

Using Six Sigma to Improve the Efficiency of Power Supply

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Abstract

Implementing the Six Sigma control method is to use define, measure, analyze, improve and control (DMAIC) framework to improve the process from the beginning, emphasize the process management, reduce the process time, eliminate the defects, and increase the passing rate. The aims of this study is to apply Six Sigma control method with DMAIC framework to shorten the power supply over time in order to enhance the power supply efficiency in T. power company (TPC). First of all, according to the daily report, the results have shown that Construction Work Second Section took the longest time for processing the applicants' requests. Then, the applicants' provided information and their attached documents are the main problem by using cause and effect diagram. This study provided two solutions for such thorny problems. Finally, the result showed that the power supply over time was reduced from 66% to 30% in the Construction Work Second Section.

Keywords: Six Sigma, DMAIC, Power supply

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1. Introduction

Six Sigma is derived from Motorola's control method [1]. Between the years of 1987 to 1997, Motorola Inc. implemented the idea of Six Sigma for its quality control regulations. During the time, it has saved the company over USD 140 billion. Besides, Six Sigma control method has gradually become an international benchmark for quality control since then. Implementing the Six Sigma control method is to use MAIC framework to improve the process from the beginning, emphasize the process management, reduce the process time, eliminate the defects, and increase the passing rate.

T. power company (TPC) is a power supply manufacturer and supplier in Taiwan. In TPC service procedure, regular residential users should request for their electrical service in their regional service branch and Service Center. In general, the time from requesting for service in the service counter to the completion of outdoor and indoor wiring construction is shorter the better. The shorter the processing time, the better the service efficiency is. Therefore, a highly significant problem in the TPC is how to how to shorten the time of the process of requesting for electrical services while providing the highest quality for greater customers' satisfactions.

Nowadays, the power supply quality problem is becoming more and more important for customers and manufacturers [2], [3]. Poor power supply quality increases risk, the cost of doing business, and hence impairs a business bottom line. Therefore, this study used the Six Sigma control method with DMAIC framework to shorten the power supply over time in order to enhance the power supply efficiency in TPC. First, in define step, we know that reducing power supply schedule is providing the highest quality for greater customers' satisfactions. In measure step, we used Pareto chart to identify the power supply's levels in every department of TPC. The cause and effect diagram is adopted to find the factors for long-time power supply in analyze step. In improve step, we provided two solutions for this problems, one is to remind the applicants to pick up a consent form for setting the access point in the proper area and with its scheduled time, and the other is to confirm the applicants by telephone two days prior the constructing date. Through the improvement strategy, the power supply over time is reduced

from 66% to 30%. Finally, we should need to construct a workflow chart after the improvement has significantly changed in the power supply over time in TPC.

2. Research Method

Six Sigma represents the quality pass rate of 99.9997% or above. In other words, only 3.4 defects in every million products. Because it is very close to zero defect requirements, one should have continuous quality and service improvement, goal setting to achieve the goals and customer satisfaction [4]. Banuelas et al. [5] and Lynch et al. [6] have mentioned that Six Sigma control method is an effective problem-solving strategy. In the Six Sigma quality control process, the MAIC framework was first used, that is, measure (M), analyze (A), improve (I), control (C). Motorola Inc.'s Six Sigma quality control movement has passed to General Electric Company. General Electric Company processed that a step of define (D) should be added before the MAIC framework, which was from the original MAIC framework to DMAIC framework. Define refers to the definition of objectives and scope, which is to define the project items, select team members to this improvement group, evaluate its financial goals, and obtain approval from the upper management level [1].

Some experts and researchers also presented the Six Sigma is a useful and effective method for quality and process improvement, for example, Cheng [8] used a questionnaire method to investigate how Taiwanese manufacturers implemented the Six Sigma control method for their business integration and maintaining quality control. Lyu and Chen [7] addressed a study of the touch panel manufacturing process using Six Sigma control method to analyze its critical manufacturing characteristics for quality control, to identify the optimal manufacturing parameters and to develop strategies for improving the manufacturing process. Chen et al. [1] combined its manufacturing capability index with Six Sigma applications to discuss its unqualified product characteristics in a ratchet wrench company in central Taiwan. Chen et al. [9] also combined DMAIC and process capability index that can effectively shorten the response time interval and the case solving time, and increase the case-solving rate. Hsia et al. [10] discussed the importance of using DMAIC framework and develop an online marketing standard operating procedure and a knowledge-based management system. Cheng and Chang [11] used Lean Six Sigma methodology decreased the non-value-added process by 70%.

