The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2020

Volume 19, Pages 1-10

IConMEB 2020: International Conference on Management, Economics and Business

Application of Six Sigma Methodology to Improve Customer Complaint Management

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Abstract: In today's competitive business environment, customer satisfaction is one of the most critical factors for sustaining a long-term success in an organization. Customers are mostly satisfied when the organizations meet all their needs and expectations. This means, organizations need to listen the voice of the customers and manage the customers' complaints in an appropriate way. In this paper, a case study about customer complaint management was carried out in a company from the plastics industry by applying six-sigma project management methodology. The aim of this project was to overcome the increase in the customer complaints by analyzing their root causes with six-sigma project management tools. The DMAIC methodology was used during the project which has been completed in nine months. In the end, customer complaints decreased %20 and the results show that six-sigma is a successful and encouraging tool for the improvement of customer complaint management process of any organization.

Keywords: Six-sigma, customer complaints, customer satisfaction

Introduction

Developing a customer centric business is one of the most important strategies for sustaining an organization. In order to do so, companies are trying to find the best methodologies to manage the customer relations. One of the best methodologies that companies are focusing on is six-sigma. According to Kansal and Singhal (2017), six-sigma offers an alternative problem-solving roadmap that can be implemented to any business function. Six-sigma is a disciplined approach, which is data driven and analytical.

Before six-sigma applications, quality management tools and techniques were more preferable especially for the production departments. El Haik and Roy (2005) explains that quality management system collects the business processes focused on achieving quality policy and aims to meet customers' needs. Different quality management techniques and tools like ISO 9001:2008; Total Quality Management (TQM), six-sigma and lean have been applied to improve internal and external customer satisfaction. Antony (2008) states that six-sigma is an important tool in order to identify the root causes of the problems and produce efficient solutions.

Since the early days of six-sigma applications, there has been a common perception that six-sigma is useful only for pure manufacturing processes and six-sigma does not very well adaptable to the other departments like sales and marketing. Although six-sigma has been very popular in production department for years, sales and marketing professionals have only recently started to use it (Pestorius, 2007). On the contrary, Desai and Shrivasta (2008) think that six-sigma is a tool that is used to do strategical planning and boost profit, increase market share and help to develop customer satisfaction by the help of statistical tools and also, service providers prefer to apply six-sigma in marketing, finance, information systems and human resources in order to improve the effectiveness and the efficiency of the system.

In this study, six-sigma management tools and techniques were applied to a company's customer complaint management system. In the company, there was a sharp increase in the customer complaints, product returns and

- Selection and peer-review under responsibility of the Organizing Committee of the Conference

some of the customers started to stop ordering and leave the company. This situation caused a stressful environment for all the employees and managers. Therefore; the top management focused on a new six-sigma project in order to find sustainable solutions to those problems. A project team was constituted, and project goals were defined.

The main goals of this research are to introduce a six-sigma case study applied to decrease the number of customer complaints, the total amount of product returns and the number of lost customers. Also, this study shows that six-sigma is a management tool that can be easily adapted to departments related to customer relations. Additionally, in this work, some recommendations for further studies are shared.

Literature Review

Six-sigma is a business management methodology that was first introduced by Motorola Inc. in the USA in 1987 (Nonthaleerak and Hendry, 2006). At that time, Motorola had an aggressive goal of 3.4 ppm defects and developed six-sigma in order to reach that aim (Barney, 2002b; Folaron, 2003). In 1994 Larry Bossidy, CEO of AlliedSignal, expressed six-sigma as a methodology that improves work processes, creates high-level results, develops employees' skills and effects the culture of the organization positively and worked on six-sigma (ASQ, 2002, p. 14). Afterwards, General Electric started to implement six-sigma to the processes of the company in 1995 (Slater, 1999).

Six-sigma has many definitions in literature in different perspectives. From the quality management points of view, six-sigma is a high-performance, data-oriented problem analyzing and solving approach that focuses on the root causes of business problems (Blakeslee, 1999, p. 78). Hahn et al. (2000) described six-sigma as an approach that improves product and process quality by the help of statistics discipline. Harry and Schroeder (2000), describes six-sigma as a "business process that allows companies to drastically improve their bottom line by designing and monitoring everyday business activities in ways that minimize waste and resources while increasing customer satisfaction. Additionally, Linderman et al. (2003) reiterated the need for a common definition of six-sigma and suggested: 'Six Sigma is an organized and systematic method for strategic process improvement and new product and service development that relies on statistical methods and the scientific method to make dramatic reductions in customer defined defect rates.'

