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Suppliers Evaluation: A Futuristic Approach

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Abstract

Purpose

Vendor evaluation is very important for the procurement department of any organization. It helps to select vendors best suited for the requirements of the organization. Traditionally organizations have evaluated vendors based on factors of past performance. They did not include factors which would indicate their future potential performance. It was also observed that organizations made efforts to improve the supply of items based on the percentage defectives record, but did not look into the supply risk and profitability impact of those items. Attractiveness of suppliers might be affected when; apart from percentage defectives their supply risk and profitability impact is also considered. The purpose of this paper is to propose a comprehensive approach towards selection of suppliers from among many suppliers for a particular component, and also to evaluate the strength of the network of suppliers an organization has developed over a period of time.

Approach

In the paper a theoretical framework has been developed to include futuristic factors while selecting a supplier, the framework included both lagging as well as leading indicators. It also proposes a methodology to evaluate a network of suppliers by including supply risk and profitability impact of different parts an organization procures.

Findings

To holistically evaluate vendors considering both lagging and leading indicators of their performance, a "Futuristic Model" was developed to help procurement team to improve its supply and to determine exactly where more efforts and time of the procurement team is to be spent. To compare the supplier network of one organization with that of another, and/or for self-evaluation purposes, the "Supplier Network Quality Index" was also developed.

Limitations

The proposed models will be applicable to organizations which maintain physical inventories and depend on external suppliers for their different component items requirements. Manufacturing organizations will find the proposed methodology relatively more suitable. Service organizations not forming part of this study could also be included.

Practical Implications

The study will prove to be of immense value to the procurement team of different

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organizations as it will facilitate them select vendors using a holistic evaluation criterion. It will therefore help them to channel their efforts in the right direction. They can also track their own performance in terms of whether they were effective in developing a strong network of suppliers.

Originality/Value

The research is conceptual and original based on literature survey, and has been pilot tested on an organization. The proposed models would be helpful to a procurement team in their decision making and will be valuable for better supplier and supplier-base evaluation.

Keywords: *Focus Index, Futuristic Model, Leading Indicator, Lagging Indicator, Supplier Network Evaluation, Supplier Network Quality Index.*

Paper type

It is a conceptual research paper. It has proposed two models to help procurement team better evaluate potential suppliers and supplier network.

Introduction

Procurement is an essential function of an organization. It involves purchasing input material required for production from various vendors. These days due to increased globalization and increased number of suppliers and vendors for any material, it has become imperative to organizations to improve their purchasing process and thus improve their supply chain efficiency. Suppliers have a very significant and effective influence on the competitiveness of an organization; any improper selection of suppliers may result into numerous problems for the organization inadvertently. Every organization wants to avoid problems of poor quality of delivered goods, ineffective delivery schedules and poor service levels after the delivery because these may severely reduce the competitiveness and efficiency of the organization. In order to avoid such situation arising in the first place and adversely affecting the success of an organization, the management nowadays has started taking supplier evaluation with utmost seriousness. An effective appraisal system for the suppliers is thus the key to strategically secure supplies.

Chee-Cheng Chen, Ching-Chow Yang (2002) notes that purchasing function directly affects a firm's ability to compete through its impact on quality, cost, technology, and supplier responsiveness. Organizations are trying to reduce the number of suppliers and establish longer-term buyer-seller relationships to achieve a competitive advantage through more effective use of the supply base. Hence, supplier evaluation and selection is becoming increasingly critical in the development of effective longer-term relationships and performance. The measurement and evaluation of a supplier's performance will therefore assume added importance in the ongoing supplier evaluation process.

Supplier evaluation as an activity can have dramatic impact on the profitability of an organization. If an organization is able to manage it correctly, then it can have suppliers who are focused and aligned with the needs of the business, and if not taken seriously, it can have huge repercussions on the delivery schedule, quality and quantity of the material delivered by the suppliers. Supplier evaluation activity is done by almost every organization by either using very simple or somewhat complex techniques. In any case the core of the exercise remains to optimize the procurement by selecting and retaining right vendors for the organization.

Objectives

The research has been conducted with the following objectives:

1. To devise a holistic model for evaluating potential Suppliers.
2. To devise a model for evaluating Supplier Network and therefore providing direction to the purchasing department of the organization.

