

Research Paper

Implementing Six Sigma DMAIC Methodology for Increasing the Competitiveness of SMEs in Ethiopia

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ABSTRACT

Six Sigma has gained wide acceptance as an improvement methodology to enhance the organization competitiveness in market. For SMEs building a competitive advantage is a difficult task. Changes in the economic environment affect the way such entities perceive factors which could help them not only survive on the market but shape their competitiveness. In the period of significant economic turbulence, the factors that play a major role in shaping the competitive market position are company image (product brand) and lower product price. This study uses Six Sigma DMAIC (Define, Measure, Analyze, Improve, and Control) approach as a framework to identify, quantify, and eliminate sources of variation in Meseret Gabi Machinery Metal Works Enterprise in Dessie (Ethiopia). This helps to improve the competitiveness of the enterprise in the market place by addressing the complaints and requirements of the customer continuously.

Keywords: Six Sigma, DMAIC methodology, Competitiveness, Small and medium enterprises (SMEs).

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1. Introduction

Small and Medium Enterprises (SMEs) play an increasingly important role for market growth domestically and abroad, driving sustainable growth in the trading, production and service sectors through attracting investments. SMEs also play an important role in maintaining a healthy balance in the economy and are main job creators in the society [1]. They comprise 33% of workers in low income countries and 62% of workers in high income countries [2]. Furthermore, the development of SMEs seen as accelerating the achievement of wider economy and Socio-economic objectives, including poverty alleviation in developing countries [3]. Even though,

SMEs play a major role in most economies, particularly in developing countries like Ethiopia, still the sustainability of SMEs due to different factor is the major tackle for economic development. According to [4], the problems facing the growth and survival of SMEs in Africa are administrative, operating, strategic, and exogenous factors. As the study conducted in East Gojjam Zone (Ethiopia), of the 650 enterprises considered in the study, 330 (50.8%) were found to be censored (sustained enterprise) and the remaining 320 (49.2%) were found to be terminated or failed enterprises. And the study points out that the main challenges for the sustainability of SMEs in the study area are lack of infrastructure, scares of resources or finance to expand the enterprise, lack of marketing linkage or access, lack of knowledge and poor access to technologies, unfair tax request from the revenue office, and weak support from the government enterprise office [5]. For SMEs building a competitive advantage is a difficult task. Changes in the economic environment affect the way such entities perceive factors which could help them not only survive on the market but shape their competitiveness. The study shows that, in the period of significant economic turbulence, the factors that play a major role in shaping the competitive market position are company image (product brand) and lower product price [1]. This paper is designed to implement Six Sigma DMAIC methodology to increase the competitiveness of Small and Medium size enterprises in Ethiopia.

2. Literature Review

Six Sigma is an innovative method of quality management introduce in Motorola by Bob Galvin and Bill Smith in the middle of the eighties [6] and [7]. Sigma is a notion taken from statistics. It means any standard deviation of the random variable around the mean value. Therefore, Six Sigma means six times the distance of standard deviation. To achieve Six Sigma a process cannot produce more than 3.4 defects per million opportunities. A defect is defined as anything outside the customer specifications [8] and [9]. Generally, Six Sigma is perceived as a philosophy or concept of a broad sense. Using it as a philosophy helps with changing the world and transformation of an enterprise. Treating it as a strategy ensures development and increase the position of the company. It is based on six main principles which should be implemented in companies that want to develop and increase their position on the market. The very first point is concentration on the customer. Every action which is taken should be in agreement with the customer specifications and requirements. Six Sigma is also based on real data and facts which are used to perform a detailed analysis. It is based on continuous improvement of all aspect of functioning development in the organization as well as proactive management and cooperation without boundaries at every level in enterprise. It should be underlined that it is not only an approach for solving the problems with manufacturing but also business processes [10]. Six Sigma is a structured approach and a discipline. DMAIC (Define, Measure, Analyse, Improve and Control) is the most familiar model of Six Sigma to the Industries in general, which is applicable to both product and process industries [11]. DFSS (Design for Six Sigma) is another model aimed at delivering defect free products or process with the focus at the design stage itself.

