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Six Sigma in the Service Industry

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ABSTRACT

This study sorts out the origin and development of Six Sigma management theory, elaborates on the connotation of Six Sigma and the current situation of industrial application, focuses on the application of Six Sigma in the service field, and analyzes and reviews the application of Six Sigma from the micro and practical levels. The final conclusion is that service industry companies improve service quality and efficiency by using Six Sigma methods, train employees to enhance their professional abilities, and optimize service processes under data-driven conditions to achieve financial efficiency enhancement.

KEYWORDS

Service industry; Six Sigma; DMAIC

1. INTRODUCTION

Six Sigma, as a business strategy, has been recognized as a necessary condition for enterprises to achieve operational excellence [1]. Six Sigma is a product-driven management approach that assists organizations in achieving strategic goals. The Six Sigma management approach focuses on minimizing defects in goods, services, and processes in order to improve the quality of operations and products [2].

In 1987, Bill Smith, a senior engineer and scientist in Motorola's communication division, first proposed the concept of Six Sigma to address high-quality warranty claims. Motorola spent $170 million over three years on education and training for workers, resulting in cost savings of $2.2 billion in quality improvement. General Electric (GE) began implementing the Six Sigma project in 1995 and is one of the most successful companies. Jeffrey R. Immelt, the CEO of GE's board of directors, once said: "We are in the ninth year of implementing Six Sigma at GE. It has become a permanent advocacy—Six Sigma is our way of working." In 2002, GE completed more than 50,000 projects, mainly focusing on three aspects: solving problems in cooperation with customers; improving internal processes to improve the customer interface; and improving the process of high-tech products and services flowing into the market. Six Sigma, by creating repeatable and reliable processes, enabled GE to reduce cash in inventory and accounts receivable [1].

In the 2000s, the combination of Six Sigma and Lean Production became Lean Six Sigma. This development is achieved by reducing the process variations used in Six Sigma and eliminating non added value through lean methods. Six Sigma and Lean philosophy go hand in hand, providing problem-solving tools and knowledge to solve Lean problems. Lean Six Sigma originated in the manufacturing industry, and its earliest application in the service industry was in the financial department of General Electric. Later, some larger financial institutions such as Bank of America and Citibank began to implement [3]. Lean Six Sigma to improve their services. The concealment and

significant waste of non value added work in the service industry are the driving force and important reasons for introducing Lean Six Sigma, and the development of information technology also provides convenience for obtaining Lean Six Sigma data [4]. After the great success of Six Sigma in manufacturing applications, many companies have found that Six Sigma can also have a profound and significant impact on their own enterprises, and have vigorously promoted it. These companies include Ford, Caterpillar, DuPont, Dow, ABB, 3M, Toshiba, Samsung, LG, Siemens, Ericsson, Intel, Microsoft, Citibank, and so on. Nowadays, the application of Six Sigma has spread from Motorola and General Electric to the whole world; From the West to the East; From Fortune 500 companies to ordinary small and medium-sized enterprises, from traditional manufacturing to service industries such as logistics, finance, aviation, and e-commerce.

2. SIX SIGMA MANAGEMENT THEORY

2.1. Theories Related to Six Sigma

Sigma (б) is a measure that represents "standard deviation" in statistics, indicating the dispersion of a set of data. In Six Sigma management theory, it represents the deviation of the service performance characteristics and their average performance, that is, it indicates the deviation between the quality level of the products and the quality level required by the customers. The higher the level of sigma (б), the more the products can meet the quality requirements of the customers [1, 4]. Six Sigma is both a business improvement philosophy and a problem-solving methodology. Currently, there is no precise and authoritative definition of Six Sigma. Some people believe that Six Sigma provides tools and techniques to determine what slows down the manufacturing process, how to eliminate delays, and improve processes to solve problems. It is a philosophical concept that can reduce costs, reduce errors, and improve the quality of products and services by eliminating a large amount of waste generated in the production and transportation process of products and services, and drive continuous improvement of the company by continuously improving quality and processes (Brue, 2006) [5, 6]. Others believe that Six Sigma is a technique for identifying important factors affecting customer satisfaction through data measurement and statistics (Akpolat, 2004) [7]. At the same time, Six Sigma is also often seen as a management philosophy, a quality improvement process that starts with the voice of the customer and ultimately solves customer problems. It is a process that achieves the highest customer satisfaction through continuous improvement in quality, which can not only effectively reduce costs but also significantly improve the company's profit level, shorten the cycle, eliminate errors, and improve customer satisfaction (Heuring, 2004) [8].

