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Vendor Selection for Service Sector Industry: a Case Study on Supplier Selection to Indian Telecom Service Provider using AHP Technique

Mr.Smrutiranjan Mohanty
Sinhgad Institute of Business Management
&
Dr.Balaji.M. Dabade
SGGS Institute of Engineering and Technology, Nanded

Abstract: *In the today's dynamic business environment the survival and sustainability of an enterprise solely depends on market force which is autonomously controlled by consumer's acceptability. It means the producer of goods or provider of service is always at tenterhook to understand and react to changing need of consumer as well as take care of competition. To make this dynamism viable a strong and reliable supplier base is inevitable. Till recently supplier management was restricted to manufacturing utility as service operation was always considered secondary. But with changing global scenario service has become more challenging a job than manufacturing. Telecom service among them has become a inevitable infrastructure not only for business and development but for very survival. Hence to stem a robust telecom system it is essential to have effective vendors vis a vis suppliers who ought to be cost effective and reliable. The technique of AHP has been used to make a structure of vendor selection system for telecom companies operating in India.*
Key Words: *Vendor Parameter, Supplier Selection and AHP*

I. Introduction

There happens to be different perception in procurement of different components that is required in operating a telecom system. And a major chunk of expenditure (64%) goes in procuring B (Medium valued less sophisticated product used in selected application) and C (Normal valued product or material used in general purpose) class items and these are procured in a relative regular interval **(Mohanty & Dabade 2013).** In this scenario the procurement department does play a key role in cost reduction by applying scientific and logical approach rather than conventional approach. And this is very much needed in today's competitive and globalised environment.

In today's scenario a telecom service provider is engaged in different types of business like landline service, cellular service ,DTH and ISP. Each of them requires different types of infrastructure in addition to some common infrastructure. The telecom service operation is highly dynamic and has to catch up with constant change in technology. Some of activities are purely technical l(e.g. telecom control system, basic service tools and software);some are infrastructure(like erection of tower, laying of cable and providing services) and some are commercial(like smart billing, different options of service and global connectivity) with low cost. But truly speaking none of them are independent of others and hence the interdependency factor plays a significant role. The service provider has to procure hardwires, procure and customize the software, may have to outsource few things and may have to go for strategic collaboration. This may involve import of some material component, procuring locally, some occasional purchase and some to be in long term purchase strategy. As evident a buyer needs to understand the suppliers' varied strengths and weaknesses. Hence selecting the suitable supplier is always a difficult task for buyers which require careful assessment before taking a final decision.

To augment different perception of buyer (procurement executive) as well as seller (supplier) it is required to make a comparative analysis by considering each and every factor of requirement and relative importance of each factor. Since the operation (i.e. Telecom service) is dynamic, so also the process of vendor selection. In addition to this huge number of varied pattern of requirement of material, component and service makes it more cumbersome to make a generalized pattern of vendor selection using the conventional tools.

The dynamism of telecom and the rapid change in technology keeps every procurement executive in tenterhook as non availability of any item may lead to delay in providing service leading to supplier dissatisfaction. At the same time the procurement authority has to keep in mind about the financial implication of his / her decision.

The operation vis a vis selection of a telecom system is an important aspect of infrastructure problem and could involve many criteria, including the technical requirements of service specifications and cost, etc. Not only the equipment cost, but also the operation and maintenance cost of equipment, upgradation and support costs, need to be considered in selecting a particular system. It is important to take into account these cost factors carefully to ensure the economic delivery of service. In the same way , performance-related criteria like reliability, availability and serviceability (with regard to spares etc) must also be taken into account to meet the service levels as set in basic service specifications and to increase customer satisfaction. Furthermore, technical criteria including system features, upgradability, R & D capability, compliance with technology standards, interfacing with existing systems, and network management capabilities, etc., should also be examined carefully.

Judging vendor reputation is also important and here the criteria might include delivery lead-time, security, accessibility, CRM, and quality of support services, etc. It is important that all these relevant factors need to be examined in selecting telecommunication equipment and its vendor who designs and delivers the same.

Even though telecom companies are ready to spend considerable amount of time and money to select appropriate vendors selection systems, they may not include all relevant criteria in evaluating telecom systems and vendors. The decision-making process may not be systematic and structured. These factors may result in many changes in selection criteria and costly engineering design changes, which ultimately delay product launches. They may also result in not meeting the financial objectives with respect to their investment in equipment and systems **(Tam and Tummala, 2001).**

Supplier selection problem is a group Multiple Criteria Decision-Making (MCDM) out of which quantities criteria has been primarily considered for supplier selection in the various decision making models **(Chen-Tung, Ching-Torng & Huanget, 2006).** In Multiple Criteria Decision-Making (MCDM), a problem is affected by several conflicting factors in supplier selection, for which a purchasing manager must analyze the trade off among the several criteria. MCDM techniques assist the decision-makers (DMs) in evaluating a group of alternatives. Depending upon the purchasing requirement, criteria have varying importance and weightage **(Dulmin & Mininno, 2003).** For Multiple Criteria Decision-Making (MCDM) problem of telecom companies a unique and suitable method is needed to facilitate the supplier selection and consequently provide the company with a proper and economical system for procuring requisite incoming materials.

