

Implementing Six Sigma to Reduce Online Petitions on the E-petition System in Taiwan Power Company

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Abstract—This study presents a case study demonstrating the application of Six Sigma (DMAIC) to successfully reduce the number of online petitions on the e-petition system in Taiwan Power Company (TPC). First, in the define (D) stage, a total of 1,292 petitions for the year 2010 in TPC are received and divided into 9 categories. In the measure (M) stage, the category that received the most petition letters is “line removal”, which accounts for 29.3% of the total petitions. The analyze (A) stage indicates that TPC did not provide relevant application procedures for “line removal” service. In the improve (I) stage, this study presents three approaches to speed up the “line removal” application process. Finally, a well-organized standard of procedure and workflow control charts has been developed in order to monitor the overall application and construction processes in the control (C) stage. After implementing Six Sigma (DMAIC), the number of petitions for “line removal” decreased by 66% from 379 in 2010 to 129 in 2011.

Index Terms—Six Sigma; DMAIC; Power Company; Online Petition; E-Petition System

I. INTRODUCTION

In the 21st century, the product itself or the ability to sell is no longer the key to a successful business, but rather meeting customer needs, decreasing customer complaints, and increasing customer satisfaction. According to Singh and Pandya [1], when customers experience dissatisfaction with a product or service, they will take the initiative in seeking compensation. Several studies have also pointed out that a business might be rejected by the customer due to its low service quality [2]. Saraei and Amini [3] present that a business with high service quality and dealing tactfully with customer complaints will increase its customer satisfaction while retaining customer loyalty.

In general, handling customer complaints properly is an act to reclaim customer satisfaction when a service provider makes mistakes. A mishandled complaint may often result in the loss of customers. Corporate image can also be easily damaged by dissatisfied customers or their negative word-of-mouth.

In recent years, due to the advances in information technology and emphasis on customer relationship management, more and more application systems are being established on the Internet for providing an easy and convenient way to complete transactions, services and applications online between customers and businesses [4]. The E-service mailbox, as a suite of electronic services (e-services) application, has been adopted in many organizations, from large organizations to smaller companies, even in Taiwan. The e-service mailbox provides several benefits in terms of being cost effective, providing fast services, and return on investments [5]. Although, the e-service mailbox is considered as a well-known way of handling customer complaints, the businesses should seek to decrease the number of customer petitions as well as to increase the level of customer satisfaction and market competition. Therefore, businesses need a significant and systematic approach to improve business service quality and handle customer complaints.

Taiwan Power Company (TPC), founded in 1946, is a government-run company in Taiwan. TPC is a vertically integrated power company; it provides services which include power generation and power supply to residential and commercial users. Driven by advances in information technology, TPC offers more diversified services by having set up an online petition system with e-service mailbox (service@taipower.com.tw) in 1996. It not only provides information about TPC to the general public, but

also acts as a platform for customers to express their opinions and comments regarding TPC's services; the more petitions TPC receives, the more dissatisfied customers TPC has.

The Six Sigma DMAIC (Define, Measure, Analyze, Improve, and Control) method is often described as an approach for solving problems and improving quality. The Six Sigma has been widely embraced by many Fortune 500 consumer products manufacturers with multiple business groups in the U.S. [6]. Many case studies also show that the Six Sigma approach is very popular in solving problems in the real world [7]. van Iwaarden *et al.* [8] present the Six Sigma process as a value-added creation through quality improvement. Cheng [9] concludes that Six Sigma could be inferred from both definitions and could be seen as a philosophy or strategy used to improve the efficiency and effectiveness of business processes to meet or exceed customers' needs and expectations. Easton and Rosenzweig [10] propose that the Six Sigma approach is a useful tool to discover a number of key factors associated with project team success and failure in practice. Shafer and Moellerm [11], by investigating a sample of 84 Six Sigma firms, indicate that adopting Six Sigma may positively impact organizational corporate performance. Therefore, the aim of this study is to apply the Six Sigma DMAIC approach to improve service quality and increase the competitiveness of TPC.

