLEMENTATION OF INTERPRETIVE STRUCTURAL MODELING

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Abstract- **Industries are modified and their selection procedure for their supplier is more innovative and advanced. For the survival of industries there is needed to modify their supplier's according to their requirement by selecting the appropriate one using their criteria's. There are many criteria's for selection of supplier. Randomly cannot find an appropriate criteria from a bunch of criteria, hence a methodology is used for finding a criteria is Interpretive Structural Modeling (ISM). ISM is a process designed at support to better understand what researcher believes and to identify clearly what researcher doesn't know. ISM method is modified by identifying the criteria which are related to the supplier. The ISM process converts uncertain, poorly spoken intellectual models of systems into noticeable and precious models. This attempt to design an explanation created on Interpretive Structural Modeling and graph theory matrix to control supplier criteria index selection. These criteria are divided into drivers, enablers, dependent and hierarchically structured. An implementation of this model is beneficial for survival of industries in today's competitive environment.**

Keywords- **Supplier Criteria Selection, Interpretive Structural Modeling, Driver's Power, Dependence Power, Structural Self-Interaction Matrix, Reachability Matrix**

I. INTRODUCTION

Supply Chain takes to get a goods or service from supplier to customer through various steps. Supply chain includes multiple steps such as suppliers, manufacturers, retailers and customers. Supplier provides basic and important part to manufacturer like raw material, small parts and sometimes supplier provides big valuable parts. Therefore supplier is a very important step of supply chain. These suppliers are elected on the basis of different criteria's. These criteria are identified on the basis of manufacturer demand. There are lots of criteria for selection of supplier but various manufacturers used different criteria for their selection preciously. Hence researcher fined a simple way of criteria selection by using Interpretive Structural Modeling (ISM). ISM develops awareness into collective understandings of these criteria. The direct and indirect relationships between the factors describe the situation far more accurately than the individual factor taken into isolation. Therefore the purpose of this researcher is to classify a best supplier by identifying different criteria's using ISM and on the basis of driving power and dependence power. At present the study of supplier selection is very popular between manufacturers. Manufacturer studied these methods for their selection of supplier. Top criteria are identified by expert's opinion. these criteria is very useful because it reduces price with rise in quality and take less time to delivery, with high performance of the product and also increase turnover. Selection of supplier is very simple in the past because at that time only few suppliers are known. But in this time there are many supplier in the market are known for providing same product. An appropriate supplier is selected on the basis of criteria. There are many criteria are known and it is difficult to select best criteria for selection of supplier because every criterion has its own importance from different point of view for different manufacturer. It is very tough to take all the criteria for selection procedure. Therefore criteria selection is a complex job for researcher. Therefore researcher fined a new way to solve this type of difficulties for industries by implementing Interpretive Structural Modeling. ISM used for selection of criteria on the basis of score value, which is an independent value, used for comparisons among many criteria's of supplier. Firstly, in the ISM, gathering information from different specialists is used for transforming the relationship matrix, it is useful in the formation of ISM model. This paper effort to use a standard model to select the right suppliers for manufacturing industries by identifying the criteria's which control the supplier selection.

II. INTERPRETIVE STRUCTURAL MODELING

Interpretive structural modeling is an effective method for dealing with difficult complex problem. ISM was firstly studied by J. Warfield in 1973. ISM is a powerful tool used for criteria calculating system. ISM has been used over 28 years in industries to solve their complicated problems and find solution of these problems. Warfield in 1982 described that Interpretive Structural Modeling is a computer-aided study process that allow particular or a group of user to change an arrangement inter relation between previously determined criteria on the basis of selected appropriate relationship. ISM is based on the expert's opinion. In ISM experts find an inter-relation between different criteria. On the

basis of this a set of different criteria directly and indirectly are structured into a systematic model. Interpretive Structural Modeling transforms unidentified, unspoken model into clearly spoken well-defined model used for various purpose. ISM converts specific relation and usually structured model into a graphical model.