The analytic hierarchy process (AHP) has been extensively used in decision making situations, involving multiple criteria in systems of many levels **(Liu & Hai, 2005).** This method has the ability to structure complex, multi opinion, multi attribute and multi period problem hierarchically **(Yusuff, PohYee & Hashmi, 2001).** The AHP can be very useful in involving several decision-makers with different conflicting objectives to arrive at a consensus decision **(Tam & Tummala, 2001).** The AHP method is known to assist in decision making to resolve the supplier selection problem in choosing the optimal supplier combination (**Yu & Jing, 2004).** Considering the present problems in the telecom sector germinating from incorrect supplier selection, either due to varied human opinion in judging the a supplier, or paying too much importance to single factor only; such as price, cost of logistics and other similar and unexpected problems. The AHP model is highly recommended to handle the supplier selection more accurately in order to arrive at a more logical acceptable solution.

The hierarchical structure used in formulating the AHP model can enable all members of the evaluation team to visualize the problem systematically in terms of relevant criteria and sub criteria. The team can also provide additional guidelines to revise the hierarchical structure, if necessary, with new criteria. Furthermore, using the AHP, the evaluation team can systematically compare and determine the priorities of the criteria and sub criteria. Based on this information the team can compare several vendor systems effectively and select the best vendor. And there happens to be are high level of inconsistency in sub criteria of main criteria.; hence it is imperative to take consideration of all sub parameters and they are to be given relative rating for making a general policy of vendor or supplier selection**(Mohanty & Dabade 2013)**.

II. Supplier Selection Criteria

One major aspect of the purchasing function is supplier selection criteria. The review of criteria for selection and measuring the capacity and capability of suppliers has been the focus of attention for many researcher and purchasing practitioners since 1960's. In the mid 1960's, researchers started developing performance criteria upon which potential suppliers could be evaluated. **Dickson (1966)** was first to perform an extensive study to determine, identify and analyze what criteria were used in the selection of a firm as a supplier. Dickson's study indicated that "quality" is the most important criterion followed by "delivery" and "performance history". **Weber, Current and Benton (1991)** presented a classification of all the articles published since 1966 till 1991 according to the treated criteria. Based on 74 papers, the outputs observe that Price, Delivery, Quality and Production capacity and location were the criteria most often treated in the literature.

A study by **Tullous and Munson (1991),** which sampled eighty (80) manufacturing firms, discovered that quality, price, technical service, delivery, reliability, and lead time were among the most important selection factors. The scope of Dickson's(1966) 23 criteria have been expanded and some new criteria were promulgated with the growth of new business needs. **Zhang, Lei, Cao and Ng (2003)** collected 49 articles between 1991 and 2003, and made a comprehensive classification of supplier selections criteria. In addition to the well-noted research studies of Dickson (1966), Weber, Current and Benton (1991) and Zhang, Lei, Cao and Ng (2003), other researchers have also recently begun discussing the importance of additional supplier selection criteria, not mentioned in the above studies. **Davidrajuh (2000)** reviewed some studies which emphasize the important criteria and their invariability. While a number of supplier selection criteria studies have been conducted over the years, Dickson (1966), Weber, Current and Benton (1991) and Zhang, Lei, Cao and Ng (2003) are still recognized as the most common, and cited as the most comprehensive studies done on selection criteria. The review performed by **Bross & Zhao (2004)** study concluded that the most valuable supplier selection criteria were cost, quality, service, relationship, and organization.

III. Model Formulation

The objectives of this study are to develop AHP method for supplier selection in a service industry like telecom. The methodology for this study has been adopted primarily from **Tam and Tummala (2001)** who had done extensive work on Honk Kong telecom with regard to vdendor selection. This was supplemented by work of **Yahya and Kingsman (1999),** and **Yu and Jing (2004)** who tried to apply this concept in enterprise modelling . In order to comply with collecting quantitative and qualitative data for AHP supplier selection model that could be applied by the telecom company a six steps approach **(Farzad Tahriri et.al)** was performed to insure successful implementation as follows:

3.1 Define criteria for supplier selection

The first step in any supplier rating procedure is to establish the criteria to be used for assessing the supplier. To comply with the criteria for supplier selection and their importance, required data were collected based on the consideration of literature.

After defining the criteria for selecting the supplier, the first structured interview was designed based on the input received; an additional criterion were added such that the respondents were asked to identify the importance of each criterion by using a 10 point scale. This structured interview consisted of the general characteristics of the company, model or the type of method used for supplier selection, and providing sixteen items indicating the best selected criteria for supplier selection. Before start of the research, according to the AHP method, the structured interview was filled out by the procurement manager to evaluate the criteria. Interviews were conducted with project managers (service executors) and a purchasing manager. This test was carried out, on account of its importance in supplier selection and upgrading the decision making accuracy. The resulting structured interviews were submitted to the selected respondents.