It is largely applicable for completely new process or product development, or new design to process or product quality when existing process or product quality attained entitlement [12].

Extensive research has been conducted on applying Six Sigma methodology in various areas. Ali [13] propose an integrated Six Sigma-DMAIC and Food Waste Hierarchy based framework for reducing food waste in University Canteen in Ethiopia. John and Areshankar [14] uses Six Sigma DMAIC methodology for reducing the bearing end plate reworks in a machining process. They focus on reducing the rework due to thickness and diameter variation. From the list of identified potential causes tool type and coolant PH are shortlisted as root causes. The optimum values of tool type and coolant PH, which would simultaneously optimize the diameter and thickness, are identified using the design of experiments and Taguchi's loose function approach [14]. Hernadewita et al. [15] applied Six Sigma methodology in magazine producing PT.XYZ Company for improving the quality of printed magazines. Three defect in the production of magazine letters in PT.XYZ are blurry ink color, 582,400 (59%), not correct in the register of 290530 (29%), and newspaper cutting of 116940 (12%). The main factor of the blurry ink color is the color setting of the engine that is less accurate, replenishing the ink volume on the color tank is not suitable for the quantity and the damage plate [15].

3. Motivation and Contribution

Both scale economies and Research and Development (R&D) have become more important instruments for competitiveness in the global economy. Since SMEs seem to be at a disadvantage for both these factors, many experts predicted the demise of SME competitiveness as globalization increased. While some SMEs in high tech sectors can make intensive use of science-based knowledge and are active technology developers, most SMEs operate in medium to low technology environments and innovate without using formal R&D inputs [16]. Furthermore, SMEs especially in developing country has knowledge gap and they operate in a similar way. However, SMEs should strive to improve the product and service quality to be more competitive and sustain in the market. Therefore, introducing a systematic approach to improve the product continuously based on the customer requirements and the competitor's product is essential. Six Sigma is a method for improving performance that focuses on reducing the number of defects in products, processes and services [17] and [18]. Various authors and practitioners implemented and investigated Six Sigma methodology in SMEs and small firms [19]-[26]. This paper uses Six Sigma DMAIC approach as a framework to build and improve competitive advantage of SMEs in Ethiopia.

4. Implementation of Six Sigma DMAIC in SMEs in Ethiopia

DMAIC is the five step approach that comprises the Six Sigma tool kit and its sole objective is to drive costly variation from manufacturing and business processes. The five steps in the DMAIC process include Define, Measure, Analyse, Improve, and Control.

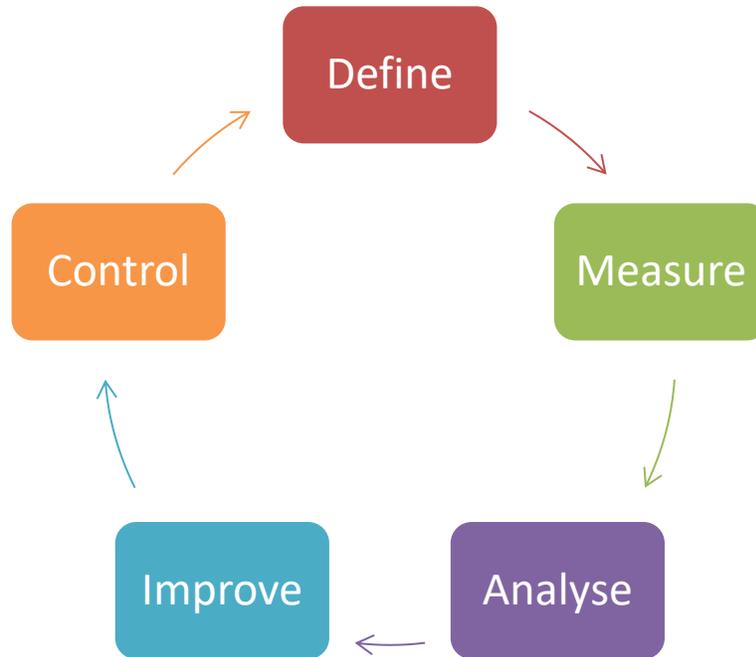


Figure 1. The Six Sigma-DMAIC methodology.