Basically, six-sigma describes how a process is performing in a statistical way (Kansal and Singhal, 2017). The purpose of the six-sigma is to eliminate and to minimize the defects in any process. Mostly used six-sigma metrics are dpo (defects per opportunity), dpu (defects per unit), z-value or the sigma value, throughput yield, rolled throughput yield, etc. (Erturk et al., 2016). According to six-sigma level perspective, in a process, no more than 3.4 defects per million opportunities (DPMO) is acceptable (Linderman et al., 2003)

There are two main six-sigma methodologies: DFSS and DMAIC. These acronyms have special meanings. DFSS means Design for Six Sigma and that is used to design or develop;

a new product or service and/or
a new process for an existing product.

DMAIC emphasizes the parts of the implementation process: Define, Measure, Analyze, Improve and Control. DMAIC methodology is designed for the improvement of an ongoing process or existing product/service performance that is not satisfactory.

DMAIC and DFSS are based on statistical tools with an assumption of 1.5 sigma shift in the process mean when calculating the process capability of six-sigma (Nonthaleerak and Hendry, 2006). In this case study, DMAIC approach were used to conduct the six-sigma project. In each phase of the DMAIC, useful quality tools and techniques are applied (George, 2002; Pepper, 2010). Table 1 (Türkan, etc., 2009) shows the stages of Six Sigma (DMAIC) and some of the tools and techniques used in detail (Turkan, etc., 2009). These tools and techniques let the project team analyze the process performance and measure the system. The transition from one phase to another is completed if all the goals of the phase have been reached (Liebermann, 2011).

DMAIC methodology's success can be clarified by its structured logic that creates networks between phases, it is important to touch each step of the methodology otherwise, there might be risky situations for finding the best solutions for the problems. Some steps can be skipped only if the solution is clear and there is minimum risk. In order to have this decision, those questions should be answered;

What data exist to show that the proposed development is the best solution possible?
How can we make it sure that the solution will really solve the problem?
What are the disadvantages of the proposed development?

Table 1. Six sigma phases (DMAIC) and tools & techniques

Six-sigma phase	DMAIC phase steps	The tools and methods
Define	Ensuring that the problem and goal are defined in terms that truly relate to key customer requirements	Project Charter Process Flowchart SIPOC Diagram Stakeholder Analysis CTQ Definitions
Measure	Tested the output and input potential. Once it has determined the right measurement system for adequacy of available inputs and outputs.	Process Flowchart Data Collection Plan/Example Benchmarking Measurement's System Analysis/Gage R&R Process Sigma Calculations
Analyze	Define Performance Objectives Identify Value/Non-Value Added Process Steps Identify Sources of Variation Determine Root Cause(s) Determine Vital Few x's, Y=f(x) Relationship	Histogram Pareto Chart Regression Analysis Process Map Review and Analysis Statistical Analysis Hypothesis Testing Non-Normal Data Analysis
Improve	Perform Design of Experiments Develop Potential Solutions Define Operating Tolerances of Potential System Assess Failure Modes of Potential Solutions Validate Potential Improvement by Pilot Studies Correct/Re-Evaluate Potential Solution	Brainstorming Mistake Proofing Design of Experiments Pugh Matrix Failure Modes and Effects Analysis
Control	After optimized the output for the sake of continuity, and in selected cases of important input just to check if continued, will help to reduce the variability of the output.	Process Sigma Calculation Control Charts Cost savings Calculations Control Plan

If there is no data to answer these questions, although the solutions are obvious, it is necessary to follow a complete DMAIC project with all stages (George, 2005).