There are some steps taken in the ISM technique given below:

1. Identifying criteria which are related to the suppliers,
2. Creating inter-relationship between these criterion with respect to other on the basis of experts opinion,
3. Developing a self-structured interaction matrix (SSIM) of criteria which show the inter-relation between criteria's,
4. Emerging a reachability matrix from SSIM,
5. Separating of reachability matrix into levels,
6. On the basis of inter-relationship of criteria's given in the reachability matrix digraph is drawing,
7. Transforming the resultant digraph into ISM model by substituting criteria nodes from statement,
8. Revising the ISM model to correct the conceptual irregularities and changing the necessary modification.

After the study of various industrial suppliers and the review of expert's opinion researcher find 15 important criteria. Various industries used these criteria for finding an appropriate supplier. On the basis of expert's view finding inter-relationship between these criteria's and develops a self-structured interaction matrix which gives driving power and dependency power, which is later used in the development of ISM model.

a) Identified criteria's are given below

1. Quality
2. Price
3. Delivery
4. Position in the market
5. Reliability
6. Warranties
7. Transportation Cost
8. Innovation
9. Financial Position
10. Geographical Location
11. Flexibility
12. No. of Employee
13. Technical Capability
14. Responsiveness
15. Employee Education

Firstly, a group of experts are assembled from industries. On the basis of their opinion about the inter-relationship between these criteria a self-structured matrix is developed. Researcher describes this inter-relationship between these criteria (i and j) in the form of four symbols. These symbols are V-i criteria will help to achieve criteria j, A- j criteria will help to achieve criteria i; X- i and j criteria will help to achieve each other; O- i and j criteria are unrelated.

TABLE 1
SELF-STRUCTURED INTERACTION MATRIX

S. No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	X	X	V	V	V	V	X	X	V	O	V	V	V	V	A
2	X	X	V	V	V	O	V	V	A	A	X	V	V	V	V
3	A	A	X	O	O	O	V	O	V	X	V	V	V	V	V
4	A	A	O	X	V	V	O	A	X	O	A	V	V	A	V
5	A	A	O	A	X	O	O	V	O	A	X	V	X	O	A
6	A	O	O	A	O	X	A	A	O	V	A	A	A	V	V
7	X	A	A	O	O	V	X	O	O	V	V	A	A	V	O
8	X	A	O	V	A	V	O	X	V	O	X	V	A	A	X
9	X	V	A	X	O	O	O	A	X	X	A	X	A	X	X
10	O	V	X	O	V	A	A	O	X	X	O	A	O	X	O
11	A	X	A	V	X	V	A	X	V	O	X	V	X	X	X
12	A	A	A	A	A	V	V	A	X	V	A	X	A	V	A
13	A	A	A	A	X	V	V	V	V	A	X	V	X	X	V
14	A	A	A	V	O	A	A	V	X	X	X	A	X	X	A
15	V	A	A	A	V	A	O	X	X	O	X	V	A	V	X

b) Reachability matrix

The self-structured interaction matrix is converted into binary matrix and form a new matrix of binary no. is known as initial reachability matrix. The making of reachability matrix on the basis of following rules

By putting "1" in reachability matrix in place of "V" in self-structured interaction matrix;

By putting "1" in reachability matrix in place of "X" in self-structured interaction matrix;

By putting "0" in reachability matrix in place of "A" in self-structured interaction matrix;

By putting "0" in reachability matrix in place of "O" in self-structured interaction matrix