Review of Literature

Evaluation of suppliers has been described in a variety of ways. Different companies adopted their own way of evaluating suppliers; it has not been considered as a serious and strategic arena. But with increased competition, the field of supplier evaluation has taken its roots in the strategy of an organization. Supplier evaluation has been defined as the process of quantifying the efficiency and effectiveness of supplier action (Neely *et al.*, 1995). Supplier evaluation is a quantification process designed to stimulate the decision process inside the evaluating buying company or through the incentives it invokes, to stimulate a change in behavior in the evaluated supplying company (Neely *et al.*, 1997). Hald Kim Sundtoft, and Ellegaard Chris (2011) showed how an evaluating buyer may analyze and control supplier evaluation processes and improve their effects. They have indicated where evaluating buying managers should look when dysfunctional outcomes of supplier evaluation practices needed revision. Schmitz and Platts (2003) explored supplier evaluation practices as instruments designed to influence supplier action. They assumed that if such an attempt was successful, it would manifest in changed supplier behavior aligned with evaluating company's interests, improved supplier capabilities and performance, and that in turn would benefit the evaluating buying company (Prahinski and Benton, 2004). Using experiments as research instrument, Dumond (1991, 1994) found that different measures produce different procurement manager decisions. Prahinski and Benton (2004) explored how suppliers perceived the buying firm's supplier evaluation communication process and how this in turn impact supplier performance. Prahinski and Fan (2007) added to this understanding by exploring how content and frequency in communication impacted suppliers' commitment to change behavior.

Some scholars have tried to research the strategic role of the supplier evaluation process, and have tried to relate the process with the performance issues of the organization. Cousins *et al.* (2008) explored the role of socialization mechanism in mediating the relationship between supplier performance measures and performance outcomes. They report that "Socialization mechanisms provide an avenue for dialogue to act upon issues identified through performance measurement 'control' process". It was concluded that it was not the performance measurement system, but rather the mediating effect of buyer-supplier socialization mechanisms that was critical to firm performance. Purdy *et al.* (1994, 2000) explored suppliers' perceptions of the effectiveness of buyers' evaluation processes. They drew three main conclusions. First, the majority of suppliers felt that their effectiveness was not accurately reflected in the evaluation; rather it seemed as a test of how much their organization looked like the buying organization. Second, the evaluating buying organization did not utilize the information gathered through the audit process properly. Instead, "suppliers felt that price and politics were the bottom line of the purchasing decision". Finally, suppliers felt that scoring high on the evaluation chart was more a question of game playing and showmanship – of "repackaging material to fit a different format rather than one of looking for ways to improve". The article rejected the undisputed power of the measurement system, stating that "simply having the required systems and procedures in place does not necessarily ensure an effective or "good" supplier", thereby attributing interpretive and transformative power to the actors involved in activating and responding to the technology.

Many scholars in the field have suggested a variety of models for vendor selection and evaluation. Weber *et al.* (1991) listed the use of linear programming, mixed integer programming models for vendor selection. The conceptual articles by Kraljic (1983), Burton (1988), and Benton and

Krajewski (1990) are examples emphasizing the strategic importance of the vendor selection process. These articles highlight the relative importance of quality, cost and delivery as performance measures. Weber & Current (1993) proposed a multi-objective approach for vendor selection, where it provided for useful decision support system for purchasing department faced with multiple vendors and tradeoffs among price, delivery reliability and product quality. In their approach, the target was focused on selecting number of vendors and order size from each one. Other studies like Wagner *et al*. (1989), Chapman & Carter (1990); Chapman (1993), have focused on evaluation of relative importance of quality, cost, delivery performance and other supplier attributes. Verma and Pullman (1998) concluded that it was difficult for any one vendor to excel in all dimensions of performance. Garg *et al*., (1996) emphasized on the need of well-designed system for vendor selection, development, evaluation and for an easy-to-implement approach. These and many other studies emphasized the importance of vendor selection for the good business prospects of an organization.

