

An Overview of the Origins and Development of the Six Sigma Management Theory

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Abstract: Six Sigma management from the beginning of statistical analysis to the later combination of statistics, data analysis and quality management principles, pure Six Sigma evolved into digital Six Sigma and Lean Six Sigma, helping enterprises to improve productivity, reduce costs and improve product quality, Six Sigma management has become an internationally popular and effective management method. The purpose of this paper is to explain the origin and development of Six Sigma, so as to provide some theoretical insights for scholars and business managers to carry out quality management research and practice.

Keywords: Six Sigma Management; Origin; Development; Quality Management.

1. Introduction

Six Sigma is not only a management strategy to improve customer satisfaction, reduce operating costs, shorten cycle time and strengthen the profitability of an organisation, it is also a key way for organisations to gain an edge in a competitive environment and achieve sustainable development. It is a management philosophy that reflects a deep consideration of the horizontal and vertical aspects of the multiple and deep-rooted factors that are closely related to quality.

2. Origins of Six Sigma Management

In the 1950s and 1960s, the United States economy was growing rapidly, and American products were supplied all over the world, with the quality of the products meeting the needs of the customers. In the 1970s and 1980s, the situation was different. As early as the 1960s, the Japanese accepted the idea of total quality management put forward by the American quality management expert Feigenbaum, and according to Japan's national conditions and its specific practices, so that the theory has been universally applied and innovated to improve the quality of Japanese products to improve rapidly[1]. The quality of Japanese products improved rapidly. Because of its excellent quality, many Japanese products began to Europe and the United States, and gradually occupy a certain market share, the United States of some products by the fierce competition of Japanese products. Motorola, which had contributed to the United States space industry, especially for the "A-pilot" moon landing, also faced great challenges, and many markets were continuously taken away by Japanese competitors.

Motorola's management team observed that when Japanese companies took over some American companies, they were able to dramatically reduce the defect rate in the manufacturing process from 15 per cent (under American management) to only 4 per cent simply by modest equipment upgrades and incorporating Deming's theory of quality management. This dramatic improvement led Motorola executives to realise that the problem essentially stemmed from their own management system. In order to meet the tough market challenges, Motorola executives had to accept

the fact that the quality of their products was lagging behind that of their competitors.

At the same time, Motorola engineer Michael Harley began to put into practice the theories of world-renowned quality pioneer Deming. Convinced that "process fluctuations are the root cause of quality defects and that a scientific methodology is needed to improve quality," he committed himself to applying it to the practice of reducing product defects. In his quest, he developed a methodology to effectively reduce process fluctuations. Harry named the method "Six Sigma" because of its extensive use of statistical knowledge and techniques. This methodology not only optimised product quality, but also gave Motorola a significant competitive advantage[2]. The Six Sigma methodology not only optimised product quality, but also gave Motorola a significant competitive advantage.

In 1998, 10 years after the introduction of Six Sigma management, Motorola was resilient, surviving and thriving.

We were among the first to receive the Nobel Prize in the field of business in the United States, the "Porto Ricci National Quality Award".

Enterprise. Motorola company to implement six sigma management 10 years of results show that six sigma management is not just reduce the defects, at the same time, the company average annual productivity increase of 12.3 per cent, quality defects caused by the cost of consumption reduced by 84 per cent, the operation of the process of error reduced by 99.7 per cent, saving more than \$ 11 billion in manufacturing costs. Today, Motorola is a world-renowned brand.

3. Development of Six Sigma Management

Six Sigma management has gone through a total of three phases, the early development phase (1980s to early 1990s); the popularisation and spread of Six Sigma (mid-1990s to early 2000s); and the evolution and expansion of Six Sigma (2000s to present).

3.1. Early Stages of Development

In the early stages of Six Sigma, the introduction of the methodology at Motorola resulted in significant quality

improvements in the production process, as well as considerable cost savings. However, the original Six Sigma concept was largely limited to statistics. The company initially measured product quality using a metric called Defects Per Unit (DPU), which was calculated by dividing the number of defects found at any inspection point by the number of units that passed through that inspection point. This metric does capture the number of defects per a given unit of product, but has limitations. Specifically, the DPU does not accurately reflect the severity of defects, which means that even if two products have the same DPU value, their quality levels may vary greatly depending on the nature and severity of the defects[3]. In addition, DPU metrics do not support side-by-side comparisons because different products have different levels of complexity, resulting in different opportunities for error. Complex products typically have a higher chance of error, while simple products have a relatively lower chance. Therefore, relying solely on DPU to measure product quality may lead to misinterpretation or bias of the actual quality status.

3.2. Popularisation and Diffusion of Six Sigma

Six Sigma management is really being recognised by the world, and even really taking Six Sigma, a highly effective quality

The transformation of quantitative management strategies into management philosophies and practices, leading to the formation of a corporate culture, was the contribution to the world of General Electric under the leadership of Jack Welch.

In 1992, Bossidy, as the right-hand man and close friend of Jack Welch, CEO of General Electric, successfully introduced the Six Sigma management concept to the United Signal Corporation and reaped remarkable results. This achievement caught Welch's attention, and he realised that Six Sigma management had helped a number of companies achieve huge successes[4]. Six Sigma has helped many companies achieve great success. Although GE was a leader in many areas of its business, Welch analysed the company and found that it was still spending an additional \$7 billion to \$10 billion a year on scrap, rework, transaction error correction and inefficiencies. At the time, GE's quality levels were still between three sigma and three point five sigma.