Define Phase. This project is conducted on Meseret Gabi Machinery Metal Works Enterprise located in Dessie, South Wollo, and Ethiopia. The enterprise produces variety of products (Home appliances) based on the order of the customer. For the current project we choose two most frequently produced products of the company: Dough kneading machine and Onion chopper machine. The study starts with a visits to the enterprise to observe the overall conditions of the enterprise and the production process of the selected products. And discuss with the manager and workers about the problems in the production of the machines. As one of the main issue of Six Sigma is to focus on the customers, their needs and requirements has to be defined. The main customers of the enterprise are bread baking enterprises, hotels, and restaurants.

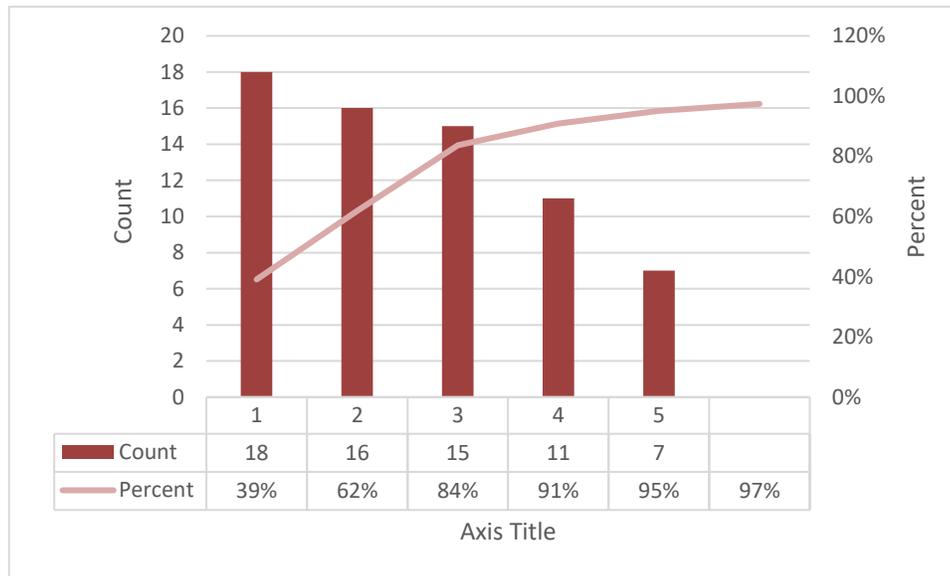
Measure Phase. The researcher discuss with 20 customers of the enterprise in Dessie and Woldia town and customers raised complaints regarding the product. The supplier-input-process-output-customer analysis of the project is provided in *Table 1*. *Table 2* shows customer complaints of the product.

Table 1. SIPOC analysis of the current project.

Supplier	Input	Process	Output	Customer
The enterprise manager	Machines (lathe, sawing, drill, welding, painter)	Part processing	Improved competitiveness	Bakeries
workers		Assembly of parts	Increased customer satisfaction	Hotels
customers		Painting		Restaurants
Raw material suppliers		Delivery of the product		Household

Table 2. Customer complaints on the current product.

No	Complaints	Rate
1	Inefficient blade design for both products.	18
2	Takes long time to prepare the dough compared to competitors product.	16
3	High electric consumption.	15
4	Expensiveness of the product.	13
5	Difficulty to transport the product for maintenance when it fails due to its high weigh.	7

**Figure 2.** Pareto chart to select a focused problem.

Analyse Phase. Compared to the competitor's product and based on the complaints of the customer the blade design for both onion cutter and mixer machine is poor and inefficient. For example for the onion cutter machine the enterprise use knife as a substitute to replace a blade, however specific blade design is necessary to improve the quality of the product and to be more competitive in the market by increasing satisfaction of the customer. In addition to that the

cylinder where the dough is being prepared and the onion is being chopped is 10 mm thick and it is thicker than the thickness of competitor's product and this incur additional cost to the product. Therefore, the design of the cylinder could be optimized to reduce the cost of the product.