Six-sigma is generally related to recover of the defects and costs of in the industry, but it doesn't mean six-sigma is only related to manufacturing problems. Six-sigma is a methodology that is adaptable not only production but also services such as sales, marketing, supply chain, finance etc. After the implementation of six-sigma, costs might decrease, process performances might increase, customer satisfaction might increase, customer complaints might decrease (Antony, 2006; Kumar, etc., 2007; Noone, etc. 2010)

The Performance Management Group LLC (2006), reported that JP Morgan Chase (Global Investment Banking) applied six-sigma methodology and reduce failures in customer related processes. After the project customer satisfaction, process efficiency increased significantly. In addition to this, Celerant Consulting (2011), shared British Telecom Wholesale's case in their report. After six-sigma implementation, customer satisfaction and process effectiveness increased significantly. The company reached million $ 77 savings and 50% decrease in customer complaints thanks to six-sigma process improvement methodology. Additionally, Kansal and Singhal (2017), explained in their paper a six-sigma study that aimed to develop customer satisfaction in an ISO 9001:2008 certificated government R&D organization. The organization had problems about customer complaints. For these problems, six-sigma tools and techniques have been applied. After that, customer satisfaction increased to more than 85%.

Although there are some limitations, Reisenberger and Sousa (2010) explains that six-sigma applications in services affect the performances positively, especially low performance processes like customer complaint management, which will be explained in a case study in the following section, can benefit from six-sigma solutions.

Case Study

In this study, a company from plastics industry was chosen in order to see the effects of the implementation of six-sigma. The company produces three main plastics raw materials for the other companies in plastics industry. The customers of the company are mostly located in Europe and have a sensitive quality and service understanding. In this company, customer complaints between the years 2016-2018 were evaluated. After the six-sigma project use, the service quality and efficiency of the customer complaint management were improved. In this six-sigma project, DMAIC approach was applied that will be explained below.

Define

The company selected six-sigma project methodology in order to overcome customer complaints' increase. Before that the company had a Customer Complaint Management department, however in years, this department had cancelled, and technical team supported the management of customer complaints. Unfortunately, technical team was very busy with the production issues, they could not fully focus on the complaints and their solutions. This situation and change caused an increase in the number of customer complaints day by day. In today's competitive environment, this increase sounded very dangerous for the economy and prestige of the company from the top management's point of view. That's why, the top management planned to make started a new six-sigma project. Team consisted of 5 professionals from sales, production, logistics and marketing departments. Two of them have black belt six-sigma certification and minimum 2 years six-sigma project experience. Most of the members of the team attended the project implementation actively. Project team organized project status meetings regularly in every two weeks.

Customer complaints data between the years 2016 and 2018 had been used and analyzed as project data. Data of the customer complaints were taken from a special database of this company. This data included customer name, product group and name, date of the complaint and other details about complaint. There are three main product groups of the company. This project aimed to improve polymer products' customers' complaints; therefore, project scope was defined as it was in the Table 2, which explains the Project Charter that shows the details of the project in the beginning. Project lasted for 9 months and after this time interval project leader continued to control project indicators monthly in order prevent recurring increases of customer complaints.

Table 2. Project charter

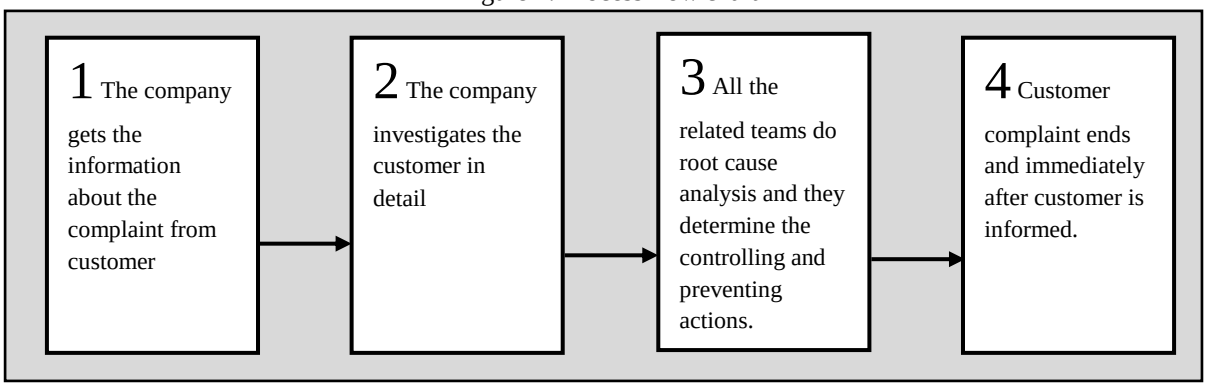
Six-sigma Customer Complaint Management Project		
Team Members		
Leader	: Gulsah Sisman	
Process Owner	: Member 1	
Members	: Member 2, Member 3, Member 4	
Problem Definition: Increase in the number of customer complaints between the years 2016 and 2018.		
Project Scope: The polymer products' customers' complaints		
Project Indicators	Unit	Goal
The Number of Complaints	Item/month	8
The Total Amount of Returns	Ton/month	0
The Number of Lost Customers	Item/month	0