Please insert Figure 1 here

The respondents were requested to include any additional criteria that seemed important, in the structured interviews, and identify their level of importance. Having received the inputs of the respondents, the criteria were identified and averaged. In addition, the presence of too many criteria makes the pair-wise comparisons in evaluating suppliers a difficult and time consuming
process. To overcome these problems, the cut-off value to reduce the number of criteria to a few is desirable **Tam and Tummala (2001).** In order to select the most important criteria, it was intended to accept the criteria

with average above 6.5. The results of the case study are summarized in Figure.1.Finally, the effective extremely important criteria such as quality, cost and vendor reputation emerged out of this analysis.

3.2 Defining Secondary and Tertiary Criteria

In this step, the definition of the secondary criteria and tertiary criteria has been done for supplier selection based on the three main criteria selected as the results of previous step with the consideration of literature. Design and modification of identified secondary and tertiary criteria, have been done similar to the first step.

By using the second structured interview, it becomes possible to find secondary and tertiary criteria. On account of the non response of questionnaires by the proper authorities through mail , as well as to minimize the efforts, second structured interviews were also applied to weight and compare pair-wise for all criteria, (i.e primary, secondary and tertiary) in the direction of main goal.

Please insert Figure 2 here

After receiving the inputs of the respondents, the criteria were identified and averaged. Six secondary criteria and twenty seven tertiary criteria were selected for stages (3) and (4) in supplier selection model as shown in (Figure 2)

3.3 Structure the hierarchical model

This phase involves building the AHP hierarchy model and calculating the weights of each levels of supplier selection model. The developed AHP model, based on the identified primary criteria, secondary criteria and tertiary criteria, contains five stages(levels): the goal , primary criteria, secondary criteria, tertiary criteria and alternatives(Perspective Vendors). Figure 2 shows an illustrative 5-level(stage) hierarchy for the supplier selection problem. The goal of our problem in selecting the supplier for the telecom service providers in India is identified in the first stage (level) . The second stage (level) (Main criteria) contains: cost, quality and vendor reputation. The third (level) and fourth stage (level) of the hierarchy consist 6 secondary criteria and 27 tertiary criteria, which were identified through various study of literature and doing a preliminary research. The lowest level of the hierarchy contains of the alternatives, namely the different supplier to be evaluated in order to select the best supplier. As shown (in Figure 2), three suppliers were used to represent arbitrarily the ones that the firm wishes to evaluate. The AHP model shown in (Figure 2) is generally applicable to any supplier selection problem of telecom companies that a procurement team wishes to evaluate, as it covers the critical factors and the related criteria , secondary criteria and tertiary criteria for supplier selection of a telecom company.

To complete the model at this point, the priority weight of each criterion in each stage (level) was determined. A second structural approach, an interaction consisting of all factors in each stage(level) of the AHP model is used to collect the pair-wise comparison judgments from all evaluation team members. This approach is found to be very useful and comparative in collecting data. The function of the pair-wise comparisons is by finding the relative importance of the criteria and sub criteria which is rated by the nine-point scale proposed by Saaty (1980), as shown in Table 1.

Please Insert Table 1 here

This indicates the level of relative importance from equal, moderate, strong, very strong, to extreme level by 1, 3, 5, 7, and 9, respectively. The intermediate values between two adjacent arguments were represented by 2, 4, 6, and 8.

3.4.1 Explanation of Pair wise Matrix of Primary Criteria

Therefore as observed from collected data a good performance on cost, the criterion for the first row, is slightly preferred to the one on Vendor Reputation (shown by the value of 2), but is little less preferred to quality.

Please Insert Table 2 here

A good performance on quality, the criterion for the second row and second column, is little more important than of cost (slightly preferred) and moderately preferable over vendor reputation (Shown by the value of 3). Vendor reputation, the third row criterion is least preferred of these three primary criteria. The information are collected to fill in the preferred rating of the comparison matrix .As per the matrix if the pair-wise comparison of Cost to Vendor reputation is 2, or equivalently a 2 to 1 ratio, it follows that the pair-wise comparison of Vendor Reputation to Cost is a 1 to 2 ratio, or 1/2. A value of 1 is assigned to the diagonal elements since Cost (row) is equally preferred to Cost (column).

After obtaining the pair-wise judgments as in Table 2, the next step is the computation of a vector of priorities or weighting of elements in the matrix. As per the rule of matrix algebra, this consists of calculating the "principal vector" (eigenvector) of the matrix by adding the members of each column to find the total sum. In the next step, in order to normalize each column to sum to 1.0 or 100%, divide the elements of that column by the total of the column and sum them up. Finally in order to get the average of each row we need to add the elements in each resulting row and divide this sum by the number of elements in that row **.** The results (principal vectors) are that the attributes have the following approximate priority weights: Cost (0.29), Quality (0.54), Vendor reputation(0.16) (Table 3).

Please Insert Table 3 here

The consistency ratio (C.R.) for the comparison above is calculated to determine the acceptance of the priority weighting. The consistency test is one of the important features of the AHP method which aims to eliminate the possible inconsistency discovered in the criteria weights. Hence the computation of consistency level of each matrix is a mandatory requirement in AHP. Weighted sum is calculated by making matrix multiplication of pair wise comparison matrix to that of average weight. Then weighted some priority is calculated by finding the ratio between weighted sum to that of average weight of each criterion. The average of weighted sum priority gives the value of Lambda (□**)**.This is followed by calculation of consistency index (CI).