From the previous cases, all have indicated that the Six Sigma control method is an effective managerial strategy. This study used the Six Sigma control method with DMAIC framework to shorten the power supply over time in order to enhance the power supply efficiency in TPC.

3. Results and Discussion

3.1. Define

In TPC service procedure, residential users should request for their electrical service in their regional service branch. They need to complete an application form with the required information. After reviewing the applications by TPC service personnel, the Service Center will send the applicants' information to the Design Section. The Design Section personnel will then inspect the nearest power line to the applicants' house, and bring the design of the needed power line allocation to calculate the cost in Business Section. The Service Center then will notify the users for payments. After completing the payment, Construction Work Section, including Construction Work First Section and Construction Work Second Section, were sent for the outer power line allocation construction. If the construction is involved the piping and underground work, a permission from the proper authority is needed. When the outer line construction is completed, one should notify the applicants to request the indoor wiring work. An electricity meter will be installed after the approval inspection from the Indoor Line Section.

This study focused on how to shorten the time from requesting for power service to the completion of supplying power service, which later defined as power supply over time.

3.2. Measure

In general, the applicants go to their regional service branch, a communicating and negotiating window between residential users and TPC where TPC respond to various requests and services. Its Service Center is an office duty division for processing electrical service

applications, compiling applications for outdoor constructions from its regional service branch, and distributing requests to each department. Once completing each required tasks, each application needs to send back to Service Center for filing purposes. It makes Service Center act as the negotiating unit for each department or division within its service branch. According the applications' processing chronological order with emergency cases, Design Section first receives the application in processing chronological with the consideration of emergency exceptions, and then distributes the cases to its design staffs for designing distribution power lines. After completing the design tasks, the work is sent to Business Section for calculating the wiring grants and the applicants are notified to pay their fee at Service Center.

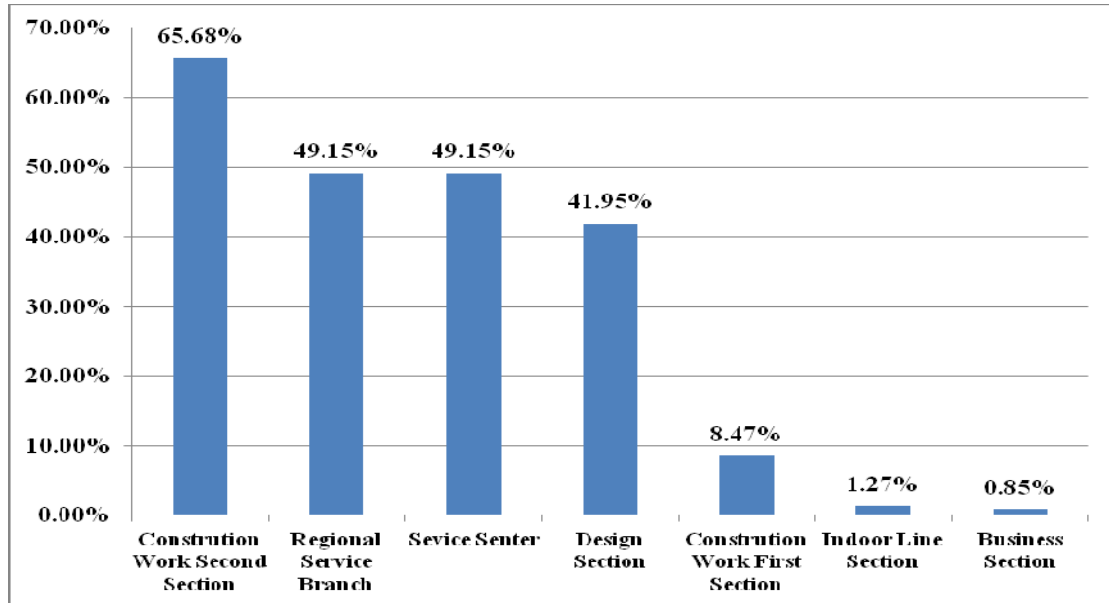


Figure 1. The percentages of daily processing time of the Pareto chart

Outside lines constructions include underground piping constructions and overhead circuit constructions. If the outside lines construction is needed, the constructing work will be done underground in a metropolitan area which is called underground piping. The overhead circuit constructions are used various supports, such as pylons, steel poles, or concrete poles to hold the electric cables high above the ground. Construction Work First Section is responsible for the underground piping construction. Approval for such work is needed from the authorities. After the piping construction is completed, Construction Work Second Section is responsible for distribution line wiring constructions and overhead circuit constructions. Based on the completion reports, Indoor Line Section inspects the constructing process then provides electrical services. When requesting for electrical services, residential users need to go through the processes in the regional service branch and its Service Center.