In Table 2, the final goals of the project were stated as project indicators, also named as critical to quality (CTQ). There were three indicators of the project. The first one was the number of the complaints. For this indicator, the company aimed to have %20 decrease that means maximum 8 complaints monthly. Second one was the total amount of returns due to unsatisfactory products or services. The company aimed to have zero returns at the end of the project. Finally, the number of lost costumers was recorded monthly as another project indicator. For this indicator, the aim of the company was to keep all the customers at the end of the project.

In Figure 1, the process flow chart of the customer complaint management can be seen below. There are four main steps in this process. Firstly, the company has the information about the complaint coming from customer.

Then, customer complaint management team tried to understand the details about the complaint. After that, root cause analysis is conducted to specify and control complaints and prevent the system. Whenever the complaint comes to a conclusion, related customer is informed about it.

Figure 1. Process flow chart



Measure

In order to better understand the current state of the customer complaint management, two years data about the project indicators, which are customer complaints, product returns and lost customers were collected from the company's database. Minitab and Excel programs were used to measure and analyze the customer complaints between the years 2016 and 2018. In this section, each indicator was explained and compared through years.

The Number of Complaints

The first step of the project measurement was to see yearly customer complaints. From Figure 2, it is easily seen that the number of customer complaints increased in every year. In other words, the number of customer complaints was 98 in 2016, 114 in 2017, while it was 118 in 2018.

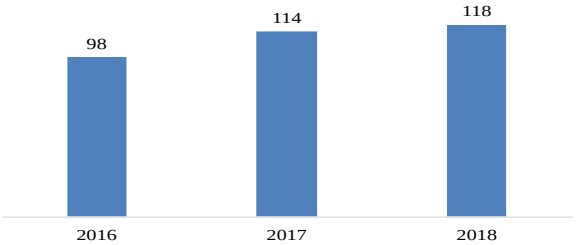


Figure 2. The number of complaints (ıtem/year)

Additionally, in Figure 3, monthly change in customer complaints between the years 2016-2018 can be seen in detail. From Figure 3, it is clear that there were some fluctuations in 2016 and 2017. In 2018, there was still some fluctuations, however it was in an increasing trend during the whole year.

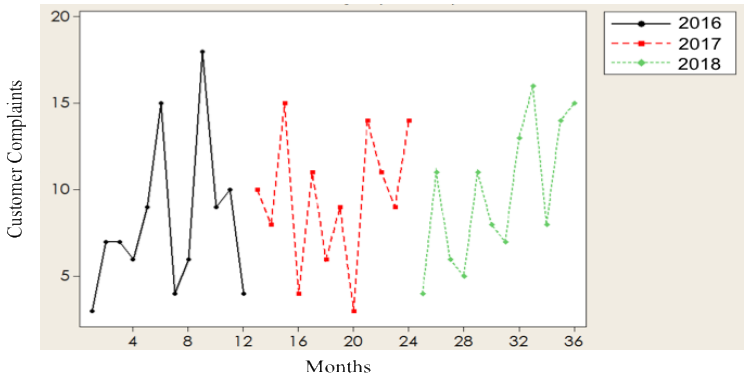


Figure 3. Time series plot of customer complaints

The Total Amount of Returns

Product returns were the most avoided procedure of the company's customer complaint management, since it was decreasing the profit of that sales badly. When a complaint happened and the customer insisted on sending back the product, the company had to face with additional costs such as logistics, stocking, controlling etc. Although the company tried to make the customer satisfied about the products or services, unfortunately, some of the customer complaints caused product returns. In Figure 4, yearly amount of product returns in tones can be seen in detail. In 2016, there were only 300 tones product returns however, in 2017 it increased dramatically to 890. This means in two years the amount of product returns had 296 % increase. Similarly, in 2018, the amount of returned product increased to 1123 tones very sharply.