Consistency Index (CI) = $(\lambda - n)/(n-1)$ Where n=order of pairwise comparison matrix. RI is a constant and values 0.58 for matrix of order 3.The ratio of CI and RI is known as consistency ratio. Based on Saaty's (1980) empirical suggestion that a C.R. = 0.10(Max) is acceptable, it is concluded that the aforementioned pair-wise comparisons to obtain attribute weights are fairly consistent as the CR value is lower than the maximum value. In contrast, if the CR value is larger than the acceptable value (i.e >0.1), the matrix results are inconsistent and are exempted for the further analysis.

Table 4 below exhibits the local weights for each criterion in each level. The results show that in the primary criteria, Quality with local weight of (0.548) had been prioritized as the first criteria followed by cost (0.292) and vendor reputation (0.16). The prioritized of secondary criteria in the third level and tertiary criteria in the fourth level also depend on the local weights. The global weight is obtained by taking the product of the local weights of primary criteria, secondary criteria and tertiary criteria. As an example the calculations of the global weights of Quality criteria (One Parameter) is shown in following. The result of priority criteria with local weights of each level and corresponding global weight(of tertiary criteria) is shown in Table 4.

Please insert Table 4 here

3.5. Prioritize (Ranking) the order of Success Factor (Tertiary criteria)

After performing necessary mathematical calculations, comparisons of criteria and allocation weights for each criterion in each level is performed. As discussed in the previous section priority weights for alternatives versus attribute are obtained, accordingly the results of each criterion weights that define important criteria are arranged and classified in each level, for selecting the supplier. After calculating the global weights of each sub sub-criteria(Tertiary criteria or user criteria) of level 4, the result is depicted in descending order of priority, as shown in Table 5.

Please insert Table 5 here

The ranking list of critical success factors(i.e. elementary factors) can be seen that servicing and operating cost occupy the top- most ranking in the list, the top rank being the servicing cost(0.095), followed by operating cost (0.060) and system reliability (0.057). The factors like delivery lead time (0.0443), packaging (0.0442) and interoperability(0.04) also constituted factors that are in the top ten ranking .

3.6 Measure supplier performance

The main reason for adopting this method is the evaluation of supplier(s) for telecom companies. After weighting the AHP model for determining priority weight for alternatives, the third structured interview was designed for validation and testing . This interview collects the weights of alternatives to identify the best supplier. In this step, to establish the priority weight for alternatives, the competitive bidders (those are actually the suppliers) who are supposed to be roped for the telecom company were compared. After finding the score of each factors of a supplier, the global weight of each factor was calculated by normal calculation. The executives were asked to just rate each factor in statement like very good, good and bad .The rating of factors is obtained by AHP technique (Table 6)

Please insert Table 6 here

The global weights evaluation of each factor is obtained through multiplying the global weights of criteria by the rating score. The final score of an alternative (Supplier) is obtained by summing all individual scores. The results and priority weight for each alternative are shown in Table 7.And from that analysis it is obtained that **VENDOR A** has the maximum score to qualify as the best alternative among the three.(This is done to find out vendor for sensors used in a Mobile tower to receive and divert signals.)

Please insert Table 7 here

Nevertheless the selection of vendor is a dynamic activity and it is more so in a service sector like telecom which is highly technology driven. Hence it is necessary to draw a bench mark of weightage for any vendor in order to qualify for consideration. As per opinion of procurement executives it is assumed that any criterion should be average rating for it to be acceptable. Hence taking the average as acceptable rating of all criteria the bench mark appears to be 0.07644. The total inference can be seen from the figure 3.

Please insert Figure 3 here

The figure 3 indicates that all three vendors qualify the minimum criteria and acceptable. However the vendor A got highest preference followed by Vendor C and Vendor B being least preferred.

IV. Conculision

As explained in earlier sections, vendor selection of a telecommunications system is an important problem to a telecom company. We first identified three strategic factors and the defining criteria and sub criteria, and then conceptualized an AHP-based model, to select the vendor of a telecommunications system as shown in **Fig. 2**. The proposed AHP model is generally applicable to any vendor selection problem of a telecommunications system. After finding the global priority weights, they can be transferred easily to a spreadsheet as shown in **Table 7** to determine the final composite priority weights of vendor systems occupying the last level of the hierarchy.

The proposed model is applied to two vendor selection problems. In both cases, the decisions reached by using the model agreed with those obtained by using the pre-existing vendor selection process. However, using the AHP model, the criteria for vendor selection are clearly identified and the problem is structured systematically. This enables decision-makers to verify and understand the strengths and weaknesses of vendor systems by comparing them with respect to appropriate (primary) criteria and sub (Secondary and Tertiary) criteria. Moreover, the use of the proposed AHP model can significantly reduce the time and effort in decision making. In addition, the results can be transferred to a spreadsheet for easy computations. It is easier for the evaluation team to arrive at a consensus decision.

From the results of the case studies, it can be concluded that application of the AHP in vendor selection of a telecommunications system to improve the team decision making process is desirable. The AHP model developed in this study can be used as a basis for implementing vendor selections of telecommunications systems. The suggested nine point **(Table 6)** rating system of assessing the vendor systems helps decision-makers in avoiding time consuming pair wise comparison judgments. If new critical success factor(s) and, hence, new criteria emerge to satisfy changing business needs, then they can be included in the AHP model to select a vendor. Similarly, any new member can be included in the evaluation team to consider his or her input. Also, the vendor selection could be made in a more routine fashion.