TABLE 2
REACHABILITY MATRIX

S. N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	D. P
1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	13
2	1	1	1	1	1	0	1	1	0	0	1	1	1	1	1	12
3	0	0	1	0	0	0	1	0	1	1	1	1	1	1	1	9
4	0	0	0	1	1	1	0	0	1	0	0	1	1	0	1	7
5	0	0	0	0	1	0	0	1	0	0	1	1	1	0	0	5
6	0	0	0	0	0	1	0	0	0	1	0	0	0	1	1	4
7	1	0	0	0	0	0	1	0	0	1	1	0	0	1	0	5
8	1	0	0	1	0	1	0	1	1	0	1	1	0	0	1	8
9	1	1	0	1	0	0	0	0	1	1	0	1	0	1	1	8
10	0	1	1	0	1	0	0	0	1	1	0	0	0	1	0	6
11	0	1	0	1	1	1	0	1	1	0	1	1	1	1	1	11
12	0	0	0	0	0	1	1	0	1	1	0	1	0	1	0	6
13	0	0	0	0	1	1	1	1	1	0	1	1	1	1	1	10
14	0	0	0	1	0	0	0	1	1	1	1	0	1	1	0	7
15	1	0	0	0	1	0	0	1	1	0	1	1	0	1	1	8
Dp. P	6	5	4	7	8	7	6	8	11	7	10	11	8	12	9	

c) Level partition

On the basis of reachability matrix, the reachability and antecedent set for each criterion are found (J. Warfield, 2005). The reachability matrix and the antecedent set both consist of criteria's itself and also the other criteria's which may help in achieving it. Further the intersections of these sets are derived for all the criteria. In the ISM Hierarchy both the criteria's for reachability and intersection sets occupies the top level. In the hierarchy the top level criteria can't achieve other criteria above its level. Once identified the top level criteria it gets separated from the other. The process gets continued unless the level of each criteria's are found. These levels help in building the diagraph and the final model.

TABLE 3
LEVEL OF SUPPLIER CRITERIA

Cr. no	Reachability set	Antecedent set	Intersection	level
1	1,2,3,4,5,6,7,8,9, 11,12,13,14	1,2,7,8,9,15	1,2,7,8	I
2	1,2,3,4,5,7,8,11, 12,13,14,15	1,2,9,10,11	1,2,11	II
3	3,7,9,10,11,12,1 3,14,15	1,2,3,10	3,10	V
4	4,5,6,9,12,13,15	1,2,4,8,9,11,14	4,9	VIII
5	5,8,11,12,13	1,2,4,5,10,11,13,1 5	5,11,13	XIII
6	6,10,14,15	1,4,6,8,11,12,13	6	XIV
7	1,7,10,11,14	1,2,3,7,12,13	1,7	XII
8	1,4,6,8,9,11,12,1 5	1,2,5,8,11,13,14,1 5	1,8,11,15	VI
9	1,2,4,9,10,12,14, 15	1,3,4,8,9,10,11,12, 13,14,15	1,4,9,10,12,1 4,15	VII
10	2,3,5,9,10,14	3,6,7,9,10,12,14	3,9,10,14	XI
11	2,4,5,6,8,9,11,12 ,13,14,15	1,2,3,5,7,8,11,13,1 4,15	2,5,8,11,13,1 4,15	III
12	6,7,9,10,12,14	1,2,3,4,5,8,9,11,12 ,13,15	9,12	X
13	5,6,7,8,9,11,12,1 3,14,15	1,2,3,4,5,11,13,14	5,11,13,14	IV
14	4,8,9,10,11,13,1 4	1,2,3,6,7,9,10,11,1 2,13,14,15	9,10,11,13,1 4	IX
15	1,5,8,9,11,12,14, 15	2,3,4,6,8,9,11,13,1 5	8,9,11,15	VI

These criterions are classified into four quadrants. The first quadrant indicates autonomous criteria. These autonomous criteria have weak driving power and also weak dependency power. These criteria are relatively separated from the selection procedure, with which they have few links, which may be strong. Second quadrant shows dependent criteria these have weak driving power but have strong dependency power. Third quadrant has the linkage criteria that have both strong driving and dependency power. These criteria are unbalanced will effects on other at any point. Fourth quadrant indicates independent criteria having high strong driving power but weak dependency power. These fourth quadrant criteria are also called as key criteria due to their independency. Subsequently, the driver power dependence diagram is constructed.

