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Analysing the Risk Issues in Supply Chain Management by Using AHP Methodology

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Abstract-In this paper we have a research work for analysing the supply chain management risk issues that occur in the industries. The application of AHP here can be used as a one of the best possibilities that can be used to evaluate the mentioned circumstances. As in this increasing competitive market, the decision making places an important role as the results depends upon the direction of concrete decisions taken. This paper represents Analytical Hierarchy Process as a multi and effective decision making methodology that if can be used in effective manner could prove to be very much useful

Index Terms:- Supply Chain, Analytical Hierarchy Process, Supply Chain Risks, Supply Chain Risk Management, Decision Making

I.INTRODUCTION

Supply Chain:-

A supply Chain or supply network is a coordinated system of organizations, people, activities and resources involved in moving a product or service in physical or virtual manner from supplier to customer. As, it a process of planning, implementing and controlling the operations of the supply as efficiently as possible. Supply Chain Management considers all movement and storage of raw material and finished goods from point to point of consumption. As fierce competition in today's global markets, the introduction of products with shorter life cycles and the heightened expectations of customers have forced business enterprises to invest in, and focus attention on, their supply chains. This, together with continuing advances in communications and transportation technologies (e.g., mobile communication, Internet, and overnight delivery), has motivated the continuous evolution of the supply chain and of the techniques to manage it effectively. In a typical supply chain, raw materials are procured and items are produced at one or more factories, shipped to warehouses for intermediate storage, and then shipped to retailers or customers. Consequently, to reduce cost and improve service levels, effective supply chain strategies must take into account the interactions at the various levels in the supply chain. The supply chain, which is also referred to as the logistics network, consists of suppliers, manufacturing centers, warehouses, distribution centers, and retail outlets, as well as raw materials, work-in-process inventory and finished products that flow between the facilities.

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In this, we present and explain concepts, insights, practical tools, and decision support systems important for the effective management of the supply chain. But what exactly is supply chain management? We defined it as follows: Supply chain management is a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system wide costs while satisfying service level requirements.

II.ANALYTICAL HIERARCHY PROCESS (AHP)

Principles of AHP

There are basically 3 basic principles of AHP as explained by Saaty.T are as follows:-

Principle of Decomposition: - According to principle of decomposition, the reanalyzed structuring of a complex problem into hierarchical modules or clusters down to the level of elementary sub module.

Principle of Comparative Judgments: - According to this principle certain comparison of pairs of all elements in a certain hierarchy taking into consideration to superior hierarchy. T. Saaty considers the comparing of pairs as necessary because local priority of elements must be defined, taking into consideration their superior elements.

Principle of hierarchic composition/Synthesis: - It implies to multiply the local priorities of the elements in a cluster by the global priority of the parent element, producing global priorities of the parent element and then adding the global priorities for the lowest level elements.

Functions:-

The T.Saaty in its study has explained the AHP functions as:-

1. Structure Complexity- decomposition
2. Measuring on a ratio scale [Ivan Pogarcic]
3. Synthesizing

III.AXIOM

As each and every theory is based on some kind of basic and implied facts that makes it applicable. Similarly, T. Saaty has explained to the same, AHP is based on the below mentioned 3 relatively simple axioms.

Reciprocal Axioms:-

It requires that, if PC(ZA,ZB) is a paired comparison of elements A and B with respect to the parent, element C, which is representing how many times more the element A possesses a property than does element B,

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Then PC (ZA, ZB) = 1/PC (ZA, ZB)

Homogeneity Axiom:-

It states that the elements which are to be compared should not differ much as this results in the higher chances of the judgments. On the same when we are constructing any kind of hierarchy of objectives, one should attempt to arrange cluster in order to avoid them to differ for more than an order of magnitude in any cluster.

Judgments Axioms:-

The Third axioms state those judgments about/ the priorities the elements in a hierarchy do not depend upon lower level elements to apply. The third axiom is considered to be very much important as it required for the principle of hierarchies to composition to apply. The Saaty in its later study has also explained the 4th axioms according to which the individuals who have reasons for their beliefs should make sure that idea are adequately represented for the outcome to match these expectations.

IV. APPLICATIONS:

The AHP is a kind of method that can be applied to number of problems and several scholars have done several research on the same in order to evaluate the results in different fields of which some are explained as follows:-

"Ivan Pogaricic" has explained the application of AHP methods in Traffic Planning in which he analyses the possibilities of applying AHP methods in making decision by presetting the desired goals as a necessary function through the series of activities in making decisions regarding planning and implementation of plans in traffic and ensuring the qualitative business logistics.

"Charles A. Briggs" has used the AHP methodology in Managing and Mitigation of the upstream of Petroleum Industry in which AHP is used to provide decision support framework that cope with multiple criteria decision making situation. Latestly "Xianwu Hu" has done a remarkable work by using AHP in its research of the small and medium sized enterprises based on AHP. In this, he establishes the evaluation index system and then uses AHP in order to decide the weight of each evaluation index.

Similarly several other major application on Wikipedia with examples on how AHP are used to dealt with in literature:-

Deciding how best to reduce the impact of global climate change.

Selecting University Faculty (Bloomberg University of Pennsylvania)

Selecting where to locate offshore manufacturing plants (University of Cambridge)

V.METHODOLOGY:

The method has the following four steps:

Step 1: decompose the decision-making problem and find out the salient factors

Or elements (criteria, sub-criteria, alternatives, etc.) of the problem. Then construct

The linear hierarchy of the problem consisting of a finite number of levels or Components. Each level consists of a finite number of decision elements. The goal, or focus, of the problem lies at the first level. Usually, the criteria and sub-criteria occupy the second and third levels respectively. Lastly, the decision alternatives are placed at the lowest level of the hierarchy.