2.2. Six Sigma Process Methodology-DMAIC Methodology

DMAIC is an acronym for Define, Measure, Analyze, Improve, and Control, which correspond to the five major implementation steps of a Six Sigma project.

1) Define Phase: In the Define phase, it is necessary to determine what the problem to be solved is, and to identify the true needs of the customer through the Define phase. Data collection from customers is the first step to clarify their needs. After collecting effective data, establishing a customer feedback system to analyze the collected data is essential. Finally, clarify the problem to be solved and the prerequisites and objectives of the research. In addition to the initial data collection from customers, companies also need to continuously collect new user feedback, update and review customer feedback data to find opportunities for self-improvement. The last step in the Define phase is to analyze the collected data, and companies should try to present the data in a visual and quantifiable form. By implementing the Define phase, companies can determine the nature of the research object and the most suitable problem for their capabilities, in order to select the target group, required work, project scope, and implementation strategy. The most commonly used tool in this phase is statistics, which serves as a graphical description of the problem to be solved [9, 10].

2) Measure Phase: The Measure phase mainly refers to the process measurement phase, the main purpose of which is to collect and measure relevant data and information to determine the current state and understand the current performance level [10]. Common measurements include daily production totals, defects detected during assembly, etc. The fundamental purpose of measurement is to identify key factors, clarify the current state, and focus on the problem [13].

3) Analyze Phase: The Analyze phase mainly determines the causes of defects or variations. After identifying the causes, start from the key reasons to find the space for improvement, reduce or eliminate factors affecting efficiency, and provide insights for the Improve phase [13].

4) Improve Phase: The main focus is to make changes to the defects in the production process to ensure that the defects are resolved. List the causes identified in the Analyze phase and sort out solutions for each cause [13].

5) Control Phase: The main purpose of the Control phase is to achieve sustainable development of the system. Through regular checks and adjustments of the system, control the new process and future performance, so that the system can operate stably and well. Without monitoring in the Control phase, old practices will re-emerge, erasing all existing progress [2].

2.3. Current Status of Six Sigma Industry Application

2.3.1. Application of Six Sigma in Manufacturing

Using the DMAIC method to analyze the current status of production quality management in the manufacturing industry, explore its shortcomings, identify factors affecting production quality, and make targeted improvements and optimizations to improve product quality [11]; apply the DMIAC method to diagnose, analyze, and find problems in the procurement process system to improve the efficiency and performance of procurement processes [12]; in addition, Six Sigma management can also be used to improve the accuracy of raw material inventory, improve electronic assembly paths, and optimize production line improvements.

2.3.2. Application of Six Sigma in the Construction Industry

Six Sigma can be used in the construction industry for quality cost control and construction project supply chain risk control. Applying the DMAIC method to delve into various business processes, identify and analyze potential problems and bottlenecks, enable companies to identify the causes of quality issues and additional costs, supplemented by relevant data analysis and real-time monitoring and control, to achieve the purpose of improving quality and cost control; using the DMAIC method to control the capital chain and information flow, is to continuously improve and improve in the operation, and then to analyze and evaluate construction engineering projects, to the construction engineering supply chain process, based on the principle of pull and flow, to enhance robustness and key factors, to achieve risk control of the supply chain.

2.3.3. Application of Six Sigma in the Medical Industry

Six Sigma management can effectively address various issues and challenges faced by medical enterprises, especially in the field of medical research and development. The DMAIC process of Six Sigma assists medical companies in analyzing and improving their R&D processes, identifying flaws and eliminating them, thereby enhancing the efficiency and success rate of medical research and development.

In addition, Six Sigma management has now entered the fields of finance, IT, new energy, etc. The financial industry improves transaction efficiency, reduces error rates, optimizes customer experience, and enhances the competitiveness of financial products; the service industry uses Six Sigma to improve service quality and efficiency; and the IT industry uses Six Sigma to pursue the production of high-quality products.

3. THE APPLICATION OF SIX SIGMA IN THE SERVICE SECTOR

With the rapid growth of China's economy, the service industry has become increasingly important in our country's economy. How to quickly and efficiently develop our service industry to promote the continuous development of our society and economy is an important issue. Six Sigma management methods first achieved great success in the manufacturing industry, and it was not until the end of last century that GE began to implement Six Sigma methods and achieved tremendous success, leading Six Sigma to enter the service field. Since then, Six Sigma methods have been widely and effectively applied in the service industry. Service industry companies have improved service quality and efficiency by using Six Sigma methods, trained employees to enhance their professional capabilities, and optimized service processes under data-driven conditions to achieve financial efficiency enhancement for the enterprise.