The five stages of the implementation are described as follows. First, in the "define" stage, petition letters in the year of 2010 are collected from the online service mailbox. Of all the petition letters, TPC receives the most in the "line removal" category. In the "measure" stage, a pie chart is used to map the proportions of different petition categories. The petition category of "line removal" accounts for the largest proportion. In the "analyze" stage, a cause and effect diagram is used to analyze the causes of the core problem. Two supervisors, who have worked in TPC for over ten years, and two scholars brainstorm the causes of the petitions in the "line removal" category regarding the nature of petitioners, persons in charge and TPC's system. In the "improve" stage, potential solutions are developed, evaluated and implemented. A two-way communication platform is recommended to provide better service. Finally, in the "control" stage, a knowledge-based system and in-service training are recommended in order to monitor the overall operation through a line chart, to illustrate the before-and-after differences. Through the steps of DMAIC, the number of petition letters in "line removal" category decreases and customer satisfaction increases.

The remainder of the paper is organized as follows. The next section presents a literature review of the development of the Six Sigma approach (DMAIC). A case study is described in Section 3. Section 4 describes the DMAIC framework used in this study. In the final section the conclusions are presented.

II. SIX SIGMA APPROACH (DMAIC)

The Six Sigma approach (Define-Measure-Analyze-Improve-Control, DMAIC), a business management strategy, originally was developed in 1986 by Motorola. The so-called Six Sigma is a quality measure for the technical point of view for each process, product, or service in terms of the probability of occurrences of defects per million being less than 3.4 times (i.e. 3.4 DPMO). Banuelas *et al.* [12] point out that if a business wants to implement the Six Sigma DMAIC approach efficiently, support from higher authorities which includes staffing and funding are needed. The Six Sigma approach works best in solving problems in the manufacturing sectors, particularly in reducing costs, improving yield and increasing production, in order to emphasize catering to customer needs. Canato *et al.* [13] indicate that the Six Sigma procedure is representative of continuity forces for manufacturers. Pillai *et al.* [14] indicate that Six Sigma is used in many manufacturing industries to achieve dramatic improvements in their operations, maintenance, engineering and business processes.

Currently, with the positive effects of Six Sigma on the manufacturing sectors, important issues of the non-manufacturing sector have been gradually noted. Aksoy and Dincmen [15] show increased quality and profitability through Six Sigma on process improvements concerning the issues of product value-added, low-cost products and services, by using statistical tools within a structured roadmap. Jou *et al.* [16] use Six Sigma to evaluate and improve the performance of new product development procedures along with performance matrix, factor analysis and theory of constraints. Moosa and Sajid [17] posit Six Sigma as a useful tool at management level to deal with complex organizational problems that need simultaneous extensive analysis of data, confirmation of results and validation of long-term actual benefits. Gutierrez *et al.* [7] propose the Six Sigma approach to measure teamwork and process management, as well as absorptive capacity in the organization. Kumar *et al.* [18] find that the Six Sigma has a significant impact on the bottom-line and working culture of an organization in their attempt to manage changes. Prisani *et al.* [19] put forward the Six Sigma methodology to focus on reducing and ultimately eliminating defects in business processes. Chang *et al.* [20] utilize the Six Sigma managerial improvement method to obtain a strategic solution for applying information systems integration as a way to improve production planning procedure, upgrade customer satisfaction and increase the performance of the production planning procedure. Hsu *et al.* [21] point out that using the Six Sigma control method with the DMAIC framework could curtail the power supply over time in order to enhance the power supply efficiency in Taiwan Power Company (TPC). In accordance with the above reasons, the Six Sigma approach is a very practical management method.

III. CASE STUDY

Taiwan Power Company (TPC), a vertically integrated power company, has provided services of power generation and power supply to residential and commercial users since May 1, 1946. TPC is the only company in the Republic of China that offers a power supply to residential and commercial users. All private-owned power plants generate their electrical power and then sell it to TPC. At the end of the year 2009, TPC had a total capacity of 4,025 megawatts (MW), including 3,206 MW stored in TPC's own facility and 819 MW stored in private-owned power plants. Electricity is generated mainly by hydro power, thermal power, nuclear power and other renewable energy. As for the electrical power grid, there are 579 substations at all levels with 340,006 kilometers of transmission and distribution grid connections, which provides electrical power for 23 million residents in Taiwan, Penghu, Kinmen and Matsu [22].

In general, if customers have any questions about TPC's services, they can file a petition for requesting a response. There are three ways to file a petition: (1) written petition through mail, fax, or public opinion reports; (2) oral petition through in-person visit, or phone, and (3) online petition system through service mailbox emails. Recently, e-mail is considered the fastest and the most convenient form of petition. Hence, in order to fully understand its customer needs and to increase service quality, TPC set up an online petition system with e-service mailbox (service@taipower.com.tw) on July 3, 1996. If customers have any kinds of questions regarding TPC's services, they can email their requests to this mailbox [23].