This study collected and compiled the daily statistical data in Nantou District branch in Taiwan between January and February of 2010. There are total 236 pieces of data collected. The following Pareto chart indicated the percentages of daily processing time exceed the standard regulation from each department/division (see Figure 1).

3.3. Analyze

According to the daily report, the results have shown that Construction Work Second Section took the longest time for processing the applicants' requests. Therefore, this section should be the first priority for improvement. In this section, this section's possible causes were discussed for further analysis. The major task of Construction Work Second Section is the overhead circuit constructions and distribution line wiring constructions. This study chose the junior supervisors with ten years of experiences to brainstorm the following diagram involved

with applicants, persons in charge, organizational culture, and its system framework. The cause and effect diagram as in Figure 2 is to identify the possible causes for having the longest processing time.

(1) Applicants: (a) Information: The general public rarely has the chance in contact with the business transactions in the local authorities or in the related business companies. When there is a need, they then go to the proper authorities. Business transactions of requesting for electrical services are not often encountered. Its processing procedures are not well known to the general public, which makes them unfamiliar with the requesting procedures. If the applicants entrust the third party to handle, such as electrical equipment company, problems might be occurred due to misunderstanding. The operating process might be delayed and cause processing over time. For example, in the case of requesting for outer power line allocation construction, after the applicants complete the payment, the construction work approval from the proper authorities should be ready in advance or the new connection pole should be ready in advance. Otherwise, the power company won't be able to finish the construction work and have power transmission completed on schedule, which might delay the time for power transmission. (b) Attached documents: If the attached documents do not match the files, such as lack of relevant identification, or undefined property rights, it may result in supply schedule delays.

(2) Persons in charge: (a) Professional knowledge base: If persons in charge are lack of professional know-how, and not familiar with the overall requesting procedures, when comes to an unexpected situation, he or she cannot solve problems immediately. The processing time may be delayed. (b) Working attitude: Following the disciplines is one of the basic and the most important working attitudes. Persons in charge should be active, take the initiative to collaborate with others, and respect for the superiors. When encounter a problem, one should seek a solution actively. A good working environment can enhance its work efficiency and quality.

(3) Organizational culture: (a) Leadership style: Leader's personal values will attract his or her colleagues with similar values within the organization. The sense of belonging and organizational identification may be increased. Different leadership styles create a different organizational culture, and may influence its organizational performance. (b) Organizational type: Bureaucratic type of organization is a level controlled system. Working responsibilities are arranged according to the bureaucratic level. Laws, regulations and its organizational operations are strongly emphasized, which makes its organization rigid, inflexible, and lack of resilience.

(4) Company system framework: (a) Legal regulations: Because of the legal regulations, operating procedures need to perform in accordance with the rules. If the task has not been completed in the previous in-charged department, it may not pass down to the next sector in charge. Persons in charge are lack of flexibility, thereby affecting the overall progress. (b) Procedures: Factors like different operating styles, highly complicated procedures with complexity, and levels of human intervention may result in delay operating time.