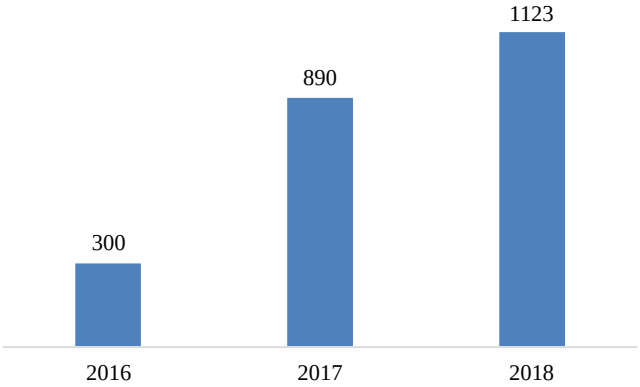


Figure 4. amount of returns (ton/year)

The Number of Lost Customers

In every customer complaint, unfortunately, did not end with a satisfactory solution. Some customers decided to end the customer-supplier relationship with the company due to the unsolvable problems. In other words, customer complaints might be a reason for the loss of customers. Figure 5 shows the yearly number of loss customers and while in 2016 it was just 2, in 2018 it increased to 5. This increase means more than a 100 % increase and affected the company's economy very negatively.

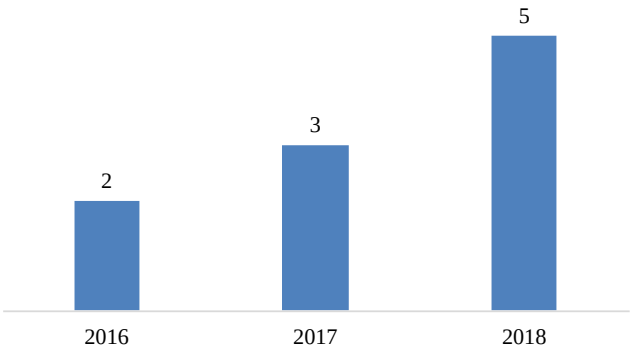


Figure 5. The number of lost customers (ıtem/year)

Analyze

In this part of the project, six-sigma project team tried to understand the root causes of the customer complaints. They came together and organized meetings with the related departments' managers to make everything crystal clear. If the main reasons of the complaints are clear, then it will be easier to manage all of them. Therefore, in this section, customer complaints' root causes were analyzed with some techniques such as fishbone diagram, process flow chart review and grouped according to their main categories. After the meetings, the team determined four main categories namely as quality, packaging, logistics and documentation for the customer complaints. When the previous years' complaints were analyzed in detail according to these categories, quality problems were the most encountered problems. About %65 of the customer complaints occurred owing to the quality problems such as melting point increase, different products' contamination, humidity, viscosity, color and shape. Afterwards, about 18% of the complaints happened because of the packaging issues. Wrong product deliveries, damaged products, or other products' contamination to the packages caused customers complain

about their unsatisfactory orders. In addition to this, some customers were not happy with the logistics process of the company. Logistics problems led to about 16% of the complaints of the company. Under this category, three subcategories, that were transport damage, delivery and loading, were decided by the project team. Transportation is a critical service for a company. Transportation needs to have a good plan and careful treatment from the first point until the last point. Sometimes, products might be damaged during transportation or might be loaded different from the customers' needs. These resulted in customer complaints for this company. Additionally, deliveries to the wrong time, place or people caused similar problems. The final category for the customer complaints was determined as documentation problems. Mostly the company's sharing the wrong documents, or some documents were being loss were the root causes of this type of complaints. Table 3 shows all the categories in detail.

Table 3. Categories of the Complaints Between 2016-2018

Main Category (%)	Subcategory
Quality (62)	Melting point
	Contamination
	Humidity
	Viscosity
	Color
	Shape
Packaging (18)	Wrong product
	Damaged product
	Product contamination
Logistics (16)	Transport damage
	Delivery
	Loading
Documentation (4)	Wrong documents
	Loss documents

Improve

After the define, measure and analyze steps of the six-sigma project, the project team organized a brainstorming session in order to designate a to-do list to improve the defects in the system. In the brainstorming meeting, potential solutions to the main problems were developed and the solutions were implemented accordingly. Established solutions were like in the following;

Assigning a customer complaints coordinator and department responsible in order to restructure the process.
Redrawing the process map.
Quality problems were analyzed in detail and special solutions were found to decrease the problems generating from the production processes.
Supply chain department organized weekly communication meetings with the customers and sales department in order not to miss any details about the shipments, packaging, required documents.
Packaging, documentation and logistics operations' process maps were restructured.
Company's customer complaints management database was reviewed, and special modules were added in order to respond the complaints quicker.