Step 2: construct pair wise comparison matrices for all the criteria, sub-criteria, And alternatives. The typical form of a pair wise comparison matrix is as follows:

Where (for i, j = 1,2, . . ., n) represents the strength of importance/preference of the factor (criterion) Fi over Fj with respect to the objective 'O',

Wi, i = 1, 2, . . ., n are the priority weights (to be determined) of the factors.

The entries aijs are normally taken from the (1/9–9) ratio-scale (Saaty, 1980).

The semantic interpretation of the matrix elements is provided in Table 1.

Table 2

	O	P1	P2……	Pn
Z=	P1	a11	a12	a1n
	P2	a21	a22	a2n
	Pn	an1	an2	ann

Step 3: determine the weights of the criteria, sub-criteria, alternatives, etc. from the

Pairwise comparison matrices obtained in Step 2 by using the eigenvalue method.

This is done by solving the following linear simultaneous equations:

Where λ max is the largest eigenvalue of the pair wise comparison matrix A.

Step 4: using the principle of hierarchical composition, synthesize all the local

Set of weights and obtain the set of overall or global weights for the alternatives.

The alternative that receives the overall highest weight with respect to the goal of the problem is selected as the best.

According to [2] Analytic Hierarchy Process (AHP) can be divided into nine phases:

I. Initializing: - Defining a problem and collecting necessary information from identification markets and users, user needs and requirements, service operation etc... If there are alternatives in the choice of available circumstances one is decided at his level already simple assessment of the project with AHP method can be applied. Methodologically this is a moment to solve the problem

II. List alternatives importance of criteria. In this phase a certain alternative is chosen out of a group of identifiable possibilities. The result of this phase is a list of all alternatives. The decision maker should examine the scores to ensure that they are sensible and should be adequately aware of the issues so as to defend the scores. If there are n alternatives, then n (n - 1)/2 pair wise comparisons are needed. Clearly, for expedient application of AHP, the alternatives must be limited to a reasonable number.

III. 1. Define threshold levels. The threshold levels are defined; these are the minimum requirements which an alternative has to fulfill.

III. 2. Determine acceptable alternatives. All alternatives listed in step 1 are reviewed with respect to the threshold levels. Alternatives which do not meet these requirements are dismissed. Phases III.1. And III.2. can be carried out simultaneously.

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IV. Define criteria. This phase assumes the completion of phase II. And III.. The project team or management structures define criteria that will be used when judging alternatives.

V. Develop decision hierarchy. This phase follows phase IV. The team develops a decision hierarchy. This hierarchy consists of at least three levels, a goal, criteria and alternatives. These elements are represented in a tree structure. The hierarchy represents the structure of the decision problem.

VII. 1. Compare criteria pair wise (important of criteria) AHP determines the relative importance of each criterion. This is done by means of the same process which was used in the previous step to derive the relative priorities of the alternatives. The Team or decision maker compares all criteria pair wise. The manager indicates which criterion is more important, and to what extent. The decision hierarchy levels for the project VI. Compare alter natives pair wise (Relative priorities of projects). For each criterion, the decision maker evaluates all alternatives pair wise. For each criterion, every possible combination of two alternatives is judged in this way. (Table2). The other criteria or characteristics of an alternative should not be considered in making the pair wise comparisons with respect to one particular criterion. Team can make numerical or verbal judgments. It is assumed that the previous phase V. is completed.

Table2. The full judgment matrix (example)

Criteria n	Project A	Project B	Project C
Project A	1	3	8
Project B	1/3	1	5
Project C	1/8	1/6	1
Total	13/8	19/6	15

Table 3. The normalized pair wise comparison matrix

Criteria n	Project A	Project B	Project C
Project A	8/13	12/19	8/15
Project B	4/13	6/19	6/15
Project C	1/13	1/19	1/15
Total	1	1	1

VII. 2.Calculate overall priorities of alternatives. The overall priorities are determined by means of a linear additive function, in which the relative priorities for an alternative are multiplied by the importance of the corresponding criteria and summed over all criteria. The AHP analysis shows which project has the highest priority. Phases VII.1 and VII.2. Are carried out simultaneously, and it is assumed that phase VI. Is completed.

Table 4. The relative priorities for the criteria n

Row Average
Project A (8/13 + 12/19 + 8/15) /3 = 0.593
Project B (4/13 + 6/19 + 6/15) /3 = 0.341
Project C (1/13 + 1/19 + 1/15) / 3= 0.066
Total=1

VIII. Sensitivity analysis. Sensitivity analysis is the most important moment in the AHP process. Before the Team or Management chooses the plan with the highest overall priority, a sensitivity analysis can show the robustness of the overall priority rating. Sensitivity analysis shows to what extent the overall priorities are sensitive to changes in the importance of criteria. The more stable the ranking of the alternatives, the more confident the manager will be in the proposed choice. This phase assumes that all the previous phases have been completed.

IX.Final activities. Preparation of a proposal: the plan or project with the highest level of priority. Preparation of the project for the realization.

VI. CONCLUSION

Decision-making is an important activity at all levels in the organization which is required to incorporate in an efficient manner. The above mentioned activities by complexity are proportionally dependent on the size and structure of the business system, but their seriousness and importance are constant. As, In the world of globalization it is very much important that the organization must upgrade its internal functions in order to maintain its position in the market. In order to do so, one should need better evaluation technique with the group of efficient team to undergo the process of decision making and in doing so AHP will be prove out to better and efficient source. As in the today world's several software technologies are also available that helps to provide much better quality results in lesser time.

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