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## The significance of supplier performance management in quality improvement – a case of construction equipment manufacturing

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**Abstract:** The competitive market situation of today's global marketplace is undergoing changes. Customers demand more variety, better quality, and greater service in terms of reliability and response time. The success in this situation is very much determined by how a company forms the entire system, mainly focusing on supplier management. A supplier plays a very imperative role as the product cost, quality, and service deliverables as they are highly dependent on the supplier performance. Besides cost and quality, an efficient delivery that can respond quickly to the customer demand is also an important issue in the customer-oriented economics nowadays. The need for the development of rudimentary but effective supplier selection method and its implementation is required to improve the product quality and delivery performance, which in turns increases the customer satisfaction. This work presents a development of supplier selection and performance management framework in a construction equipment manufacturing company. The problem of customer rejection due to suppliers has been significantly reduced; almost 60% reduction whereas improvement in production delay due to non-availability of purchased material is excellent. In the past, almost production was stopped but after implementation, it has been seen hardly interrupted. The problem is reduced to only 1%.

**Keywords:** supplier management; supplier performance monitoring; supplier selection; quality management; quality improvement.

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## **1 Introduction**

Supplier selection and performance monitoring is imperative process meant for building effective interactions in the company's system. The overall goal for selection criteria is to make suppliers more competitive and increase sense of ownership towards better product development and quality (Atousa et al., 2017). Purchasing process is the fundamental part of organisation, be it manufacturing organisation or service provider, and it has the primary responsibility of supplier selection. In the extremely diffident environment, it is difficult to manufacture products or deliver services at low-cost with high-quality without the support of proficient suppliers (Weber et al., 1991). Supplier selection and performance management become significant for organisations to grow healthy and mutual beneficial affiliation with their suppliers to form active system which can produce quality outputs (Lee and Wellan, 1993).

Generally, any organisation has processes such as sales, planning, production, purchasing, finance, quality control, etc. The system is the integration of these processes. It helps the organisation to achieve customer requirements, at lowest cost and highest quality (Hahn et al., 1990). Interrelation of processed, called as departments at broader level, is termed as a supply chain. It is from purchasing of material to delivering the finished products to the customers includes manufacturing of a product as well. Purchasing has a substantial role in organisation as it is key link of supply chain and an unavoidable part of the organisation especially in the manufacturing industry also it typically represents 40% to 60% of the sales of its end products (Bhutta and Huq, 2002). It becomes the input to the organisation manufacturing processes. If the input is bad then the output will be bad also. Hence, controlling and monitoring of suppliers becomes more valuable in improving and maintaining the quality level (Modi and Mabert, 2007).

This research paper anticipates offering practical criteria and the procedures for the supplier selection and performance monitoring process which can improve the product quality and customer satisfaction. The proposed method aims to reduce complexity in the supplier management process and makes easier to understand implications of suppliers' performance, on time delivery and quality of parts, on other processes.

## **2 Literature review**

Manufacturing organisations have to produce products as per customer requirements include technical specifications or based on market demand. It is very important to control the manufacturing process including the supply chain, along with manufacturing process parameters are continuously monitored (Radej et al., 2017). There is a material stream between suppliers and the manufacturing organisation (Figure 1), where quality management including supplier performance monitoring has to be implemented in order to guarantee final product quality as per customer requirement (Pavlínek and Janak, 2007).

To provide quality products and services to the manufacturer as per requirements is become more important as a point of quality management; otherwise, it becomes a case of quality improvement (Doshi and Desai, 2014). The stronger the supply chain, the output product will be stronger in quality. Supply chain quality management (SCQM) is concept and it is combination of supply chain management and quality management (Lin

and Gibson, 2011). It is amalgamation of business processes with all suppliers' processes. The aim is to build value and accomplish the satisfaction of internal as well as external customers by continually improving products and processes (Robinson and Malhotra, 2005). Improvements in supply chain improve resource utilisation, improve process efficiency and reduce the cost (Wang et al., 2004). There are some studies that investigate how the quality management can be used to improve the performance of the entire supply chain and inclusive solve some problems within the supply network (Lin and Gibson, 2011); and other studies that identify various theoretical and methodological characteristics of the way in which knowledge management applications are proposed in the supply chain context (Robinson and Malhotra, 2005). Quality management helps in cultivating culture of supportive learning along with knowledge sharing within supply chain; hence, it improves supply chain performance and satisfaction (Mahour, 2013). Weber et al. (1998) defined three methods for selecting and monitoring of suppliers. Additionally, they clarified how two multi-criteria analysis tools, can be used simultaneously for this process of selection and monitoring of suppliers under some circumstances. This consists of three main goals: minimising the net cost, reducing the net rejections, and minimising the net late deliveries depending on realistic restrictions over customer's demand, vendor's capacity as well as quota flexibility, purchasing value of items, allocating the budget to the individual seller, etc. (Saeid et al., 2018). Quality control tools such as fishbone, root cause analysis, SPC, etc., are simple, yet effective QC tools for continuous improvement. These QC tools aim to improve quality performance such as reduction in internal rejections, reduction in customer-end rejections and ultimately improve customer confidence for organisation's product (Doshi et al., 2012). The use of these tools can also be encouraged to suppliers to improve their performance and monitor them properly. However, there still some issues that remains unexplored (Yeung, 2008). Marra et al. (2012) also recommend a detailed understanding of quality practices along the supply chain and the association between quality practices and a system's overall performance. This case also needs to focus on supplier management to improve their performances and improve overall quality improvement in manufacturing company.