We have observed that the majority of the existing models are based on the indicators of past performance which in a way important, and there is no reason normally to believe that the future will not be a function of the past. But the process of evaluation could be further strengthened if we act and think futuristically. Therefore our premise is that the evaluation necessarily adopts past as well as future potential whenever evaluation is attempted. The proposed models in the paper are an attempt to fulfill this gap. Contribution of the paper will also be to enable comparison of network of suppliers of one organization with that of another in the same industry if available, or to facilitate comparison with its own past performance. This study contributes to the part of the supplier evaluation literature which is helpful for companies to consider sourcing as a competitive force. Kraljic (1983) model is based on portfolio model concept originally developed by Markovitz (1952) who used it as an instrument for managing equity investments. Kraljic was the first to bring portfolio models into the purchasing area. The model is used to analyze the purchasing portfolio of a firm. Accordingly procurement strategies for different items must be based on supply risk and profitability impact of the item. Kralijic classified the items in four categories based on supply risk and profitability impact (Figure 1).

Figure 1: Product Purchasing Classification Matrix

- **Strategic items**: These are high profit impact, and high supply risk items. Strategies to manage such items include doing extensive analysis on demand forecast, developing long-term relationships with vendors, analyzing and managing risks regularly, planning for emergencies.
- **Bottleneck items**: These are low profit impact, and high supply risk items. The main aim of the purchasing department should be to have the security of inventory all the time. The management must be ready with the back-up plan as well as in the event of any shortfall of such items. Useful approaches include over-ordering when the item is available and looking for ways to control suppliers.
- **Leverage items: These are** high profit impact, low supply risk items. The approach for such items includes exploiting full purchasing power and making full use of the bargaining power and substituting products or suppliers, have negotiations with suppliers, selecting few suppliers and giving high-volume orders to them.
- **Non-critical items: These are** low profit impact, low supply risk items. The management approaches include using standardized items for the production of output, monitoring and optimizing volume of the orders given to the suppliers (generally the suppliers are given bulk order or blanket orders for such items), and optimizing inventory levels by such means as devising economic order quantity.

Suppliers Evaluation: Different Approaches

Hughes Missile Systems Company (HMSC) had proposed the following evaluation indexes for rating the suppliers:

Part Performance Index (PPI) - Used for bid evaluation for best value supplier. This index is used to find out the best supplier for a particular part.

Supplier Performance Index (SPI) - Used for tracking and analyzing the trends of all of supplier's parts. This index is used for analyzing the performance of all the suppliers for all items delivered by them.

Commodity Performance Index (CPI) - Used to identify the performance of all the suppliers in the same specific commodity group. Here the analysis is done on all the suppliers of a particular category of items procured such as fasteners, coolants, containers, etc.

Here, Performance Index is defined as:

PI = (purchased costs + nonproductive costs) / purchased costs

If *PI > 1*, it points at the inefficiencies involved in purchasing.

The non productive costs include numerous heads like- costs of returning to vendor, costs of material inspection, costs due to late delivery, costs due to early delivery etc.

Another widely used model is the Weighted Average Rating Model. In this, supplier is rated by the purchasing department *subjectively* on the basis of past performance and experience with the vendor. Various parameters included in the model are as follows:

- Quality of the items delivered
- Minimum Quantity that can be ordered
- Lead time of the delivery of items
- Supplier service after the sales

- Price charged by the vendor etc.

An illustration of the above model is given below:

Factor	Weight	How Measured	Supplier A Rating	Supplier A Score	Supplier B Rating	Supplier B Score
Quality	40	1 = Worst 5 = Best	(3/5) X 40	24	(4/5) X 40	32
Delivery	30	1 = Worst 5 = Best	(4/5) X 30	24	(3/5) X 30	18
Price	20	1 = Worse 5 = Best	(2/5) X 20	8	5/5 X 20	20
Service	10	good = 100% fair = 70% poor = 40%	.7 X 10	7	1.0 X 10	10
Ttl. Points	100			63		80

Figure 2: Suppliers Evaluation using Weighted Average Method

In the above illustration (Figure 2) various factors like Quality, Delivery, Price and the Service were given various weights based on their importance to the firm. Then vendors are rated (e.g. vendors A and B are rated on the Likert scale of 1 to 5 for each of five factors). Then the score is calculated by multiplying the weight of each factor with its rating and then adding the individual scores to get total points. In the illustration it can be seen that the Vendor-B is preferred over Vendor-A; as B got more points (80 points) in the evaluation than A (63 points).