It should be noted, however, that the data collection and computational problems would increase with the increase in the number of criteria and sub criteria, as well as the number of vendors considered in the selection. This is one of the reasons that warranted short listing the number of vendors first and then applying the AHP model. Also, as it is at the begining, the number of success factors can be grouped to minimize the number of criteria and sub criteria used in formulating the AHP model.

The number of evaluators can be increased to collect more data and determine the priority weights to examine whether they are changed as the evolution of telecom is quite dynamic in nature. In this fashion, one can conduct sensitivity analysis and determine the optimum number of evaluators to be used to collect data.

However, several case studies in the literature using the AHP indicate the use of three to seven evaluators in order to reduce biases of evaluators in assessing pair wise comparisons.

V. Further Research

One thing comes out of this analysis indicating the trend of gradual fall in priority of different parameter(Figure 4). Servicing and operating cost being at high priority and the technical features take a back stage initially. The fall of priority in technical region is relatively gradual in nature. And least priority is being given to problem solving capability and vendor's experience in related product. It gives a faint indication that the user mostly want the product to be replaced rather than being repaired.

Please insert Figure.4 here

And we can observe that the priority rating varied from zero to 0.1. Hence additional exploration needs to be done to understand this trend and whether this would remain the same with rapid change in technology and introduction of modular product.

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Appendix

FIGURE 1 Ranking of Vendor Selection Parameter for Telecom Co.