When there was a complaint, customer satisfaction-oriented solutions were applied. For the all the employees, customer satisfaction and communication trainings were arranged in order to raise awareness for this situation. Project improvement actions lasted for about 4 months. In this period, the project team managed each little step devotedly. Customer satisfaction awareness in the company increased very well with all the effort.

Control

The aim of this step was to see the effects of the improvements about customer complaint management in the company. In every month, three main project indicators were observed and reported to the top management. Additionally, some configurations about the procedures were planned and implemented when there was a need. In the following Table 4, indicators' monthly results were shared.

Table 4. Monthly project ındicators

Project Indicators	Unit	Goal	1	2	3	4	5	6
The Number of Complaints	Item/month	8	8	9	7	8	7	8
The Total Amount of Returns	Ton/ month	0	0	0	0	0	0	0
The Number of Lost Customers	Item/ month	0	0	0	0	0	0	0

As it can be seen in Table 4, in six months, all the complaints decreased about %20 when it is compared with 2018 average six-month results. In other words, there was a decrease from 59 to 47. For the second project indicator, there wasn't any product return during this control period. All the complaints could be resulted positively in a satisfactory way. Final project indicator was the number of lost customers. Luckily, there wasn't any customer leaving the company during the control period.

Conclusions

This case study describes the implementation of a six-sigma project for customer complaint management in a company from plastics industry. Six sigma methodology and DMAIC approach were used to improve the defects of the customer complaint management process. There are three goals of this project. The first one is to decrease the number of customer complaints. The second one is to decrease the amount of product return. The last one is to decrease the number of customer loss. Project has lasted for totally 9 months; about 5 months was spent for define, measure and analyze steps and about 4 months was spent for the improvements of the customer complaint management system. In this section, experiences and recommendations about managing a successful six-sigma project are explained together with the conclusions of this case study.

In the beginning, project started with generating a powerful and sophisticated team. Every team member had the responsibility and desire to carry out the project plan. In such a big project, team members' having the same energy and approach to the project is very important in order to finalize it successfully. Team leader should delegate the jobs to the right member who has enough knowledge, experience and capability to finish that job. Therefore, constituting efficient teams is crucial to have a successful six-sigma project in a company. Additionally, communication is one of the keys for the project success. In this case, team members met regularly in every two weeks in order to check the project status and have information about how the project was going on.

Also, in the six-sigma projects, top management's support changes the employees' approach to the project positively. If top management of the company has a special interest into the project, project team would be much more flexible and comfortable about the potential solutions and implementations. In this case study, the top management of the company was very enthusiastic about improving the customer complaint management process, therefore, the employees supported and accepted the change in the system faster.

This six-sigma project was different from the general six-sigma projects since originally six-sigma was developed for manufacturing processes. However, today's world, service organizations need to have different perspectives and management approaches in order to increase profits and performances. Service sectors are implementing six-sigma in marketing, finance, information systems and human resources with the aim of solving problems and find the best solutions. Therefore; six-sigma is a methodology that is used for to manage problems and increase customer satisfaction (Antony, 2008).

Project goals should be meaningful and reachable. In this case, project team focused on a decrease about 20% in the customer complaints. Additionally, project team wanted to have no other product return and customer loss since product return and customer loss are very painful experiences for the company. At the end of the six months, there were about 20% decrease in the customer complaints and there wasn't any product return or customer leave at that period of time.

According to the experiences from this case study, six-sigma is a useful methodology for customer complaint management improvements. In this case, it provided a collaborative and communicative environment in the company. After the project, production, marketing, sales, quality and supply chain departments were much more aware of each other's problems. The customer satisfaction awareness increased in the whole company.

As many of the case studies, there are some limitations in this work. Firstly, this project was implemented for just the plastics products' customers, other product groups' customers were kept out of the scope. Also, this project was conducted in a company from Turkey. If this kind of study would be repeated in another region, the cultural or corporate differences and effects should be kept in mind.

Recommendations

For the future works, in addition to customer complaint management system, customer satisfaction measurement system or customer communication system might be improved by the help of the six-sigma project management approach. Additionally, for a similar case, different six-sigma tools or techniques might be used for the measurement or analysis steps of the project.

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