Methodology

The paper is based on gap analysis of the current models. Based on the literature survey, period of development and testing, we propose two models for supplier evaluation. Methodology is based on the analysis of suppliers and suppliers' network and presenting 'Futuristic Model' and 'Supplier Network Quality Index'. The models were pilot tested with one of the leading multinational companies operating in India. The executives of the organization lauded the models and shown interest on the application of the same. The research results were also presented before the academicians and participants of post graduate management course who have had worked with various leading organizations of the country. They also had ratified the applicability of the models in the industry. However as the work was under progress therefore the complete work was not shared with them.

Proposed Models

Futuristic Model for Supplier Evaluation

Past performance is an indication of future performance and to have a better understanding of future potential, we have to consider both. This model is based on such attempt wherein both past performance criteria and future potential of suppliers are considered to quantitatively evaluate the same. Therefore evaluating the suppliers, it is important to rate the vendors based on both

leading as well as lagging indicators. This helps in further reducing uncertainty in supply. The traditional way of evaluating the suppliers based on only lagging indicators gave an indication of the past performance of the suppliers but did not tell anything about their future potential. Unless leading performance indicators are included suppliers evaluation would remain incomplete. Therefore there is a need of modifying the traditional rating systems for proper evaluation of suppliers. We propose a comprehensive Futuristic Model for Supplier Evaluation as described in the following paragraphs.

The lagging indicators of performance are the aspects which look into the past- performance of the vendors. Following **lagging indicators** have been included for rating vendors:

- **The quality of the item supplied-** Quality of the material purchased is one of the very important criteria for the purchasing organization. It can have significant effect on the quality of the final product the organization is producing. Quality is generally measured in terms of percentage of the defective products supplied. The organization can devise their own checklist according to the industry practices or the specific factors pertaining to the organization to rate the supplier on quality.
- **Lead time taken to deliver the item-** Lead time denotes the time taken by the supplier to supply the items once the order has been placed by the purchasing organization. It is very important for any organization that the lead time taken by the supplier is as low as possible. High and fluctuating lead time may lead to lost sales due to delay in production or stock of more inventory for the organizations which may lead to high inventory costs which are undesirable. Lead time performance is measured in the number of days the supplier takes to fill the order.
- **The price of the item supplied-** Price of the supplied goods is also very important for the organization. Most organizations show no tolerance for quality, delivery and price of the supplied items. It is important for the organizations to place orders with lowest costs suppliers without compromising with quality and delivery. The lower costs charged by the suppliers help them to keep the costs of their final product also low. Thus price charged by the supplier is also important for the organizations.
- **The minimum order quantity-** Most suppliers deliver the goods only above a certain minimum order quantity. This is done in order to save the transportation costs that the supplier may have to incur in order to deliver the goods. For example a supplier may have a policy of delivering only Full Truck Load (FTL) and no Less than Truck Load (LTL). Thus it is important for the organizations to have supplier which have low minimum order quantity so that the organizations can exercise flexibility of ordering and save on the inventory carrying and holding costs.
- **After sales service provided by the vendor-** It is also important for the organizations to look at the after sales service provided by the supplier. Whether they replace the defective goods, whether they provide any guarantee or any technical support after the items have been supplied, whether they help in maintenance, are certain things that organizations care about. Thus rating on this parameter is also of use to the purchasers.

The Leading Indicators of performance include factors which will help predict the future performance potential of vendors. Following **leading indicators** may be used to rate the vendors:

- **Technological Competency-** In certain sectors like automobiles the suppliers are required to keep pace with the latest technologies being developed and deployed in the market. Thus it is important for organizations to look at the technological competency of the work force as well as the technology used by the supplier. The technological progress of the

supplier gives a fair idea that in future the supplier is going to be at par with the best practices in the industry. In order to determine the technological competency the purchasers may have to visit the facility of the suppliers and see the facility as well as have interaction with the supplier's work force to determine their proficiency.