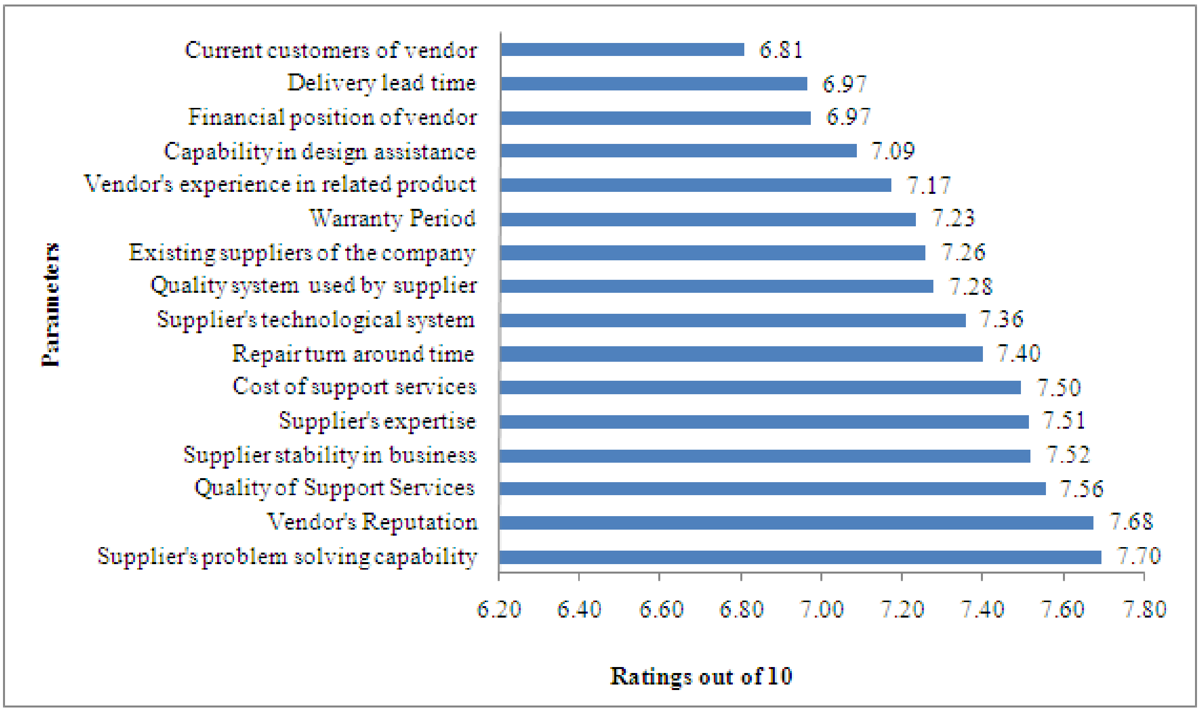

FIGURE 2.Criteria and Sub Criteria of a Vendor Selection Model for AHP

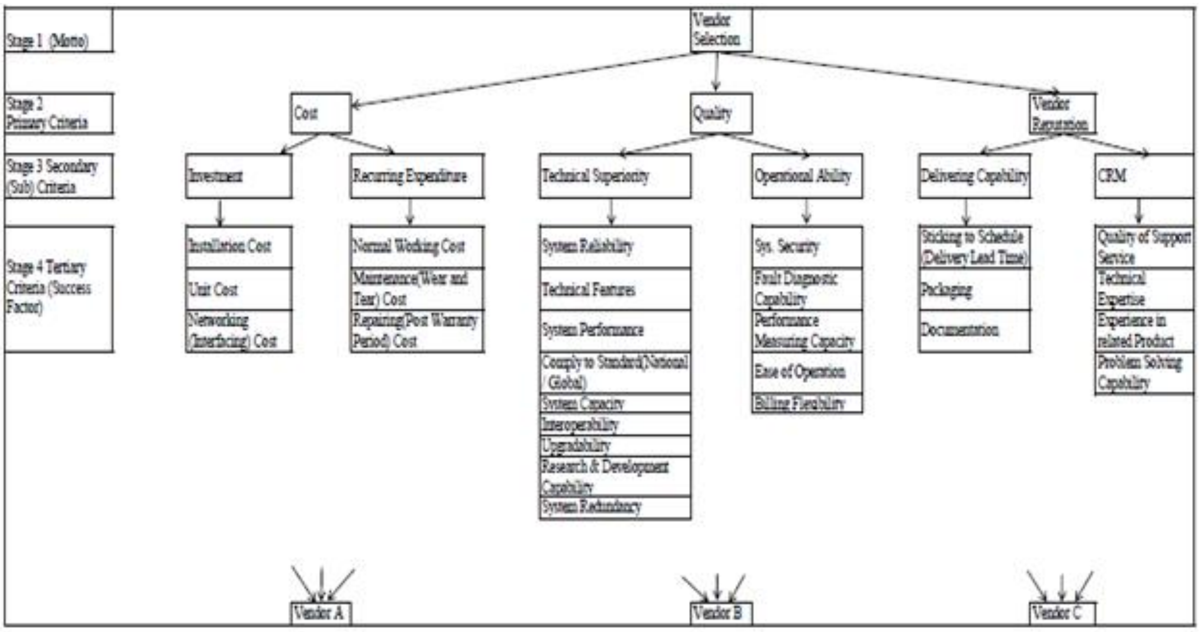

FIGURE 3. Vendor Selection Summary

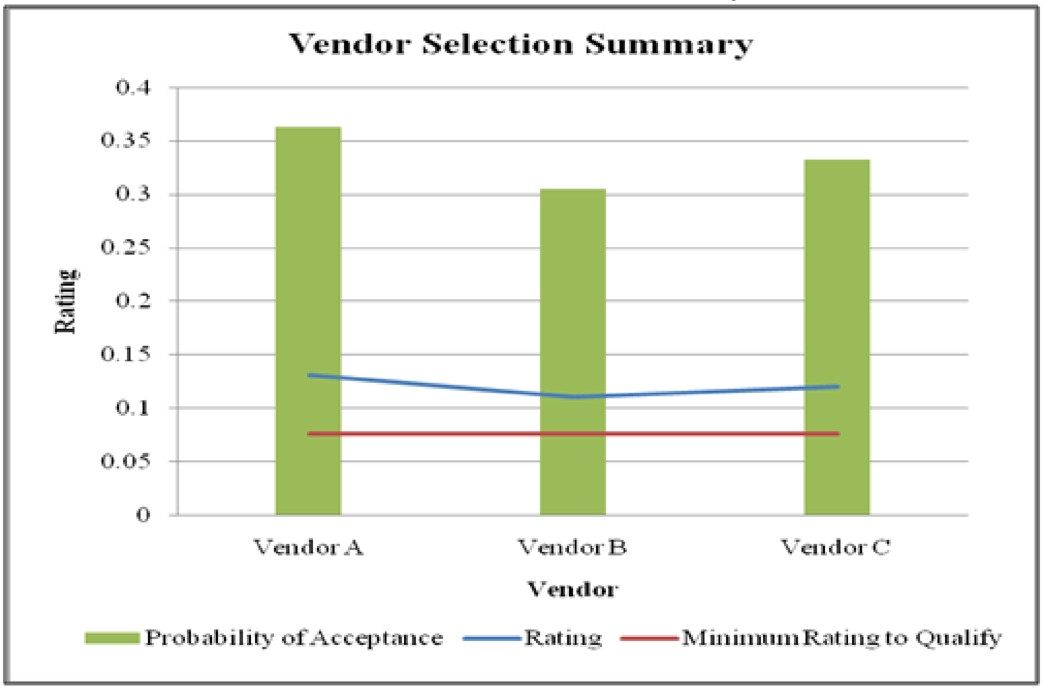

FIGURE 4. Vendor Selection Parameter Rating

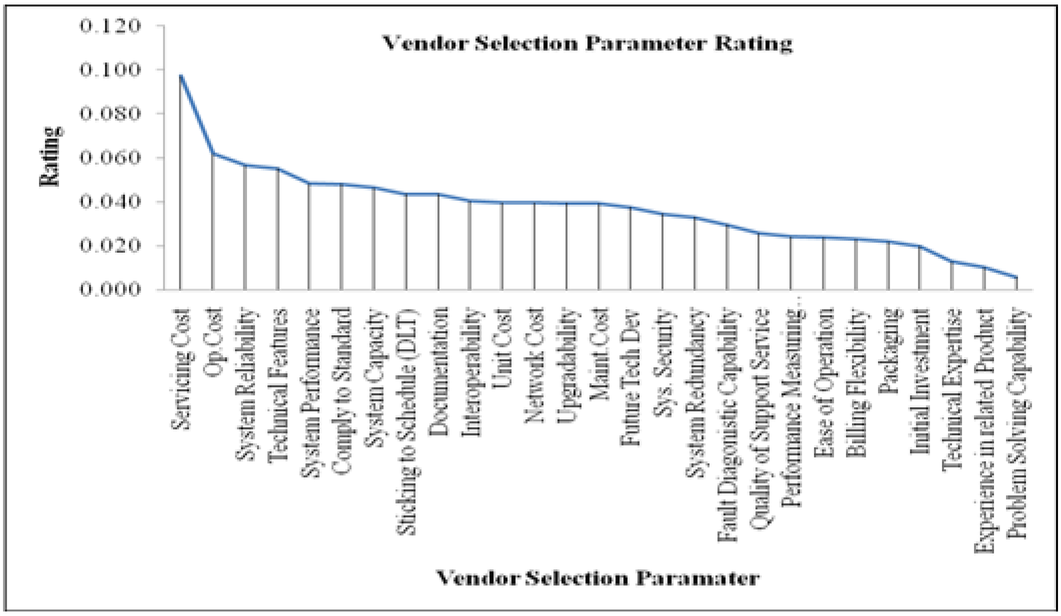

TABLE 1.Scale of Preference (As Developed by Saaty)

Scale	**Relative Importance**
1	Equally Preferred
2	Slightly Preferred
3	Moderately preferred
4	More Preferred
5	Strongly Preferred
6	(As per perception between 5 and 7.)
7	Very Strongly Preferred
8	(As per perception between 7 and 9)
9	Extremely Preferred

TABLE 2.Pairwise Matrix for Primary criteria

	Cost	Quality	Vendor Reputation
Cost	1	0.5	2
Quality	2	1	3
Vendor Reputation	0.5	0.33	1

TABLE 3.Normalised weight and calculation of priority weights

	Cost	Quality	Vendor Reputation	Normalised Value			Average weight	Wtd. Sum	Wtd. Sum Prio
Cost	1	0.5	2	0.28	0.27	0.33	**0.29**	0.89	3.004
Quality	2	1	3	0.57	0.56	0.5	**0.54**	1.62	3.011
Vendor Reputation	0.5	0.33	1	0.14	0.18	0.17	**0.16**	0.48	3.000
Total	3.5	1.83	6	1	1	1		□	**3.005**
								CI	**0.0027**
								RI	**0.58**
								CR	**0.0047**

TABLE 4 Composite Priority Weight of all Criteria (Primary, Secondary and Tertiary)

Goal	**Primary Criteria**	**Priority (Local Weight)**	**Secondary Criteria**	**Priority (Local Weight)**	**Tertiary Criteria (Success Factor)**	**Local Weight**	**Global Weight**
Vendor Selection	Quality	0.548	Technical Superiority	0.75	System Reliability	0.1398	0.057
					Technical Features	0.1362	0.055
					System Performance	0.1192	0.048
					Comply to Standard(National / Global)	0.1187	0.048
					System Capacity	0.1146	0.046
					Interoperability	0.0997	0.040
					Upgradability	0.0973	0.039
					Research & Development Capability	0.0928	0.038
					System Redundancy	0.0816	0.033
			Operational Ability	0.25	Sys. Security	0.2558	0.034
