

Improve the Quality Level of Purchasing Based on Six Sigma

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Abstract: Purchasing management is a quite important link in the supply chain management. The quality level of the purchasing process would affect the quality level of the supply chain directly. Therefore, improving the level of quality of the purchasing process must be significant for enhancing the quality level of the supply chain. In this paper, Six Sigma approach is applied in purchasing quality management. It uses five steps, called DMAIC defined in Six Sigma, to define, measure, analyze, improve and control the quality of the purchasing process aiming at enhance the quality level of the purchasing process.

Keywords: Six Sigma, purchasing process, quality level

1 Introduction

1.1 The significance of the research

Purchasing is a process that through the exchange of commodities and logistics to obtain resources from the resource market. Purchasing, as an important link in the supply chain, the quality of it will directly affect the level of following production and sales activities. The data shows that 20% -25% of defect of products is due to the unqualified goods in purchasing. Obviously, the quality of purchased materials directly restricts the quality of the final product and the quality level of the whole supply chain. Therefore, to strengthen the quality of purchasing process management is an important measure to ensure the quality of products and to meet customers' needs.

1.2 Literature review

There are many researches about the application of Six Sigma to the quality management in and out of the country, but researches on how to control the quality during the process of purchasing are less. In this paper, in order to enhance the level of the quality of purchasing, how to form a means to take the purchasing quality under control based on Six Sigma will be discussed.

Roger G. Schroeder and Kevin Linderman (2008) propose that the Six Sigma structure for quality management helps organizations more rigorously control process improvement activities. Zu and Fredendall (2008) make a study reviewed both the traditional quality management and Six Sigma literatures and identified three new practices that are critical for implementing Six Sigma's concept and method in an organization. Chakravorty (2009) develops an effective implementation model which consists of six steps.

2 The Basic Principle of Six Sigma

2.1 The origin of Six Sigma

The name of Six Sigma comes from the statistics. Sigma (σ) is used to describe the extent of the individual deviating from the mean in the population. Six Sigma is a target which means that 99.99966% of products are qualified in all the processes and results. It can be seen, Six Sigma is a quite high level of quality. However, this is just the statistical explanation of Six Sigma. Actually, the meaning of the Six Sigma management is already far beyond its statistical significance.

2.2 Quality management based on Six Sigma

Six Sigma is described as a methodology and an approach that can make improvement in product quality. When it is implemented, there must be a process. So Six Sigma defined the process as DMAIC. In short, DMAIC is the process model for Six Sigma. The meaning of the letters are define, measurement, analysis, improvement and control.

In the quality management of purchasing, the application of Six Sigma is reflected in five aspects. In the definition phase, the core business procedures of the purchasing process should be defined. What's more, the output and the key customers have to be confirmed. Then we can drop the map of core business procedures and the map of organization system model (the map of SIPOC). In the assessment phase, according to customers' needs, first, we can evaluate the performance of the purchasing process. In the analysis phase, we should make analysis of past and present business data, and then set a clear quality improvement objectives based on Six Sigma. Second, by analyzing the key problems obtained in the assessment phase we have to make some causal hypotheses. Last, the key points in the process should be defined. We ought to identify the exact causality through the business collected data. In the improvement phase, we should propose and implement solutions to the problem, and then design and implement the new workflow. Finally, in the control phase, all the members take measures to maintain the improved level of quality to ensure the quality level stable in a long term.

3 The Implementation of Six Sigma Approach

In order to explain the specific application of Six Sigma approach, the QS Food Company will be taken as an example to illustrate the five phases of DMAIC specific measures. The main products QS Company purchased are raw materials and various auxiliary materials. The Company has the ERP system and each procurement data is inputted into the database. Therefore, the company has the condition to implement the Six Sigma management with abundant data.

3.1 The definition phase

In the definition phase, the main task is to identify the core business processes and key customers, and then draw a map of core processes and a map of SIPOC.

3.1.1 The identification of core business processes

The core business processes of purchasing include four steps. They are the forecast of materials demand, the search of right suppliers, the formation of a purchasing contract and the implementation of the contract. They are shown in Figure 1.