- **The employee satisfaction at the supplier company-** The satisfaction of the employees in the supplier's facility has effect on quality and delivery time of the goods to the purchasers. Thus it is important that employees are satisfied and work with dedication in the supplier's facility. This can be analyzed by having field visits to the supplier's facility and having discussions with the employees. Other methods may include checking the history of the organization and looking at the strike-records etc. Employee's satisfaction is also a parameter which may affect the performance of suppliers in future.
- **The management policies of empowering the workers-** The purchasers must also look the management practices used in the supplier's organization. For example, whether the workers are given training on self control, which includes training on the work they are supposed to do, the effect of their work on the next step and also equipping and empowering them with measures which help them to control their performance?
- **The quality improvement efforts by the supplier company-** The quality improvement efforts made by the suppliers to ensure good quality products are also important for the purchasers. The purchasers must look at the corporate quality goals of the supplier and also the technology they use to ensure quality. For example whether they make use of certain fail safe designs to ensure good quality products. Quality certifications of the suppliers must also be checked. These things give the indication of the quality of the supplier's future products.
- **Financial stability of the company-** The suppliers must be financially stable in the market. They should not be loss making companies because in such a condition there are high chances that the supplier may shut down its facility and will create problems for the purchasing organization. Thus the purchasers must look at the profitability of the suppliers, the interest payments and the ability of the suppliers to sustain financially in the future.

In the proposed Futuristic Model for Supplier Evaluation, suppliers will be rated on the above mentioned set of lagging and leading indicators which are critical for purchasing organization. The rating would be done on a five point Likert scale, where 5 represents Very Good, 4 Good, 3 Average, 2 Poor, and 1 Very Poor. Based on the knowledge of manufacturing practices currently followed by the vendors and their past performance, the purchasing department can rate the vendor on each of these factors through their experience and judgment.

The organizations may also choose to award differential weights to these lagging and leading indicators based on their importance in the particular industry or the organization as per the organization specific scenarios and requirements. Thus a particular vendor will be evaluated on a maximum of 50 points. The vendor which scores maximum points would be selected for awarding a contract or for renewal of the same. An illustration is given below (Table 1) to demonstrate how the model will work:

Two hypothetical suppliers namely Supplier-A and Supplier-B, for a particular component have been rated on parameters of the proposed model. The weight of different factors will depend on the industry and organization requirements. The suppliers were rated on five point Likert scale; a maximum level of 5 and minimum level of 1. These scores were then multiplied by the weight of the factor to give the weighted score of a supplier on a particular parameter. The individual weighted score of different parameters was then added finally to give a total score of that

Table 1: Futuristic Model for Supplier Evaluation

Sr. No.	Supplier rating criteria	Weightage	Supplier A		Supplier B	
			Score (on 5)	Weighted score	Score (on 5)	Weighted Score
1	Quality	0.25	4	1	4	1
2	Price	0.12	3	0.36	2	0.24
3	Lead time	0.08	1	0.08	3	0.24
4	Service	0.1	3	0.3	2	0.2
5	Minimum Quantity	0.05	4	0.2	4	0.2
6	Technology and Automation	0.1	4	0.4	2	0.2
7	Management Policies	0.04	3	0.12	3	0.12
8	Worker Satisfaction	0.05	3	0.15	3	0.15
9	Financial Stability	0.06	4	0.24	5	0.3
10	Quality Control	0.15	4	0.6	4	0.6
	Total	**1**		**3.45**		3.25

supplier. In this illustration, Supplier-A scored a total of 3.45 points while the Supplier-B scored a total of 3.25 points. Thus according to this model Supplier-A fared better than Supplier-B for this particular item and the order must be awarded to Supplier-A.

Supplier Network Quality Index (SNQI): A Model for Evaluating Supplier Network

This model is built on the Kraljic model briefly introduced in Section 3.0 (Figure 1). For evaluating the ***Supplier Network*** of an organization, the items should be rated based on its supply uncertainty and profitability. After the items have been rated based on these two criteria, the items will be classified in the following four categories according to the Kraljic's model:

1. High supply risk – High Profitability Impact (Strategic Items)
2. Low supply risk – High Profitability Impact (Leverage Items)
3. High supply risk – Low Profitability Impact (Bottleneck Items)
4. Low supply risk – Low Profitability Impact (Non Critical Items)

Supply uncertainty can adversely affect the production planning of any organization. Suppliers should be willing to act as partners in the business. Organizations should treat suppliers as business partners, an extended arm of themselves. Supply risk or uncertainty will be evaluated based on the judgment, experience and knowledge of purchasing department on the following factors:

- **Number of suppliers for the item-** Supply risk of a particular item is higher when the suppliers available for the item are few in the market. Higher number of suppliers reduces the supply risk as the purchasers can switch to other supplier if one of the suppliers fails to deliver the item.
- **Vulnerability to breakdown of the Supply Chain-** Supply risk is higher for the items whose supply chains are vulnerable to breakdown due to political and/or other reasons. For example, an item being received from Pakistan is highly risky for Indian manufacturers as the supply may be disrupted anytime due to political reasons.