Chen *et al.* [24] confirm that there is a positive correlation between the level of convenience and the number of petitions. Owing to the convenience and low-cost of filing an online petition, people tend to overuse this option, which causes a greater workload and higher costs for processing. When a customer complains, it means he/she is not satisfied with the product or the service. When the level of customer satisfaction is low, it may influence customer loyalty. Therefore, this study adopts the Six Sigma DMAIC approach to improve the service quality of the category that receives the most petitions. A managerial system is developed to control the situation and then to decrease the number of petitions, as well as to increase the level of customer satisfaction.

IV. DMAIC FRAMEWORK

A. Stages of Define and Measure

This study explores ways to reduce TPC's number of complaints and email petitions by using the Six Sigma DMAIC approach. In TPC's e-service mailbox, there are 10 petition categories: power usage applications, billing, power distribution quality, line removal, compensation, service attitude, operational suggestions, questions regarding TPC regulations, illegal power usage, and others. The category of "others" means the general public can indicate any complaints that are not listed in

the previous 9 categories. Owing to the broad nature of issues in this category, the contents are not taken into account in this study.

In the define (D) stage, TPC collected a total of 1,292 petition letters from the e-service mailbox during the year of 2010, divided into nine categories (see Figure 1).

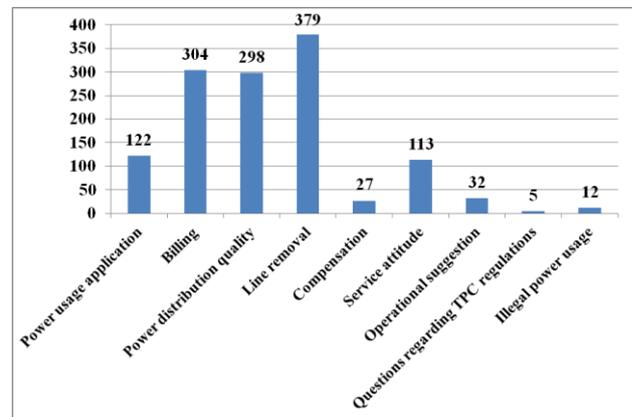


Figure 1. Number of cases in nine petition categories in Taiwan Power Company in 2010

This study analyzed these nine petition categories as follows:

- The first category is power usage application, which includes petitions about time allocation of power usage, location and range. There are 122 cases in this category.
- The second category is billing, which includes complaints about abnormality in power consumption and sudden increase in payments; 304 cases belong to this category.
- The third petition category is power distribution quality, which includes complaints about voltage surge or outage situations; 298 cases are in this category.
- The fourth petition category is line removal, which includes issues and complaints regarding safety, transportation and construction due to line removal; 379 cases are in this category.
- The fifth category is compensation. Customers claim compensation for damages to their electrical equipment caused by unstable power supply; 27 cases are included in this category.
- The sixth category is service attitude. This category contains customers' complaints about employees' attitudes, manners and tone of voice; 113 cases belong to this category.
- The seventh category is operational suggestions, which includes any proposals or suggestions about the management and planning of TPC; 32 cases are counted in this category.
- The eighth category includes any questions or doubts regarding TPC regulations. There are only 5 cases in this category.
- The last category is illegal power usage. In this category, the general public feels discontent regarding illegal power usage and payment recovery; 12 cases are in this category.

The define stage shows that the fourth petition category, “line removal”, which includes a total of 379 cases, is the first in line for improvement. Next, in the measure (M) stage, as shown in Figure 2, a pie chart is used to illustrate the proportion for each petition category.

