International Journal of Engineering Research ISSN:2319-6890)(online),2347-5013(print)
Volume No.5 Issue: Special 2, pp: 371-373 11-12 Feb. 2016

Prioritising and Ranking of Factors Affecting Supplier on-Time Delivery

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Abstract : Supplier delivery performance is low leading to production, market and customer goodwill loss. Objective of this study is to realize that the supplier on-time delivery is affected by both buyer and supplier processes and toidentify those elements of the buyer and supplier processes that affects the supplier on-time delivery. Weighted cause-effect matrix was developed and ranking of the most critical parameters affecting on-time delivery is attributed to both buyer and supplier processes.

Keywords- Supply chain, On-time delivery, delivery performance, delivery window.

I. Introduction

The term supplier is defined as a person, company, organization or country that delivers product or service to the customers [1], [2]. These product or services are delivered to customers who buy and use them.Supply chain is a set of organizationsin which a continuous flow of products, services, finances and information from a source to a customer takes place.It is defined as the process through which a company creates and distributes its products and services to the end user. It includes a number of functions such as production planning, material sourcing, transportation management, warehouse management and demand management. All these functions are integrated with each other and aimed to provide the products and services to the end user in an efficient, timely and profitable manner.Nowadays, increased competition in the market forquality, time, cost and other facts have forced organizations to pay special attention to the supplier and supply chain issues [3].Supplier's ability to provide satisfactory quality, quantity, delivery, stock exchange information is part of communication build between buyer's and the supplier's organization[4].

As about 60% price of finished goods consistsof raw material and parts purchased from suppliers, the importance of supplier management and its performance is an ongoing problem. Therefore to remain competitive in market, to meet standard requirements and also continuous improvement in business, companies need to monitor the performance of their supplier. Delivery performance is one of the most important indicators of supplier performance [5].

The timeliness of delivery is a key concern to the customers.Supplier delivery performance is based on the concept of the delivery window, which is defined as the difference between the earliest acceptable delivery date and the latest acceptable delivery date [6].On-time delivery plays an important role in the operation of the supply chain. Supplier delivery performance is critical to enabling the buyer's organization to meet its customer requirements [7].Supplier on-time delivery measures the amount of finished goods or services delivered to customers on time and in full. It helps in determining how efficiently we are meeting the deadlines. If the supplier delivery performance is too low or below the benchmark it means there are some bottlenecks, inefficient or time consuming processes in the supply chain which are not adding any value to it [8].

Generally the purchase orders are classified in two types: regular orders and high priority orders. The regular ordershave the longer cycle times, looser target due dates but lower margins, while the high priority orders have shorter cycle times, tighter target due dates and higher margins. If the deliveries of high priority orders are late, it will affect the buyer's organisation to a very large extent [9].

The manufacturing organisations buy as much as 75% or more of their products from suppliers, so the chances for supplier failures are more. However, the supplier failures frequently are not the reason material are missing when needed, usually, the failures are induced itself by the buying organisation [10].

II. Material and Methodology

Supplier On-time Delivery

The supplier on-time delivery is defined as the ratio of the number of on-time delivered parts (with flaw less match of quality, quantity and price as quoted in purchase order and invoice) to the total number of parts ordered [v].

It helps in determining how efficiently supplier is meeting the agreed deadlines.

$$\text{On-time delivery} = \frac{\text{Number of on-time delivered parts}}{\text{Total number of parts ordered}} \quad \text{- - - - - - - (1)}$$

$$\%\text{On-time delivery} = \frac{\text{Number of on-time delivered parts}}{\text{Total number of parts ordered}} \text{ X 100- -- (2)}$$

Delivery window

Supply chain delivery performance models are based on the concept of the delivery window, which is defined as the difference between the earliest acceptable delivery date and the latest acceptable delivery date [6].

Production requirements and cash flow are the two main factors affecting the on-time delivery window. If a particular delivery is expensive, its delivery may be planned very close to the production so it cannot be late. Also as it is expensive it cannot be early as well, so a tight window is appropriate. If an item is inexpensive and planned in bulk (e.g. floor stock of screws) it can arrive within a very wide window and be considered on-time. Common delivery window sizes are -5+0 for A Class items, -5+1 for B Class items, and -10+5 for C Class items. It is critical to note that these windows must be coordinated with the planning lead times in MRP. You cannot have +5 day window for C Class items if the MRP is driving C Class items to arrive on the day of need.