- **Capacity constraint of suppliers-** The capacity of the suppliers to deliver the items when there is peak demand for the purchaser is also a factor which can affect the supply of items. Thus it is important for the purchasers to see whether the purchasers keep extra capacity for production with them or not.
- **Variability in lead time (reliability) -** Purchasers must also look at the reliability of the supplies for the production. For example certain goods can be transported with constant lead time for delivery but certain others have variable lead time because of distance or other factors.
- **Difficulty of change over-** If it is difficult to switch over to other suppliers then there is a supply risk for the purchasers. The purchasers may get stuck due to inherent nature of the product of the items received to certain supplier. In that case, the supply risk of the purchaser increases.

The impact on profitability of a particular item will be evaluated based on the judgment of purchasing department on the following factors:

- **Cost of the item used as a part of total cost of the final product-** Profitability impact an item can have on the final product depends on the cost of that item. For example in a laptop, the LCD screen is more important than a mouse or the keyboard for the manufacturing organization.
- **Competitive edge provided by the item-** Profitability of the final product increases with the differentiation the item provides to the final product. For example in the same laptop, use of Intel chip will give more advantage to the laptop than an AMD chip.
- **Improvement in performance of the product-** It is important that the performance of the product must be improved with the use of the particular item. In the same laptop, the profitability will increase if Windows 2010 operating system is used instead of Windows 97.
- **Reduction in cost of production-** The items which can help reduce the cost of production of the final product will improve the profitability of the final product. For example the standardized items used by Dell in manufacturing the laptops help it reduce its costs as compared to HP.
- **Effect on demand by the use of item-** The components used may also affect the demand of the product and thus improve the profitability of the organization. For example the accessories given by the laptop manufacturers increase its demand and thus profit increases.

Each of the factors for supply risk and profitability impact will be rated on a five point Likert Scale. The item can be provided with maximum of 5 for very high supply risk or very high profitability impact, and rating of 1 for very low supply risk profitability impact. The rating convention is similar to the one, used previously (5-Very High, 4-High, 3-Average, 2-Low, 1-Very Low). Thus the supply risk of an item will be evaluated out of 25 points and the profitability impact of the item will also be evaluated out of maximum 25 points.

According to the Kraljic's model the items are categorized in different categories. The items scoring above 12.5 in supply risk will be categorized as "High Supply Risk items" and the items scoring below 12.5 in supply risk will be categorized as "Low Supply Risk items". Similarly the items scoring above 12.5 in profitability impact will be categorized as "High Profitability Impact items" and the items scoring below 12.5 in profitability impact will be categorized as "Low Profitability Impact items". Once the items have been categorized in the 4 categories we can calculate the quality performance of various categories by finding the percent defectives in each of the four categories from the records of the organization.

Now let us describe how the SNQI will work. The demonstration of the working of the above model is shown as below with a hypothetical example. Let us assume an item whose part name is “A”, the Supply Risk rating of this item can be found by Procurement department as follows (Table 2):

Table 2: Supply Risk Rating of an Item

Supply Risk of Item- A	Rating(on 5-Point Scale)
Number of suppliers for the item	5
Vulnerability to breakdown	3
Capacity constraint of suppliers	4
Variability in lead time (reliability)	5
Difficulty of change over	3
Total	20

Similarly, the Profitability Impact rating of the item - A was found as follows (Table 3):

Table 3: Profitability Impact of an Item

Profitability Impact of Item-A	Rating
Cost of the item	5
Competitive edge provided by the item	4
Improvement in quality	4
Reduction in cost	5
Effect on demand	5
Total	23

Now since the Item-A has scores more than 12.5 in both Supply Risk as well as the Profitability Impact, Item-A falls in the category of Critical items. A similar exercise should be conducted for each of the items procured and it should be placed in the appropriate category as per its Supply Risk and Profitability Impact.

Once the Supply Risk and Profitability Impact of the items have been found out, they can be segregated based on their category as shown in the table below (Table 4). This table shows a hypothetical case with some twenty six (A to Z) items. A table similar to this can be developed for the items procured by the organization:

Supplier Network Quality Index (SNQI) = 0.833

In the above table, the **Column-5** denotes the importance of an item to the purchasing department and it is found by multiplication of the Supply Risk rating and the Profitability Impact rating. Thus for Part-A, importance is 20*23 = 460.