Faced with this challenge, Welch decided to make GE a Six Sigma company. Under his leadership, GE officially launched its Six Sigma management programme in January 1996. Welch declared at the company's annual meeting that year that it was "the single greatest opportunity in the company's history to grow, profit and satisfy every employee."

However, Six Sigma as Welch sees it has moved beyond its original definition. It is not just a statistical tool, although it relies on statistical techniques, and it is not just concerned with quality improvement, although it ultimately improves quality dramatically. Welch elevated Six Sigma to the strategic level of a company's core competencies. According to him, Six Sigma was "the most important development strategy General Electric had ever experienced".

Although GE only began to include Six Sigma as the first of its three strategic initiatives (the other two being globalisation and services) and to implement Six Sigma process changes across the company in early 1996, the implementation of Six Sigma management has led to its gradual evolution from a quality management methodology to the world's most popular and effective quality management theory[5].

3.3. Evolution and Extension of Six Sigma

Following the pioneers such as Motorola, DXN, Unicredit/Honeywell, General Electric, almost all of the world's 500 mandatory modelling companies have implemented Six Sigma management strategies, especially Japanese companies that have been leading in the field of quality have also joined the ranks of the implementation of Six Sigma at the beginning of the 21st Century, including Sony and Toshiba, and South Korea's Samsung and LG have begun their journey towards Six Sigma. It is worth noting that since the successful implementation of Six Sigma management by General Electric, some of the world's leading companies have applied Six Sigma strategies to optimise all of their business processes, not just limited to manufacturing processes. More and more service enterprises, such as the largest bank in the United States, Citibank, the world's largest B2C website company, etc. have also successfully adopted Six Sigma strategy to improve the quality of service and maintain a high degree of customer loyalty. So Six Sigma management is no longer a pure, manufacturing-oriented business process management methods and strategies. Internationally, even some governmental organisations have begun to adopt Six Sigma concepts to improve government services.

3.4. Six Sigma Management in China

With the remarkable achievements of Motorola and General Electric due to the implementation of Six Sigma quality strategies, Six Sigma has gained wide recognition in the management community worldwide and has gradually become a cutting-edge topic in the field of management. Currently, many top companies have adopted Six Sigma as their quality management strategy in order to maintain and expand their success.

However, Chinese entrepreneurs' awareness and learning of Six Sigma started around 2000. From about 2002, more and more Chinese enterprises started to introduce Six Sigma management, including well-known companies such as Baosteel, TISCO, COSCO, Lenovo, Gree, Meilan, Midea, TCL and so on. These companies have achieved different levels of results after implementing Six Sigma management.

For example, Baosteel launched its first Six Sigma pilot project at its hot rolling mill in 2002, generating a financial contribution of up to RMB 240 million for the company that year alone. On the basis of the success of the pilot programme in the hot rolling mill, Baosteel further put forward the "Six Sigma Lean Operations" strategy in 2003, combining the Six Sigma strategy of solving "defects" and "volatility problems" with the Six Sigma strategy of solving "waste". Six Sigma, which addresses "defects" and "volatility", is combined with Lean Operations, which addresses "waste" and "speed", to realise the complementary advantages of the two management methods.

As another example, according to the December 2005 issue of Quality Culture, through the implementation of Six Sigma operations, the TCL Group has significantly reduced the customer complaint handling time of the Electrical Division from the longest 44 days and the shortest 15 days to 3.5 days; the Computer Division has reduced the defective rate of products coming off the production line by 7 per cent; and the Multimedia Electronics Division has completed 64 review projects, of which the benefits of the second phase have reached RMB 83 million yuan, according to the report. The input-output ratio is as high as 1:15. These successful cases

fully prove the effectiveness and value of Six Sigma management in Chinese enterprises.

In these years, the domestic service industry has also introduced Six Sigma management, such as some commercial banks have also begun to implement Six Sigma management and actively explore it. In particular, China Construction Bank is a strategic partner with Bank of America, and when it learnt that Bank of America had achieved great success using Six Sigma management, China Construction Bank also started to fully implement Six Sigma management.

Six Sigma management continues to evolve and expand in China, not only being applied in the manufacturing industry, but also widely promoted in various industries such as finance, healthcare, and services. In addition, with the advancement of technology and the improvement of data analysis capability, Six Sigma methodology also focuses more on data-driven decision-making and process optimisation.

4. Conclusion

The origins and development of the Six Sigma management methodology reflect the relentless efforts and continuous exploration of organisations in their pursuit of quality, efficiency and competitiveness. By combining the principles of statistics and management practices, Six Sigma provides a systematic approach to quality management to help companies achieve continuous improvement and

performance excellence. Six Sigma management methodology has not only been widely used and successfully practiced in the manufacturing industry, but has also had a far-reaching impact on different industries globally, becoming one of the most important tools to enhance the operational efficiency and competitiveness of enterprises. With the changes in the global economic environment and the development of technology, the Six Sigma methodology will continue to evolve and adapt to new challenges and opportunities.

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