3.1. Improving Service Quality and Efficiency Hypothesis

The T branch of the Agricultural Bank has seen a certain degree of improvement in retail business operation capabilities through the use of Six Sigma methods. The waiting time for customers has been reduced from 9 minutes and 16 seconds before implementation to 7 minutes and 32 seconds, with a 40.1% increase in the number of new customers signing up for financial management, and a 66.7% decrease in the customer complaint rate. The overall business operation level of the T branch is also continuously rising [16]; After implementing the Six Sigma management method, the IT operation and maintenance service quality of Company A has seen the average time for problem response reduced from 19.9 minutes to 16.2 minutes, a decrease of 18.6%, and the average time for problem resolution reduced from 148.8 minutes to 18.4 minutes, a decrease of 20% [17]; A certain top-tier comprehensive hospital in Jinan City optimized its medical imaging service process using the Six Sigma management method. The optimization results show that the total process time for plain CT scans was reduced from 530.12±194.78 minutes before the method was implemented to 463.99±152.57 minutes, and the total process time for enhanced CT scans was reduced from 928.87±329.10 minutes before optimization to 897.94±206.62 minutes. It can be seen that the overall process time for both plain and enhanced CT examination processes has been significantly shortened [18].

3.2. Training Employees to Enhance Their Professional Capabilities

The implementation of Six Sigma can reduce the error rate in employees' business processes and enhance their professional capabilities. The T branch of the Agricultural Bank's lobby manager, through the implementation of business optimization, increased personal retail volume by 20% compared to the previous quarter, and the effect of improving retail business capabilities was very obvious [16]; The Affiliated Cancer Hospital of Zhengzhou University divided 96 clinical nurses into two groups for an experiment. One group was the experimental group, which was trained and managed using the Six Sigma DMAIC model, while the control group was managed with conventional training. By scoring their theoretical assessment results, clinical communication skills, problem-solving abilities, and overall capabilities, it was found that the basic knowledge, professional knowledge, and total scores of the experimental group after the DMAIC training and management method intervention were all higher than those of the control group [20]. The specific score comparison is shown in Table 3-1 below:

Table 3-1. Theoretical Assessment Results of Two Groups of Clinical Nurses

Group	Experimental group (n=48)	Control group (n=46)
Basic knowledge	34.84 ± 4.82^{a}	29.34 ± 4.92^{a}
Professional knowledge	52.16 ± 6.96^{a}	49.21 ± 6.43^{a}
Total score	87.00 ± 8.87^{a}	78.55 ± 9.05^{a}

3.3. Data driven and Service Process Optimization

A gathering and transportation station collected the process parameters of its crude oil export and conducted computer simulation analysis on the collected data. Combined with Six Sigma management method, the manual crude oil temperature regulation time was reduced from the previous 10 minutes to 10 seconds, and the efficiency was improved by 98.3% [19]; D&S warehouse is a third-party logistics company that provides logistics services for manufacturing companies. It uses analysis methods such as X-Bar Chart, R Chart, and multi criteria decision model to measure and analyze various indicators of the warehouse's process cycle efficiency. Combined with the use of Six Sigma management method, the second lead time of the warehouse has been shortened from 233160 seconds to 131769 seconds, a decrease of 39.8%, and the non value added time has been reduced from 140460 seconds to 39069 seconds, a decrease of 72.1% [22]. A subsidiary of a large American oil company that provides maritime services and transportation solutions, the team collected user needs through interviews and optimized its slate distribution process using Six Sigma management methods. As a result, the "usability" of the distribution process increased by 2 points, or 66.6% [23].

In summary, Six Sigma has been widely applied in various fields of the service industry. Implementing Six Sigma management methods in service type enterprises can not only improve the quality and effectiveness of enterprise services, but also enhance employees' project management, data analysis, and problem-solving abilities, which helps employees better execute Six Sigma projects. The Six Sigma method is data-driven, and enterprises can measure service processes through various technologies, such as customer feedback surveys, operation time data collection, etc., and then conduct process analysis based on the data results to identify potential problems and opportunities.

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