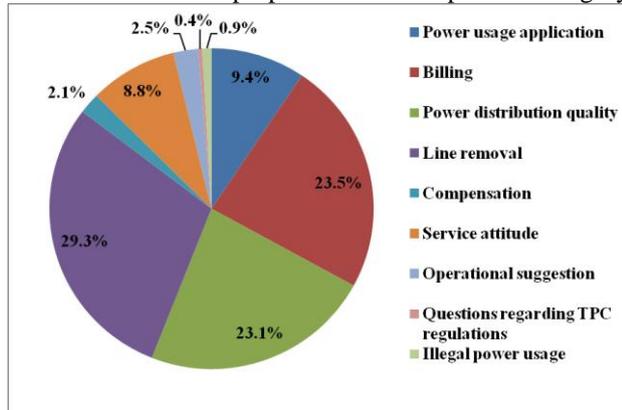


Figure 2. Percentages of cases in nine petition categories in TPC in 2010

Figure 2 shows that the number of petition cases in “line removal”, “billing” and “power distribution quality” account for over 75% of the total petitions, while the six remaining categories only represent less than 25% of the total petitions. The category that receives the most petition letters is “line removal”, which accounts for 29.3% of the total petitions, followed by “billing” and “power distribution quality”, which account for 23.5% and 23.1%, respectively. The six remaining categories in order of percentage are “power usage application”, “service attitude”, “operational suggestion”, “compensation”, “illegal power usage” and “questions regarding TPC regulations”.

B. Analyze, Improve and Control Stages

In recent years, TPC wants to process their customers’ requests in a faster and more efficient manner. Thus, TPC specially set up an e-service mailbox system. The general public can easily use this e-service mailbox system to apply for power usage or to make any other requests online. However, when an excessive number of petitions occur, it may result in a much longer processing time for responding to these petitions. Therefore, TPC urges finding a way to provide a more prompt service, increase the level of customer satisfaction and reduce the number of complaints.

As described in the measure (M) stage, the petition category of “line removal” is the one that needs immediate attention. A cause and effect diagram is used to analyze the category of “line removal” in the analyze (A) stage. In the “line removal” category, most petitioners complain about their safety, route changes, or construction building quality.

Two scholars and two supervisors, who have worked at TPC for over 10 years, brainstormed the main reasons why “line removal” receives many petitions; they find that “petitioners”, “employees” and “the Company’s system framework” are the three main reasons. “Petitioners” usually file complaints because TPC does not provide specific application procedures or sufficient

public notification prior to construction. Petitions about “employees” are usually complaints about inexperienced employees, i.e. that they are not sufficiently service-minded. “Company system framework” includes complicated regulations and problems so that the cases are sent to the wrong department. A cause and effect diagram is shown in Figure 3:

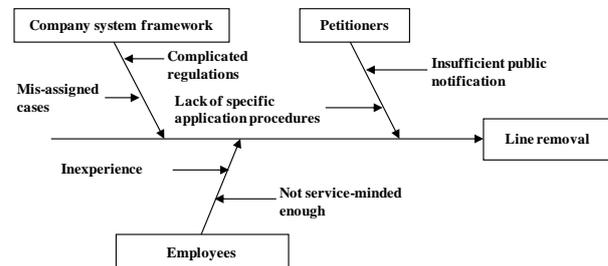


Figure 3. Cause and Effect diagram for “line removal” petition category

Figure 3 shows the cause and effect relationships among the three main reasons why “line removal” receives many petitions. Below, the diagram is explained in greater detail.

1. Petitioners

1) Insufficient public notification

Insufficient public notification about “line removal” construction caused inconvenience to the people in the nearby area. TPC did not provide enough information or clear notification about the “line removal” construction to the neighborhood prior to the construction, causing great inconvenience to the neighborhood around the construction site. Neighbors often complain about the traffic congestion around the neighborhood and power outage caused by “line removal” construction.

2) Lack of specific application procedures

TPC did not provide a specific application procedure online for “line removal”. When the general public applies for “line removal” service, the submitted documents are often rejected due to insufficient information or ambiguous description of the construction site.

2. Employees

1) Inexperience

Employees dealing with customers have limited knowledge about their work, so they cannot solve the problems effectively and efficiently. This situation often leads to delays in processing and later creates potentially dissatisfied customers.

2) Not service-minded enough

If employees did not take the initiatives in assisting customers’ problems during the application procedures, more customers might complain about being dissatisfied with the service.

3. Company system framework

1) Complicated regulations

Many companies have strict regulations that seem complicated and overly-lengthy. For example, if the previous step is not done during the processing procedure, it could not advance to the next level to be processed.

This often results in inflexibility and affects the overall progress, and thus causes more complications.

2) Mis-assigned cases

Head office sometimes assigned “line removal” projects to the wrong department. It often causes processing and time delays in each unit. Along with the complicated procedures and high degree of manual intervention, more and more complaints accumulate over time.