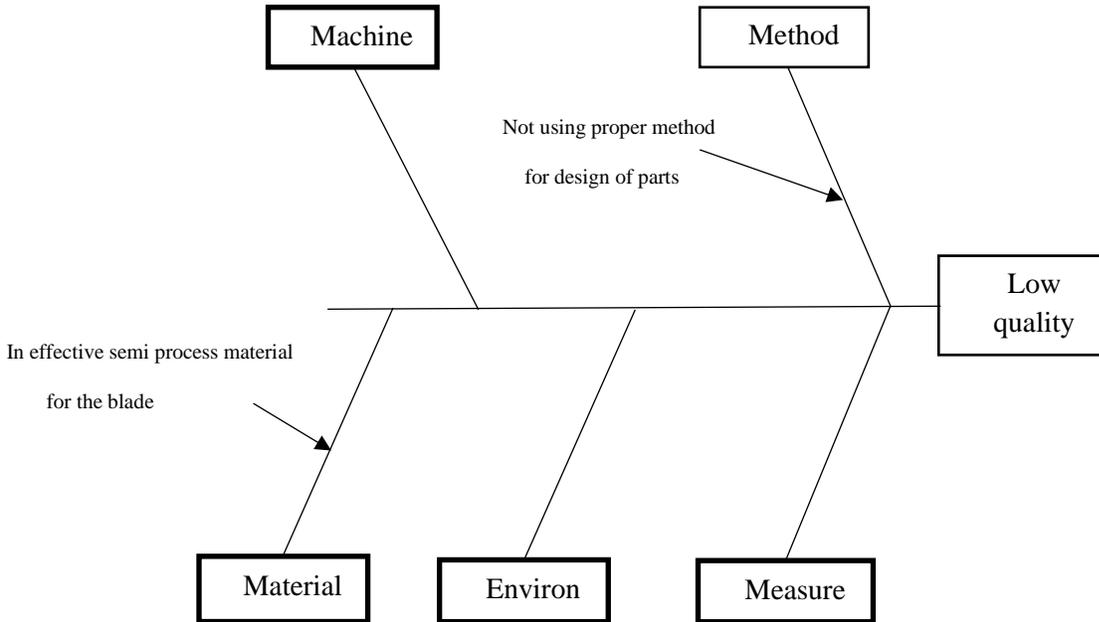


Figure 3. Cause and effect diagram.

Improve Phase. By assessing the overall conditions of the enterprise, we suggest that the enterprise need to recruit at least one university graduate to carry out the design works of the enterprise. So that the design of the product could be improved continuously based on the complaints of the customer. This helps the enterprise to stay in the market sustainably and increase market share of the company.

Control Phase. After executing improvement actions, this phase ensures the process continue to work well, produce desired outputs and maintain quality level. This phase will carry out periodic reviews of various solutions and strict adherence to the process yield. The enterprise plays an important role in ensuring the measures taken responds to the customer needs and they can use a short survey questionnaire to assess the perception of the customer regarding the product.

5. Conclusion

Six Sigma is very powerful tool to achieve financial goals for the organization and improve the company's value by data driven, project based, disciplined and systematic, customer focused for process improvement [27]. If there are processes that generate negative customer feedback,

components of Six Sigma should be considered as a means to study and rectify the problem. This study uses Six Sigma DMAIC approach as a framework to identify, quantify, and eliminate sources of variation in Meseret Gabi Machinery Metal Works Enterprise in Dessie (Ethiopia). This helps to improve the competitiveness of the enterprise in the market place by addressing the complaints and requirements of the customer continuously.

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