					Fault Diagnostic Capability	0.2189	0.030
					Performance Measuring Capacity	0.1786	0.024
					Ease of Operation	0.1763	0.024
					Billing Flexibility	0.1704	0.023
	Cost	0.292	Recurring Expenditure	0.667	Repairing (Post warranty Period) Cost	0.4905	0.095
					Normal working Cost	0.3119	0.060
					Maintenance (Wear and Tear) Cost	0.1976	0.038
			Investment	0.333	Unit Cost	0.4	0.039
					Networking (Interfacing) Cost	0.4	0.039
					Cost of Installation	0.2	0.019
	Vendor Reputation	0.16	Delivering Capability	0.667	Sticking to Schedule (Delivery Lead Time)	0.4	0.044
					Packaging	0.4	0.044
					Documentation	0.2	0.022
			CRM	0.333	Quality of Support Service	0.4720	0.026
					Technical Expertise	0.2365	0.013
					Experience in related Product	0.1860	0.010
					Problem Solving Capability	0.1055	0.006
						Total	1.000

Quality	Technological factor	System Reliability	Global weight
0.548	**0.75**	**0.1378**	**0.05766(=0.057)**

TABLE 5: Ranking of elementary factors

Rank	Detailed Factors	Global weight
1	Servicing (Post Warranty Repairing)Cost	0.095
2	Operating Cost	0.060
3	System Reliability	0.057
4	Technical Features	0.055
5	System Performance	0.048
6	Comply to Standard(National & Global)	0.048
7	System Capacity	0.046
8	Sticking to Schedule (Delivery Lead Time)	0.0443
9	Packaging	0.0442
10	Interoperability	0.040
11	Upgradability	0.039
12	Unit Cost	0.039
13	Network(Interfacing) Cost	0.039
14	Maintenance Cost	0.038
15	Future Tech Dev(R & D Capability)	0.038
16	Sys. Security	0.034
17	System Redundancy	0.033
18	Fault Diagnostic Capability	0.030
19	Quality of Support Service	0.026
20	Performance Measuring Capacity	0.024
21	Ease of Operation	0.024
22	Billing Flexibility	0.023
23	Documentation	0.022
24	Installation Cost	0.019
25	Technical Expertise	0.013
26	Experience in related Product	0.010
27	Problem Solving Capability	0.006