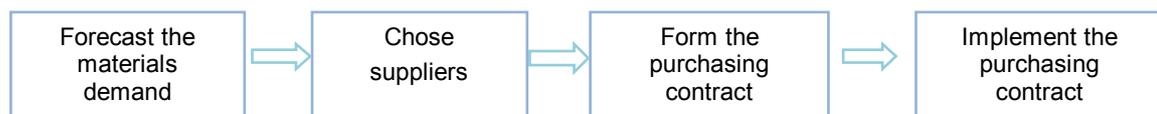


Figure 1: the core purchasing processes

3.1.2 Define customers and identify customers' needs

Throughout the purchasing process, customers include external and internal customers. External customers are often referred to the ordinary consumers, while internal customers primarily refer to internal quality and manufacturing sectors.

Companies through interviews, questionnaires and other forms to collect customer demand information. So they can know that customers' needs for purchasing department include timely arrival, accurate quantity and qualified products and the lowest possible cost.

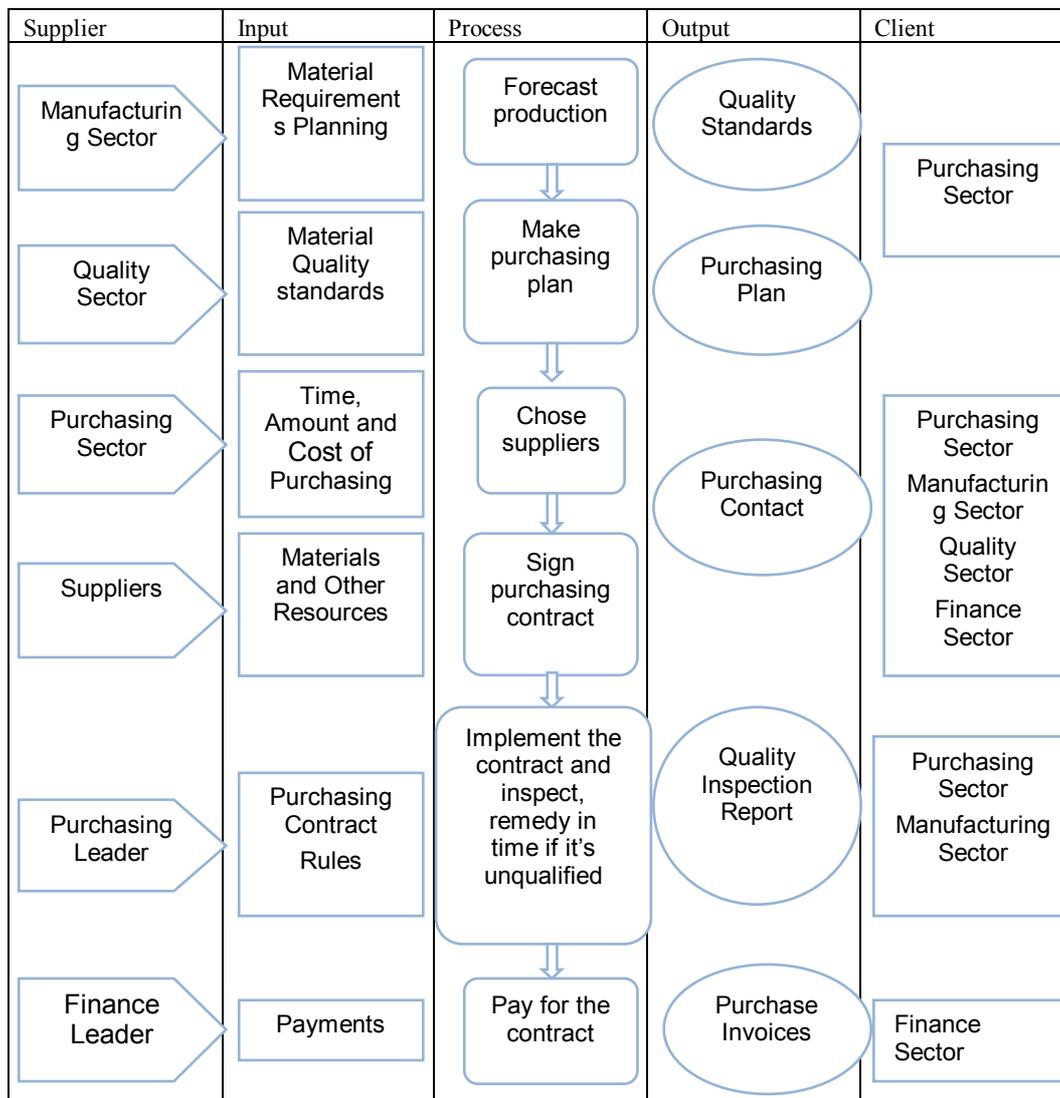


Figure 2: the map of SIPOC of purchasing process

3.1.3 The map of SIPOC

SIPOC model is a commonly used techniques proposed by Deming. It is an organizational system model and commonly used in process management and technology improvement. Each letter refers to supplier, input, process, output and client. Deming points out that any organization is a system that consists of supplier, input, process, output, and customers.

Supplier is the organization that provides the critical materials or other resources to the core processes. There may be many suppliers in one of a process of a company, but who plays an important role in creating value is just the supplier who provides the key things. Input is the resources provided by suppliers. In SIPOC map, there are usually clear standards for input. Process is a set of activities that change input into output. Organizations pursue that through this process the input value can be increased. Output is the result of process which is product. The requirements for output will be clarified. Customers can be individuals, organizations and processes who receive the output, including not only external customers, but also internal customers.

Figure 2 shows the map of SIPOC of purchasing process of QS Company.

3.2 The assessment phase

In the assessment phase, the key problem is to evaluate the performance of the purchasing processes in accordance with customers' needs.

3.2.1 Identify the object of the evaluation