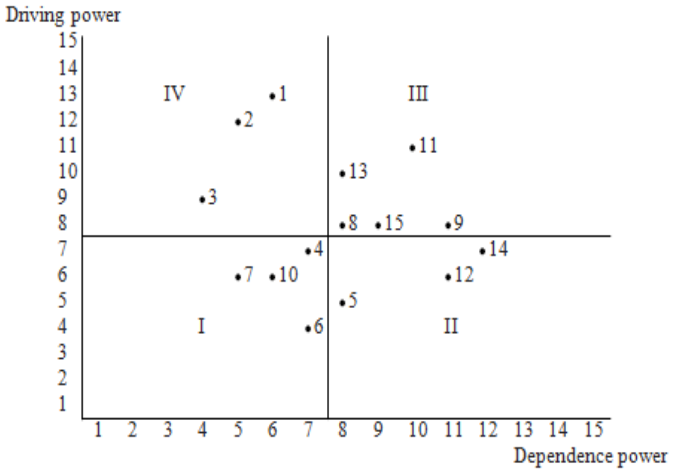

Fig. 1 Quadrant of criteria

d) Formation of ISM model

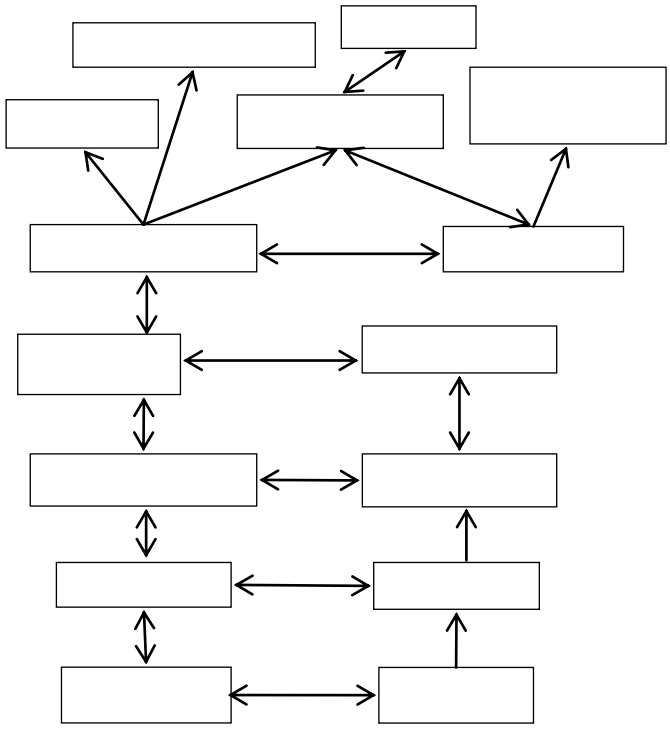

Fig. 2 interpretive structural modeling

Interpretive structural modeling is modified by a final reachability matrix. The relation between two criteria i and j are shown by an arrow. This final graph is known as digraph. The diagraph is finally converted into the ISM model.

III. CONCLUSION

This paper attempts to maintain a relationship between the supplier criteria. These all criteria's are important for supplier selection. Researcher takes 15 important criteria for developing of ISM model. In this Paper these criteria are

arranged and give them preference according to their level for selection procedure. It can be observed from quadrant of criteria that price, quality and delivery are the main criteria having high driving power and low dependence power. Therefore these three criteria are treated as key criteria in the selection process. On the basis of research it is concluded that all the fifteen criteria are important for successful selection of supplier. Here only 15 criteria's are used for developing of ISM model, but there are many criteria are included to develop the relationship between them by using ISM methodology. This research is used in industries for selection of appropriate supplier. This research gives the better idea or importance of each criterion used for selection process. Further research, there is a huge scope of ISM methodology used for solving the complex problem related to identifying criteria and giving them importance in the manufacturing industries.

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