**Figure 1** Supply chain (see online version for colours)



### 3 Approach – a case study

Types of the case study can be classified as exploratory, explanatory and descriptive (Doshi and Desai, 2016). The exploratory stage comes before the theory-building stage

and seeks to ‘uncover areas for research and theory development’ (Voss et al., 2002). The advantages of the case study approach at this stage of research include the ‘exploratory depth’ of understanding that can be achieved (Meredith, 1998). The combination of exploratory and explanatory research is appropriate here as enough is known about supplier management but little or no work has been carried out in the road construction equipment manufacturing industry to improve quality.

#### 4 Research problem

Road construction equipment industry is one of the sectors in which suppliers have significant impact. Several types of suppliers ranging from general utilities to large plant equipment are involved for manufacturing such machineries. A case company is the manufacturer of road construction equipment, as well as they, provide support for installation and commissioning. Their products are drum-mix plants, wet-mix plants, pavers, etc. The road construction is a much-unorganised sector. Due to the large product, they follow the group manufacturing process where various components are fabricated separately; critical components like motors, engines, burners, etc., are bought out and then assembled. Hence, a case company is highly dependent on suppliers to achieve required quality levels and deliver the product on time.

A case company has encountered high customer rejections and complaints of delay in the past, as presented in Table 1 and become the point of panic. The delay data and rejection reasons indicate the suppliers are the weak link as well as their own processes of monitoring suppliers.

**Table 1** Past data

<i>Sr no.</i>	<i>Problems</i>	<i>Unit</i>	<i>Month 1</i>	<i>Month 2</i>	<i>Month 3</i>	<i>Month 4</i>	<i>Month 5</i>	<i>Month 6</i>	<i>Avg.</i>
1	Final rejection (customer end)	%	8.1%	10.1%	8.5%	12%	7.2%	5.2%	8.5%
2	Delay in delivery due to supplier delay	%	25.2%	20.5%	22.0%	21%	20.3%	18%	20.6%

#### 5 Research methodology

A case study approach has been selected for this study. The first step identified is to study the problem in detail and to identify root causes. Root cause analysis has been carried out by the cross-functional team (CFT) through five why technique. Based on the root causes identified, the solution to the most critical cause is to be identified and implemented. That is to develop and implement supplier selection and evaluation process followed by its implementation. The next important step is to data gathering and analysis to measure the impact on quality improvement. The graphical representation of the methodology is presented in Figure 2.

**Figure 2** Methodology (see online version for colours)

## 5.1 Case study implementation

### 5.1.1 Root cause analysis

The CFT has been formed to identify the solution to the problem stated above. The CFT consist of members from production, quality control, purchase, sales, and maintenance functions. The fishbone method has been used to identify the root cause of the problems. Figure 2 shows the fishbone analysis results conducted for the rejection problem. After the detailed brainstorming session, CFT has concluded following solution.

- standardisation of purchase process
- to develop and implement supplier selection and performance monitoring process
- training to the purchase team.

### 5.1.2 Standardisation of purchase process

To simplify and standardise the purchase process, the contracts with suppliers are categorised as fixed quantity contract, rate contract, running contract (open order) and cash purchase, so the purchase can be simple and specific. Another step finalised is to issue a purchase order in all type of contract, except cash purchase. The purchase order must have a full description of the item with detailed specifications, required delivery date, testing requirements, cost, and taxes.