Now in the next column **(Column-6)** of the table, the weighted importance of the part is found by aggregating the total of importance of each item (4244) and dividing the individual importance by the aggregate. Thus weightage of Part A as compared to other all the parts is found as 460/ 4244 = 0.11.

Table 4: Supplier Network Quality Index (SNQI)

Category (1)	Part name (2)	Supply Risk (3)	Profitability Impact (4)	Importance (5)	Weightage (%) (6)	Percentage Defective (7)	Focus Index (8)
Strategic	A	20	23	460	0.11	0.08	0.009
	B	18	24	432	0.10	0.10	0.010
	C	23	16	368	0.09	0.13	0.011
	D	17	15	255	0.06	0.26	0.016
	E	14	20	280	0.07	0.31	0.020
	F	22	13	286	0.07	0.17	0.011
	Aggregate						0.078
Bottleneck	G	20	10	200	0.05	0.24	0.011
	H	18	12	216	0.05	0.15	0.008
	I	24	8	192	0.05	0.21	0.010
	J	14	4	56	0.01	0.05	0.001
	K	19	9	171	0.04	0.08	0.003
	L	17	11	187	0.04	0.18	0.008
	Aggregate						0.040
Leverage	M	5	21	105	0.02	0.20	0.005
	N	11	15	165	0.04	0.27	0.010
	O	8	18	144	0.03	0.16	0.005
	P	3	13	39	0.01	0.13	0.001
	Q	5	20	100	0.02	0.30	0.007
	R	10	17	170	0.04	0.08	0.003
	Aggregate						0.032
Non Critical	S	9	3	27	0.01	0.10	0.001
	T	10	6	60	0.01	0.35	0.005
	U	7	11	77	0.02	0.12	0.002
	V	9	8	72	0.02	0.16	0.003
	X	12	7	84	0.02	0.04	0.001
	Y	5	10	50	0.01	0.26	0.003
	Z	6	8	48	0.01	0.18	0.002
	Aggregate						0.016
Aggregate				4244			**0.166**

Supplier Network Quality Index (SNQI) = 0.833

The next column **(Column-7)** in the table is the percentage defective of the products obtained by the purchasing department for each item. This can be found by the previous records of the company. For Part-A, it was found to be 0.08, based on past performance of the vendor.

Finally, the last column **(Column-8)** is called the ***"Focus Index"***, it is the multiplication of the percentage defective of the item and the weight of that item. Thus Focus Index of Part A becomes 0.11*0.08 = 0.0088

To calculate the Aggregate Focus Index, let's take the sum total of column-8; i.e. 0.166

Now, Supplier Network Quality Index (SNQI) is calculated as follows:

SNQI = 1 - Aggregate Focus Index

In this case, SNQI was = 1 - 0.166 = **0.833**

This value of 0.833 can be compared with benchmark organization or could be tracked from period to period for comparing organizations' strength of supplier network.

The following major observations can be made from this exercise done for evaluating suppliers and calculating the Supplier Network Quality Index (SNQI):

- The first part of Futuristic Model for Supplier Evaluation provides a methodology of evaluating Supplier' based on lagging and leading indicators of performance.
- The efforts made by purchasing department must be depended on the Focus Index of that item rather than just the Percentage Defective. Greater the Focus Index of an item, greater must be the efforts put up by the organization to improvise its supply of that item. Traditional way of determining the improvement potential was that the organizations looked at the percentage defective only as the criteria. The proposed model is an improvised version.

For example, Part-F (17%) is having more percentage defective than Part-C (13%). Generally organization would put more emphasis in improving the supply of Part-F, but since the Supply Risk and Profitability Impact of Part-C is more than Part-F thus the importance of improving the supply of Part-C is more for the organization than for Part-H even though its percentage defective is less than that of Part-H. Thus the efforts required for improving the supply of Part-C are as important as that for Part-F.

- The aggregate value of the Focus Index for different category items (Critical, Bottleneck, Leverage and Non-Critical) tell us as to where is the need of more efforts required by the purchasing department for strengthening of supplier network. Each of the different categories requires different kinds of approaches and efforts from purchasing department and thus accordingly will direct the purchasing department to put in efforts.