The above analyze (A) stage indicates that TPC did not provide relevant application procedures for “line removal” service, and the general public is not familiar with the instructions for applying for such service. Moreover, TPC often performs government-assigned “line removal” improvement projects but do not provide enough information to the general public about the improvement projects prior to the construction work. Therefore, in the improve (I) stage, this study presents three approaches to speed up the “line removal” application process, reduce the numbers of complaints and improve service quality in TPC as follows:

1. To establish a two-way communication platform to solve petitioners’ problems immediately;
2. To design a specific “line removal” application procedure and provide complete instructions, especially emphasizing the most frequently asked questions and solutions. Samples of completed application procedures should also be provided.
3. When performing any projects, TPC should take the initiative to notify the neighborhood with detailed information, such as the time period of construction, the construction site and contact information prior to commencement.

At the end of improve (I) stage, evaluations should be based on the Six Sigma standards. If the results fail to meet the expectations, the improve stage should be revised until the problems are fixed.

In the control (C) stage, petition letters in 2011 from TPC’s e-service mailbox are collected for the purpose of monitoring the improvement of TPC’s service quality. As shown in Figure 4, after implementing the Six Sigma DMAIC approach, the number of cases in the “line removal” petition category decreases from 379 in 2010 to 129 in 2011, with a reduction rate of 66%, while the total number of TPC e-service mailbox petitions decreases from 1,292 in 2010 to 481 in 2011, with a reduction rate of 62.77%. In other words, implementing Six Sigma successfully improves TPC’s service quality in the “line removal” category.

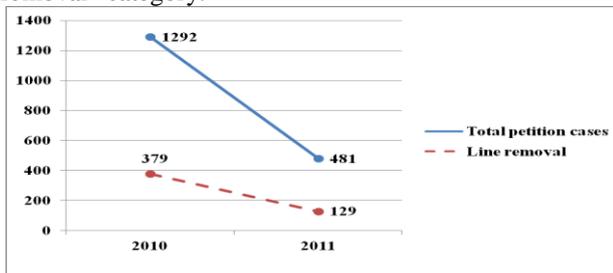


Figure 4. Number of cases in the TPC e-service mailbox petition and “line removal” petition category from 2010 to 2011

This indicates that there was significant improvement in the TPC e-service mailbox petition. If the improvement approach is well-implemented, a systematic knowledge-based system and in-service training programs should be developed. A well-organized standard of procedure and workflow control charts should be developed in order to monitor the overall application and construction processes in the control (C) stage. After a year of observation and improvement implementation, this study found that TPC did not provide the standardized application procedure to the general public for applying for “line removal” service. As a result, applicants often did not know which proper documents were needed. All kinds of cluttering documents have caused an overall delay with discrepancies in construction sites.

For these reasons, this study established a standardized application procedure for “line removal” service, including three stages of pre-construction, construction and post-construction. Descriptions are as follows:

1. Before the construction, the applicants should fill out their names, contact information, construction sites (preferable with photos) and date of application.
2. During the construction, TPC or the contractors should confirm the construction site and time with the applicants. After this two-way communication, applicants should confirm all the information and sign on the application form. This way, there will not be problems about any discrepancies in regard to the construction sites. Applicants, therefore, will not have any dissatisfaction regarding the “line removal” process.

After the construction, TPC inspectors should be sent to investigate how applicants feel about the “line removal” service. This way, TPC would be more aware of the problems in the process and try to solve them immediately. TPC service quality will therefore be improved.

V. CONCLUSIONS

The study demonstrates how the Six Sigma DMAIC approach is adopted to reduce the number of petitions for TPC’s online petition system (e-service mailbox system). 1,292 petition letters are collected from TPC e-service mailbox system in 2010, and then divided into 9 petition categories; 379 cases are in the “line removal” petition category, which is the highest among all the categories. Thus, “line removal” petition category is the first priority for improvement.

Based on the cause and effect diagram analysis, the main reasons for “line removal” petitions are “petitioners”, “employees” and “the Company’s system framework”. TPC should develop a two-way communication system. A complete “line removal” application manual and a sample of an application procedure with proper attached documents should be included. Also, a week prior to the construction, a sign with information of construction date and location along with person-in-charge’s contact information should be provided to notify the neighborhood.

After implementing the Six Sigma DMAIC approach, the number of cases in the "line removal" petition category decreases from 379 in 2010 to 129 in 2011, with a reduction rate of 66%, while the total number of TPC e-service mailbox petitions decreases from 1,292 in 2010 to 481 in 2011, with a reduction rate of 62.77%. This shows significant improvement. In order to have better control, a standardized application procedure for "line removal" service was developed, including pre-construction, during construction and post-construction.

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