The main materials of QS Company are flour, sugar, peanuts and packing materials. So we can evaluate the performance of the purchasing processes in terms of these four kinds of materials.

3.2.2 Determine the method of evaluation

We use the method called Defects per Million Opportunity (DPMO) to evaluate the performance. It means how many opportunities of defect happen in one million opportunities. Defect is that the results of the product, service or process do not meet customers' requirements. The number of opportunities of defect is the amount of defects may occur in products, services or process.

During the process of purchasing, receiving the proper quantity of goods in time is the key part of purchasing. In the figure of SIPOC, any problem in any link will cause the defect of the purchasing business. In the process, there are four major opportunities of defect. They are arrival delay, quantity mistake and cargo documentation errors and damaged packaging.

3.2.3 The specific calculation of DPMO

Calculate DPMO according to the purchasing data of QS Company in November 2009. Table 1 shows the data.

Table 1: the purchasing data of November in 2009

materials	Batches	Defect				
		time	number	document	packing	total
Flour	127	4	2	0	1	7
Sugar	45	2	1	0	0	3
Peanut	113	4	2	0	0	6
packing	17	1	0	0	0	1
Accessories	9	0	0	0	0	0
Total		11	5	0	1	

(1)The calculation of DPO

DPO means that the ratio of the number of defects in the total number for each sample.

Flour DPO=7/ (127*4) =0.0137 DPO

Sugar DPO=3/ (45*4) =0.0137 DPO

Peanut DPO=6/ (113*4) =0.0133 DPO

Packing DPO=1/ (17*4) =0.0147 DPO

Accessories DPO=0/ (9*4) =0 DPO

PurchasingDPO =(127*0.0137+45*0.0167+113*0.0133+17*0.0147+9*0)/ (127+45+113+17+9)
=0.0136 DPO

(2) The calculation of purchasing DPMO

DPMO is a calculated result which will be used in the improving activities of Six Sigma. It means the total number of the defects occur in every opportunity in the process. DPMO=DPO*1000000.

Purchasing DPMO in November=0.0136 DPO*1000000=13600 DPMO

(3) Change DPMO to Sigma

The DPMO can be changed to the level of Sigma according to the Sigma Conversion Table. Table 2 is part of the whole conversion table.