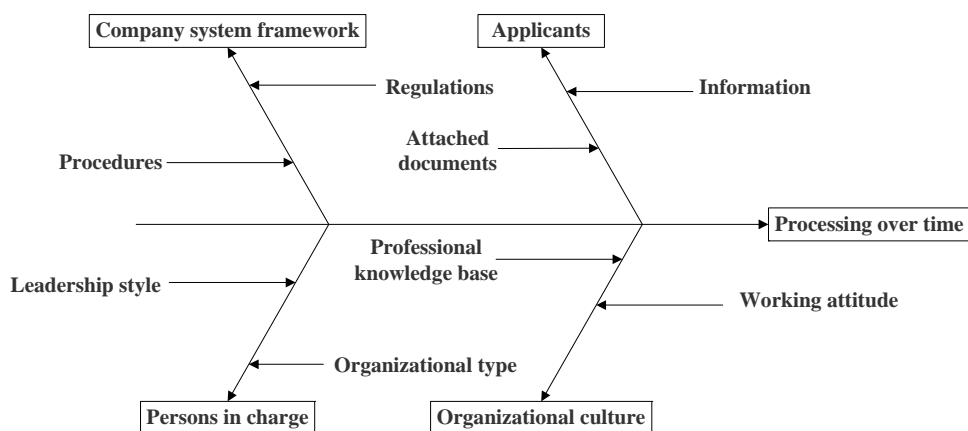


Figure 2. Cause and effect diagram for processing over time

3.4. Improve

According to the results after evaluating with Six Sigma control method, the major cause for power transmission over time is that Construction Work Second Section took the most time to process its work. Based on the diagram of causes for processing over time, the causes for processing over time in Construction Work Second Section are applicants, persons in charge, organizational culture, and company system framework. The applicants' provided information and their attached documents are the main problem.

The applicants are not familiar with the process of requesting for electrical services. Setting a dual-way communication platform for immediate advisory purposes is recommended. A complete version handbook of requesting for electrical services should also specify the most frequently asked areas and the corresponding solutions. All application forms and related information should as well include inside the handbook. All information should be online or can be taken by people.

In addition, during the process of requesting for electrical services, some procedures the applicants might miss or not familiar with such steps. Situations like whether an outer power line construction is needed. Or whether an approval for certain construction work is needed. Applicants may not know it. When the technicians from Construction Work Second Section come to perform the tasks and find out one or all of the above mentioned is not done, a rescheduling is required. The construction work then again is delayed.

Three senior executive's indicated that the applicants' provided information and their attached documents are the main problems. Based on the above reason, this study provided two solutions for such thorny problems. Option one is to remind the applicants to pick up a consent form for setting the access point in the proper area and with its scheduled time. The persons in charge should call the applicants to make sure whether the access point is ready two days before the constructing work. Their scheduled constructing time should be mentioned while confirming with the applicants. Option two is like previous mentioned to confirm the applicants by telephone two days prior the constructing date. If the access point is not set, one should inform the technicians in Construction Work Second Section. The access point should be set up first then perform the overhead circuit construction. This way, the rescheduling will not be necessary and the following procedures will not be delayed.

3.5. Control

Monitoring the overall operation should be implemented. This study used the Six Sigma control method to shorten the power supply process and improve its quality. The steps of improvement are as shown in Figure 3.

Through the improvement strategy mentioned above, the power supply over time from the Construction Work Second Section is reduced from 66% to 30% (see Figure 4).