For example, Focus Index calculated for Critical Item: 0.078, Bottleneck: 0.040, Leverage Item: 0.032, Non-critical: 0.016. Thus more efforts must be made for improving the Critical Items, then for Bottleneck items, next for Leverage items and lastly for Non-critical items.

- The Supplier Network Quality Index value shows- how effective is the current supplier network maintained by the organization. This value can be used to compare the supplier network of two different manufacturing units of a particular company and determine which unit is doing better in managing the supplier network; SNQI can also be used to compare performance of one unit at two different points in time.

For example, SNQI found in the above example is 0.833 for facility at location-A. Suppose another manufacturing location of the same company at location-B has the SNQI value of 0.723. Thus the top management can easily know that the facility at location-A is performing better in managing the supplier network than the facility at location-B, and therefore the facility-B needs improvement in this regard. Similarly from time to time progress of a single unit can be tracked in terms of how strong the suppliers' network is.

- SNQI is also helpful in suggesting differential efforts required to maintain the different suppliers depending on the criticality of them.

Discussion

In this paper we have proposed two models one for selecting a preferred supplier from among many, and another for evaluating network of suppliers. The proposed models (Futuristic Model and Supplier Network Quality Index) can be used for better evaluation of suppliers and supplier network. These models are applicable to any industry which require substantial amount of input

raw material in order to effectively carry out their operations. Thus these models can be used by any organization which is mainly into manufacturing. The practitioners and the academicians have given positive response to this theoretical framework for evaluation of suppliers and supplier network and it can have great use for the procurement team of an organization to find correct vendors and to find out the areas where their efforts are needed the most. Futuristic Model is used for selecting one vendor from among many vendors for a specific part. Different suppliers of different parts are accordingly shortlisted.

Kraljic had provided in his model a way of categorization of different parts in an organization namely Bottleneck, Strategic, Leverage, and Non-Critical items, while we have attempted to quantify the items in our proposed model. Although this quantification is having some subjectivity within but still is a powerful technique for distinguishing different items and their suppliers. The proposed futuristic model consider the weighted averages of leading as well as lagging factors for evaluating the best supplier from among the shortlisted ones. We call this *futuristic* because factors of future performance have been considered during evaluation. Drawing inspiration from Intellectual Capital management (Jain et al., 2004) which proposed to include intangible indicators of performance we have combined the leading as well as lagging indicators of evaluating suppliers. Based on the classification scheme of Kraljic model we have extended the model and calculated (Column-5, Table 4) importance of different parts suppliers. Then individual supplier's weight in terms of importance was calculated by comparing the individual weight with the overall weight (Column-6). This individual weight was multiplied with percentage defectives and the Focus Index of all suppliers was calculated. Focus Index of individual Suppliers was added to develop the aggregate focus index. This aggregate focus index was subtracted from 1 to get the Composite SNQI. This SNQI is helpful in comparing one company from its competitor company. SNQI also will be helpful in comparing supplier network of one organization with that of another. This SNQI is also useful for an organization comparing its own supplier network at two different points in time.

Limitations and Future Scope

The proposed models are mainly related to the industry in manufacturing sector and any other such sector which need to manage inventories and have strong supplier base. The study will be mainly applicable to organization which maintain physical inventories and depend on suppliers for their items so that final product could be produced. Thus sectors like automobile, FMCG and retail will find these models very useful.

The process of assigning weights to different factors makes the process subjective. However efforts could be made to reduce the subjectivity to the extent possible. Subjectivity can be reduced by using the technique called Analytic Hierarchy Process (AHP) which can simplify the rating process by freeing the rater from the problems of assigning weights to different factors. Through pair wise comparisons of all suppliers and of the various factors, AHP reduce the subjectivity while the evaluation is in progress. However AHP would have to carry out pairwise comparisons for many factors, thus the procedure will become a bit stretched and cumbersome for the evaluator.

The technique was applied for an illustrative example. Validation and application in a real world setting is required, although we have got it validated by making a presentation and taking feedback before one of the leading manufacturing organization and executives having corporate experience. There are many additional opportunities to further integrate other modeling tools into this process. Managers can use this technique to help them more effectively deal with suppliers. The suggested portfolio is a good tool for operational and strategic management of suppliers.

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