### 5.1.3 Development of supplier selection and performance monitoring method

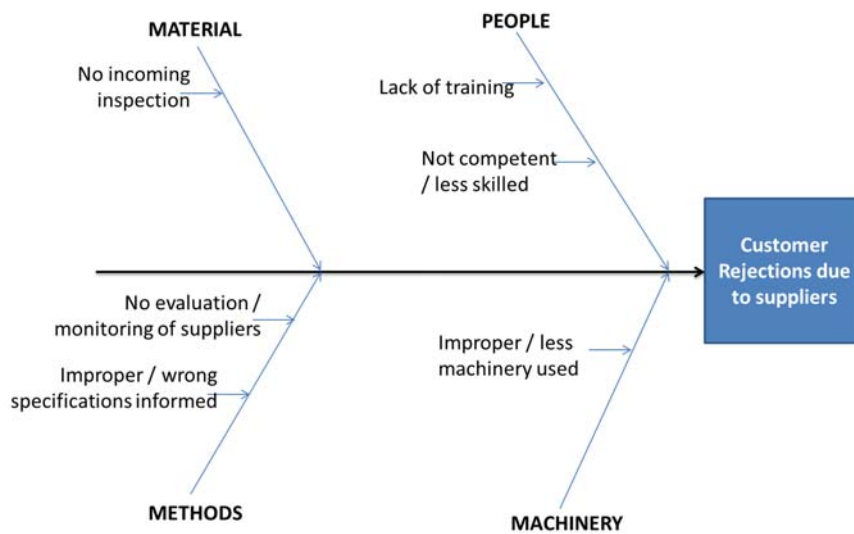
Considering the product characteristics, nature of the business and following standard industry process, the new supplier evaluation, and selection process has been developed in the organisation. Figure 3 represents developed supplier selection and performance monitoring method. The process is divided into two parts, new supplier selection, and supplier performance monitoring regularly.

Supplier selection process consists of the identification of new supplier, their initial evaluation, and approval. The need of a new supplier may arise from the poor performance of existing suppliers, new product or a change in design, change in technology, etc. Accordingly, the purchasing team has to identify potential suppliers available in the market.

On identification of potential suppliers, it is very important to assess their ability to provide the required quality of product or service at the required time. The cost of supply, capacity and its reputation are also important parameters to be assessed. If found satisfactory, then next will be to visit his manufacturing facility to check their technical

competence and their quality management system. Next step will be to provide a trial order to verify its quality and delivery performance. If the performance found satisfactory the regular orders can be given to that supplier. The important is not to stop the monitoring of the performance of the supplier after initial evaluation as the quality of product and services has to be maintained consistently and continually. Hence, the supplier performance monitoring process has been adopted as below.

**Figure 3** Fishbone diagram for customer rejection (see online version for colours)



Supplier performance shall be monitored for quality of product supplied, quantity supplied against required and delivery of product as per required. The following are the formula for calculating performance.

- Quality performance

The quality performance is the ratio of the number of goods received as per specification to the quantity ordered.

$$\text{Quality performance index (QaP)} = \text{Qa} / \text{Qs} * 100$$

where

Qa quantity accepted as per specifications.

Qs quantity supplied.

- Quantity performance

The quantity performance is the ratio of the number of goods received to the quantity ordered.

$$\text{Quantity performance index (QP)} = \text{Qr} / \text{Qo} * 100$$

where

Qr quantity received.

Qo quantity ordered.

- Delivery performance

The delivery performance is the ratio of the agreed lead time to the actual lead time.

$$\text{Delivery performance index (DP)} = \text{Lt} / \text{la} * 100$$

where

Lt agreed on lead time.

La actual lead time.

- Overall performance

It is to be calculated by giving weightage to the three performance parameters as below.

a quality performance: 60%

b quantity performance: 20%

c delivery performance: 20%.

$$\text{Overall Performance Index} = 0.6 * \text{QaPI} + 0.2 * \text{QP} + 0.2 * \text{DP}$$

The classification criteria have been also defined for suppliers to categories them and it will also help them to improve their performance. The criteria are shown in Table 2.

**Table 2** Classification criteria for supplier performance

<i>Grading</i>	<i>Criteria</i>	<i>Classification</i>
Grade A	Greater than 90%	Excellent
Grade B	81–90%	Satisfactory
Grade C	71–80%	Needs improvement
Grade D	Less than 70%	Not satisfactory-supplies to be suspended