When an order is placed, a fixed delivery date is given to the supplier by the customer. Under the concept of a delivery

ISSN:2319-6890)(online),2347-5013(print)
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window, the customer supplies benchmarks in time which are used to classify deliveries as being early, on-time, and late. The delivery window curve is as shown in figure 1 below:

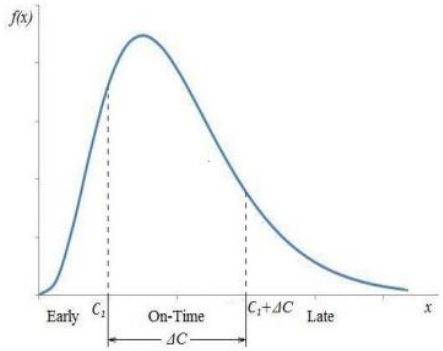

Figure 1: Illustration of Delivery window

Where,
x = Delivery lead time.
f(x) = probability density function (pdf) of delivery time,
C1 = beginning of on-time Delivery,
ΔC = width of the delivery window.

Ideally, $\Delta c = 0$.
However, the extent to which $\Delta c > 0$ may be measured in hours, days, or weeks depending on the industrial situation.Early deliveries contribute to excess inventory holding costs while late deliveries may contribute to the market, production and customer goodwill loss. These costs have been characterized as "penalty costs" that are incurred in addition to the normal operating costs of the supply chain and are hence considered to be forms of waste. When a delivery is within the on-time portion of the delivery window, no penalty cost is incurred.

III. Results and Discussions

The delivery data of suppliers of 8 categories (Manufacturing, fabrications, bearings, pneumatics, hydraulics, electrical, fasteners and name plates) is collected for the period on 9 months i.e. April-2015 to December-2015. As the computer database does not allow the accurate measurement of supplier delivery performance, the data for the study is collected manually by reviewing completed orders and the related documentation at the end of each month during the sample period.The % On-time delivery of these supplier's is calculated by using formula given by Eq. (2).The %OTD data suppliers of various categories for the period of 9 months is as shown in Table 1 below:

Table 1: %OTD of suppliers of various categories

	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15
MANUFACTURING	54%	62%	61%	60%	59%	61%	58%	61%	60%
FABRICATION	63%	55%	62%	58%	56%	59%	57%	58%	53%
BEARINGS	57%	61%	50%	56%	56%	50%	67%	53%	50%
PNEUMATICS	58%	50%	57%	52%	64%	51%	56%	58%	57%
HYDRAULICS	53%	57%	62%	50%	52%	56%	52%	59%	57%
ELECTRICAL	64%	61%	63%	58%	60%	52%	57%	62%	57%
FASTENERS	62%	62%	56%	56%	57%	60%	61%	64%	58%
NAME PLATES	73%	75%	70%	65%	68%	74%	71%	68%	70%

The graphical representation of the Category wise %OTD per month for period of 9 months is as shown in figure 2 below:

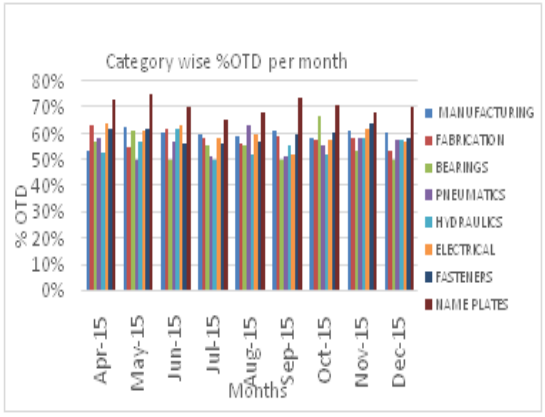

Figure 2: Category wise %OTD per month

The graphical representation of the %OTD vs supplier category is as shown in figure 3 below:

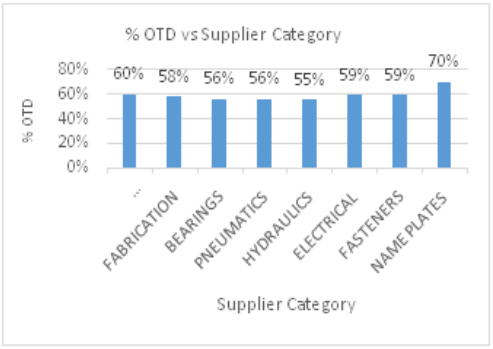

Figure 3: % On-time delivery vs supplier category

From the above graphs, we can observe that the %OTD of all the categories over the period of 9 months is very low. The range of %OTD is between 50% to 75%. The %OTD for all the categories except Name Plates are below 60%.

Factors affecting Supplier on-time delivery

Through analysis, it is observed that the supplier on-time delivery is affected by both the buyer and the supplier processes. This can be viewed as a problem as well as an opportunity to improve efficiency and effectiveness of the system. In order to improve the supplier on-time delivery we must find out, analyse and eliminate these factors.

Cause-effect diagram

The cause effect diagram of factors affecting supplier on-time delivery is as shown in figure 4 below:

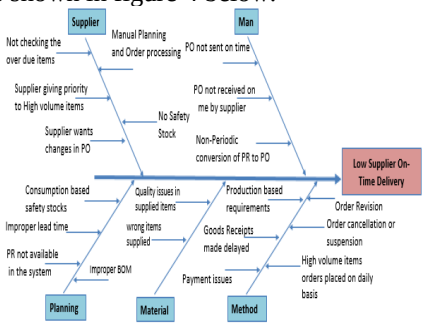

Figure 4: Cause-effect diagram of factors affecting supplier on-time delivery

ISSN:2319-6890)(online),2347-5013(print)
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Weighted Cause -effect Matrix

Using the factors affecting delivery performance above a weighted cause-effect matrix is developed which assign a weights to the root causes on criteria such as ease of implementation, cost impact and controllability.

The objective is to rank and prioritize these factors. The weight of each root cause is calculated through interview session involving purchasing, inventory control, end user and supplier. For weights, the bigger the weight, the bigger the risk of having the problem.

The cause effect matrix is as shown in the Table 2 below:

Table 2: Weighted cause-effect matrix of factors affecting supplier on time delivery

	Rating of Importance	6	9	3	
		1	2	3	
	Importance of Factors affecting Supplier On-Time Delivery	Ease of Implementation	Cost Impact	Controllable	Total
SRN	Factors				
1	Improper BOM	9	9	6	153
2	PR not available in the system	6	3	3	72
3	Non-Periodic conversion of PR to PO	3	6	3	81
4	PO not sent on time	6	3	6	81
5	Improper lead time	9	9	6	153
6	Consumption based safety stocks	6	9	6	135
7	Production based requirements	9	9	3	144
8	Order Revision	3	3	3	54
9	Order cancellation or suspension	3	3	3	54
10	High volume items orders placed on daily b	6	3	6	81
11	Goods Receipts made delayed	3	6	6	90
12	Payment issues	6	3	6	81
13	PO not received on time by supplier	9	6	6	126
14	Manual Planning and Order processing	6	3	3	72
15	No Safety Stock	6	3	3	72
16	Not checking the over due items	9	3	3	90
17	Supplier giving priority to High volume item	3	9	3	108
18	Supplier wants changes in PO	3	3	3	54
19	Quality issues in supplied items	9	9	6	153
20	wrong items supplied	9	9	6	153

As shown in the above weighted cause-effect matrix, the factors havingtotal sum greater than 100 are considered to have more risk and these factors must be eliminate first in order to improve the supplier on-time delivery.

IV. Conclusion

The on-time delivery performance of the suppliers of various categories for the period of 9 months is calculated. The elements of both buyer and supplier processes affecting supplier delivery performance are identified. Weightages are given to these factors to determine their rank and priority.

Acknowledgement

Authors are thankful to the Mr. Anil Pande, Divisional Manager (MTD- Purchase Department), TAL Manufacturing Solutions Ltd., Pune and College of Engineering, Pune for the support.

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