Table 2: part of the conversion table

Pass Rate (%)	DPMO	Value of Sigma
93.32	66800	3
97.73	22700	3.5
99.38	6200	4
99.87	1300	4.5

The purchasing DPMO=13600, so the value of Sigma should be between 3.5 and 4 according to the conversion table. Then we can use the method of interpolation to calculate the specific sigma.

$$(22700-13600)/(3.5-\text{Sigma}) = (13600-6200)/(\text{Sigma}-4)$$

The result shows Sigma is 3.78. So the quality level is 3.78 Sigma.

3.3 The analysis phase

In this phase, the main task is to set the improved goal according to the result of the evaluation and then analyze the main problems that cause the defects.

3.3.1 Set the improved goal

If the quality level of a process is between 2 Sigma and 3 Sigma, then it is relative economy to enhance it to the level of 4 Sigma. However, if we want to enhance it to the level of 5 or 6 Sigma, we have to make more efforts and use more complicate tools. The difficulties increased exponentially with the level of Sigma improving. So the improved goal is 4 Sigma.

3.3.2 Analyze the main problems

According to the data of November, draw a map of defect distribution as figure 3.

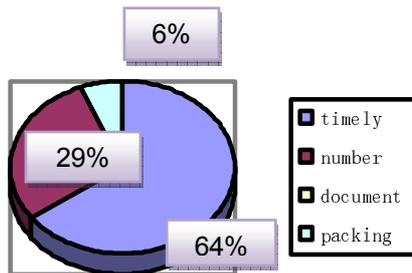


Figure 3 : Defect distribution of materials in purchasing

It can be seen that the defect of timely purchasing is the major problem of the entire purchasing process. There are many reasons that cause the timely purchasing defect, including the purchase order errors, supplier issues, transport errors, delivery errors and other reasons. To improve the quality level, it is urgent to make efforts in these areas to reduce timely purchasing defects and improve the performance of the purchasing.

3.4 The improvement phase

According to the goal and the main problems gotten in analysis phase, we ought to propose an approach to improve the quality level of process.

The factors resulting in purchase order errors, transport errors and delivery errors include mistake of purchasing sector, supplier failures, transportation failures and other kinds of effects (such as weather, etc.). Aimed at solving these potential errors, the corresponding solutions are shown in Table 3.

Table 3: solutions to potential errors

Defect	Reason	Solutions
Timely defect in purchasing	Mistake of purchasing sector	1. According to the production plan from the manufacturing sector, the reasonable production lead time should be determined. 2. Improve the ability of the member of purchasing by training, etc. to improve the professional level.
	Supplier failures	1. Choose reputable suppliers and build up long-term relationship with them. Then assess their level of service on schedule. 2. Make regular communication with suppliers to know their actual supply capacity, and then arrange purchasing reasonably.
	Transportation failures	Select the transport company of high reputation and strong transport capacity or sign long-term contracts with third party logistics companies with the high quality of service.
	Others (such as weather)	In order to solve some sudden and unexpected issues ,we can raise the material re-order levels or increase the purchasing lead time appropriately

3.5 The control phase

In the control phase, all members of the organization should work together to take measures to maintain the improved level of quality to ensure the steady improvement of the quality level.

After the implementation of the new improved measures, all members have to make full efforts to carry out the purchasing process in accordance with improved business processes to maintain the steady implementation of the new processes so that the level of the quality will be improved. Meanwhile, with the implementation of improved measures, there may be some new defects and problems, so it will return to the first phase of DMAIC. It means that Six Sigma quality management is a cycle process which can improve the quality of the purchasing process consistently.

4 Conclusion

Purchasing business plays an important role in quality management of the organization and the supply chain. Improving the quality level of the purchasing process is an important guarantee for the following manufacturing, transportation, sales. In the purchasing process, we use the method of Six Sigma management to evaluate and improve the quality level of purchasing processes. With this method, we identify the core purchasing processes, evaluate the performance, analyze the problems, propose and implement the improved measures to make the quality level of purchasing processes improved consistently.

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