## 5.2 Implementation and analysis of data

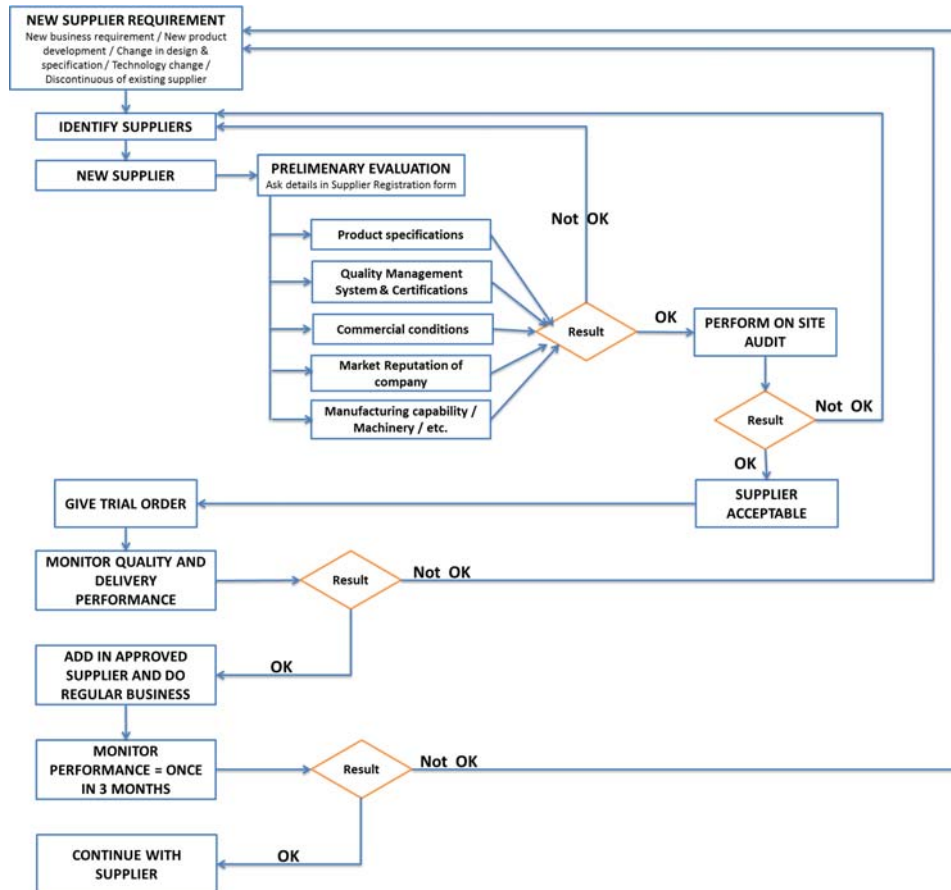
As discussed in the above topics, the supplier selection and evaluation process and supplier performance monitoring system have been developed. Also, the purchasing process has also standardised. The lots of efforts have been put on to develop those systems but it is very necessary to know how effective they are. The developed systems have been implemented for six months and data has been collected.

**Table 3** Data analysis

<i>Sr no.</i>	<i>Process</i>	<i>Result</i>
1	No. of supplier passed through supplier selection and evaluation process	12
2	No. of new suppliers selected	4
3	Purchase order raised	32
4	Number of supplier's performance monitored (vendor rating)	15
5	No. of material inspected at incoming stage	52

The brief data analysis is as in Table 3.

**Figure 4** Developed supplier selection and performance monitoring process (see online version for colours)



## 6 Results

The result of the development and implementation of supplier management system is very superior; the same is evident from Table 4. The problems whose initiate this work have been significantly decreased. The problems of rejection due to purchased material from the customer are reduced significantly. Same way delay in production is also decreased effectively as suppliers are being monitored for their delivery and quality performance. The significations result data are presented in Table 4 and Figure 4. The problem of customer rejection due to suppliers has been significantly reduced; almost 60% reduction whereas improvement in production delay due to non-availability of purchased material is excellent. In the past, almost production was stopped but after implementation, it has been seen hardly interrupted. The problem is reduced to only 1%.



**Table 4** Improvement in problems

Sr no.	Problems	Before implementation					
		M1	M2	M3	M4	M5	M6
1	Final rejection (customer end)	8.1%	10.1%	8.5%	12%	7.2%	5.2%
2	Delay in delivery due to supplier delay	25.2%	20.5%	22.0%	21%	20.3%	18%
Sr no.	Problems	After implementation					
		M7	M8	M9	M10	M11	M12
1	Final rejection (customer end)	8.5%	8.0%	6.5%	4.5%	3.0%	2.5%
2	Delay in delivery due to supplier delay	15%	12%	8.0%	6.0%	3.0%	1.0%

**Figure 5** Improvement in problems (see online version for colours)



## 7 Conclusions

This research presents a case study to demonstrate how the effective introduction and implementation of supplier management process, especially supplier evaluation and selection in construction manufacturing, can lead to a detailed monitoring of supplier capacity and performance to improve quality. The supplier evaluation and selection problem are of vital importance for the operation of every organisation because the solution to this problem can directly affect quality and customer satisfaction and substantially affect cost. Effective supplier management, supplier selection to supplier performance evaluation, is critical success factor for organisation. Ample amount of work has been conducted to determine what process along with parameters should be used to select suppliers and to appraise supplier’s performance. In actual practice, parameters must be selected based on the real-life limitations to ensure supplier management process helps in decision making and continual improvement. Since this has been the first ever exercise carried out in the selected case company, defining continuous quality improvement became difficult. It is recommended for the future to carry out such exercise at least three or four times each year for continuous improvement and then some concrete framework may be drawn up for continuous improvement.

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