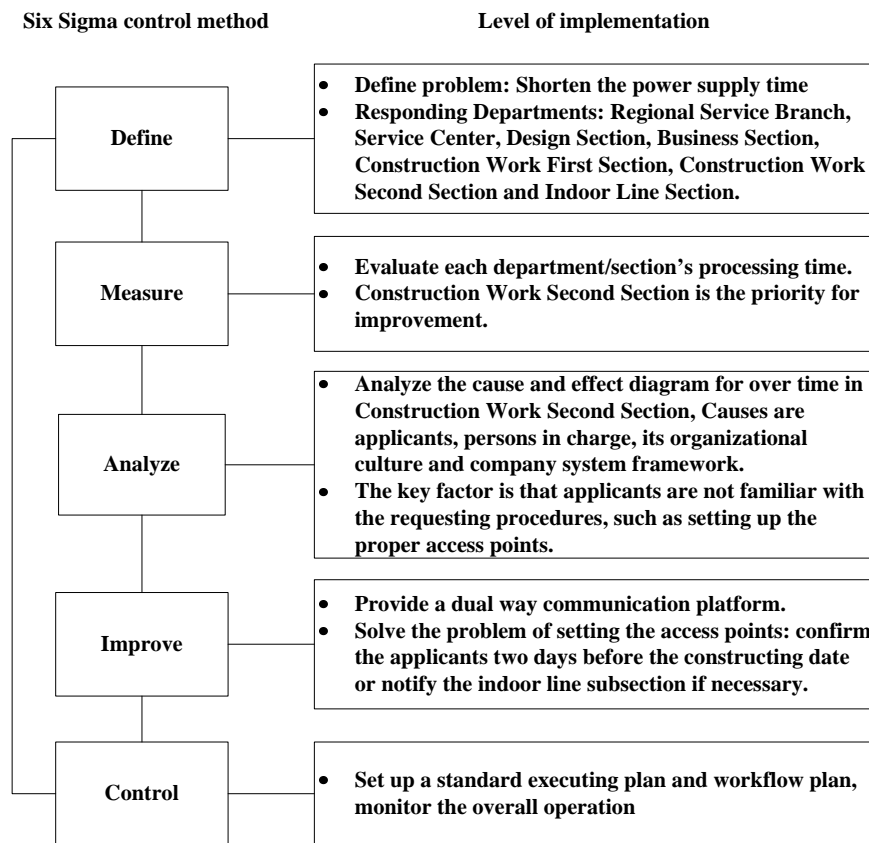


Figure 3. Shorten the power supply time by implementing Six Sigma

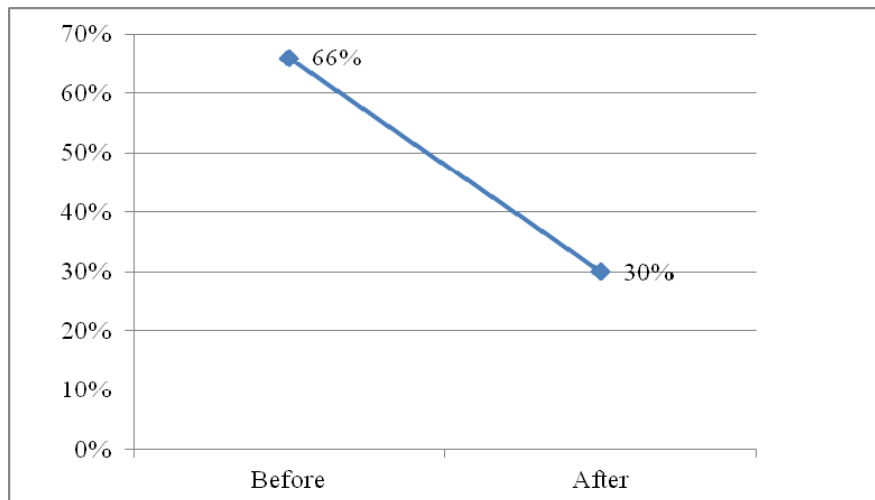


Figure 4. Before and after improvement of the line chart in department of Construction Work Second Section

4. Conclusion

Although Six Sigma control method has been successfully applied in many different industries, such as physical disabilities services [12], case reporting system [13], semiconductor industry [14], it has not yet been applied to power supply.

This study implemented Six Sigma control method to shorten the power supply time, enhance the TPC's services. Beginning with goal setting in the section of definition, this study wanted to shorten the power supply process time. The power supply time or power supply processing time is defined as starting from the beginning when requesting an electrical service to the completion of power transmission. In the section of measurement, all processing time were gathered from each department/section. The result indicated that Construction Work Second Section had 66% over the standard processing time. This section was urgent for immediate improvement. Using cause and effect diagram analysis to identify the causes for over processing time in Construction Work Second Section are applicants, persons in charge, its organizational culture, and company system framework. Among these factors, not familiar with the operating process is the most crucial.

The key factor for affecting the Construction Work Second Section's schedule is its information processing problem. Most importantly, after paying the payments, applicants have to obtain an approval for setting the access point in the property authority. Or if it's new set up, the work should be completed in advance. Most of the time, applicants may ignore such step and delay the later operating procedures. Power line construction and the power transmission work cannot be completed because of applicants' ignorance. Therefore, persons in charge should remind the applicants to obtain the consent form in advance and set up the access point. Also confirmation by telephone should be completed two days before the constructing date.

Through the improvement strategy by using Six Sigma control method, 66% processing over time is reduced to 30% in the Construction Work Second Section. Even after the implementation of Six Sigma control method, tracking each department or section's working schedules is necessary. Monitoring and controlling in the set range should be acknowledged. A Workflow chart with its standard executing plan should be developed and established. Monitoring the overall operation should be implemented. Regular education training is needed to upgrade staffs' quality, strengthen the process cycle, solve problem, improve performance efficiency, and enhance overall service quality of TPC.

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