TABLE 6 Rating Parameter & Score

Rating Parameter	Score	Symbol
Out Standing	0.306953	O
Very Good	0.218204	VG
Good	0.154323	G
Reasonably Good	0.108882	R
Average	0.076442	A
Below Average	0.053309	BA
Fair	0.037028	F
Manageable	0.025946	M
Poor	0.018914	P

TABLE 7 Priority Weight for Each vendor

	Vendor A			Vendor B			Vendor C		
Tertiary Criteria (Success Factor)	Rating	Score	Weight	Rating	Score	Weight	Rating	Score	Weight
Cost of Installation	F	0.037	0.0007146	A	0.076	0.001468	G	0.154	0.002974
Unit Cost	F	0.037	0.0014292	G	0.154	0.005949	O	0.306	0.01182
Network (Interfacing) Cost	G	0.154	0.0059487	A	0.076	0.002936	O	0.306	0.01182
Normal Working Cost	A	0.076	0.0045852	A	0.076	0.004585	F	0.037	0.002232
Maintenance(Wear and Tear) Cost	F	0.037	0.0014143	A	0.076	0.002905	F	0.037	0.001414
Repairing (Post warranty period) Cost	A	0.076	0.0072103	A	0.076	0.00721	A	0.076	0.00721
Technical Features	O	0.306	0.01686	A	0.076	0.004187	G	0.154	0.008485
System Capacity	G	0.154	0.0071407	G	0.154	0.007141	A	0.076	0.003524
System Reliability	G	0.154	0.008711	A	0.076	0.004299	G	0.154	0.008711
System Performance	G	0.154	0.0074249	G	0.154	0.007425	G	0.154	0.007425
Comply to Standard	G	0.154	0.0073908	G	0.154	0.007391	G	0.154	0.007391
Interoperability	O	0.306	0.0123458	G	0.154	0.006213	G	0.154	0.006213
Future Tech Dev	G	0.154	0.0057792	A	0.076	0.002852	G	0.154	0.005779
System Redundancy	G	0.154	0.0050813	A	0.076	0.002508	G	0.154	0.005081
Upgradability	G	0.154	0.0060629	G	0.154	0.006063	A	0.076	0.002992
Ease of Operation	G	0.154	0.0036604	O	0.306	0.007273	A	0.076	0.001806
Performance Measuring Capacity	G	0.154	0.003709	A	0.076	0.00183	G	0.154	0.003709
Fault Diagnostic Capability	G	0.154	0.004544	G	0.154	0.004544	F	0.037	0.001092
Billing Flexibility	A	0.076	0.0017459	G	0.154	0.003538	A	0.076	0.001746
Sys. Security	A	0.076	0.0026215	A	0.076	0.002621	A	0.076	0.002621
Sticking to Schedule (DLT)	A	0.076	0.0033097	G	0.154	0.006707	A	0.076	0.00331
Packaging	G	0.154	0.0033533	A	0.076	0.001655	A	0.076	0.001655
Documentation	A	0.076	0.0033097	A	0.076	0.00331	A	0.076	0.00331
Quality of Support Service	A	0.076	0.0019508	A	0.076	0.001951	G	0.154	0.003953
Problem Solving Capability	A	0.076	0.000436	A	0.076	0.000436	A	0.076	0.000436
Technical Expertise	A	0.076	0.0009773	A	0.076	0.000977	A	0.076	0.000977
Experience in related Product	O	0.306	0.0030952	G	0.154	0.001558	G	0.154	0.001558
		Total	0.1308118			0.109531			0.119246
		Normalized	**0.3637813**			**0.304602**			**0.331617**

AUTHORS' INFORMATION

Mr.Smrutiranjan Mohanty* is working as an Assistant Professor of Operations Management at Sinhgad Institute of Business Management, Mumbai, India. He has wide experience in teaching and consulting in the area of Operational Planning, Project Management, Productivity, Technology Optimization and Materials Planning. He holds a Masters Degree in Manufacturing Technology from National Institute of Technology, Rourkela, India and Masters Degree In Business Management from Berhampur University, India. At present he is pursuing his Ph.D in Industrial Engineering under the guidance of Dr.B.M.Dabade at SGGS Institute of Engineering and Technology, Nanded, India (Affiliated to S.R.T. Marathwada University)

Dr.Balaji.M. Dabade is working as a Professor of Production Engineering at SGGS Institute of Engineering and Technology, Nanded, India. He is having around three decades of experience in teaching and research in the area of Industrial Enginering, Qulity Management, Reliability, Inventory control, Supply chain optimization and Technology Management. He is a Master Degree holder in Production Engineering from National Institute of Technology, Rourkela, India and obtained his Ph.D (Industrial Engineering & Management) from Indian Institute of Technology, Kharagpur, India.