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The role of the six sigma method in controlling and improving product quality

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ABSTRACT
The Six Sigma method has been proven effective in industry for reducing process variability, increasing customer satisfaction, and optimizing operational efficiency. This research aims to analyze the role of the Six Sigma method as a systematic approach in controlling and improving product quality. This research uses qualitative methods with descriptive methods. The results of this research reveal that the application of the Six Sigma Method in controlling and improving product quality has a significant positive impact. Controlling process variability, focusing on customer satisfaction, and using statistical methods in data analysis have succeeded in increasing product consistency, building customer loyalty, and providing a strong basis for fact-based decision making. Implementation of the DMAIC concept provides a structured framework for continuous improvement, while cross-functional employee involvement creates a work environment that supports collaboration and innovation.

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INTRODUCTION

Industry is an economic sector that has the main objective of increasing the prosperity and welfare of society through efficient use of human resources, cost management, optimization of natural resources, and various other factors (Crouch & Ritchie, 1999). One form of industry that has a crucial role in achieving this goal is the processing industry. The processing industry is an industrial sector that focuses on the process of transforming raw materials into semi-finished or finished products (Larger et al., 2017). In this process, added value is given to the product through various stages of production, so that the final result has a higher economic value compared to the initial raw materials. This value addition process involves various skills and technologies to produce high quality products (Sathre & Gustavsson, 2009).

In the context of the processing industry, utilization of human resources is the main key in achieving efficiency and productivity. Involving a workforce that is skilled, innovative and has deep knowledge of modern production technology is an important factor in improving product quality and industrial competitiveness in the global market (Caeneiro, 2000). Not only that, cost management is also a crucial factor in the processing industry. Efficiency in the use of raw materials, energy and production processes is a challenge that

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needs to be overcome to ensure operational sustainability and long-term profitability (Yusuf etal., 1999).

Optimizing natural resources is also a major concern, considering that processing industries often depend on raw materials from nature. Environmentally friendly practices and the development of green technology are important elements in maintaining a balance between industrial growth and environmental conservation (Goldman & Nagel, 1993). The development of the processing industry is not only about increasing production efficiency, but also about creating a positive impact on society, the environment and the economy as a whole (Lieder & rashid, 2016). Integration of the latest technology, effective human resource management and awareness of environmental impacts are the keys to achieving the goals of prosperity and prosperity in the context of the processing industry (Duflou et al., 2012).

According to Forza & Filippini (1998), product quality is a critical factor that must be taken seriously by every company. Customer satisfaction, as the main benchmark, can be achieved through positive evaluation of the quality of the products they use. Customers will feel satisfaction and trust in a brand or company if the product they receive meets or even exceeds their expectations regarding quality. Customer satisfaction with product quality not only impacts specific transactions, but also has significant long-term implications. As highlighted by Anderson et al. (1994), customer satisfaction with product quality can be the main driver for building loyalty. Customers who are satisfied with product quality tend to become loyal customers, which then forms a strong basis for loyalty. Not only will they continue to use the products offered by the company, but they may also become brand ambassadors who provide positive recommendations to others (Zhou et al., 2008).

Customer loyalty is not just a short-term gain; the company also sees it as a long-term investment that can protect and improve its results in the future. By having loyal customers, companies can achieve stability in market share and increase their resilience to changes in market trends or competition (O,Malley, 1998). Customer loyalty also plays an important role in building a positive company image, creating a strong customer base, and ensuring business sustainability. the company not only saves existing customers, but also protects itself from the risk of losing market share (Dowling & Uncles, 1997). Therefore, paying serious attention to product quality, maintaining customer satisfaction, and developing customer loyalty is an important strategy for companies in achieving long-term success and business sustainability (Bernan, 2006).

To improve quality in a company, a company can apply a method called Six Sigma. Six Sigma is an effective management method in improving quality within a company. This method not only replaces the role of Total Quality Management (TQM), but also brings a more focused and measurable approach to quality improvement (Antony & Banuelas, 2002). While TQM provides general guidance about maintaining and improving quality without always proving the success of those improvements, Six Sigma offers a more detailed and measurable approach (Revelle & Kemerling, 2005).

In comparison with TQM, Six Sigma's contribution is more focused on customer or consumer value. Six Sigma allows companies to more accurately identify specific aspects that need to be improved in performance or systems to meet customer expectations

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(Folaron & Morgan, 2003). By emphasizing the reduction of process variability, Six Sigma provides a strong foundation for measuring and improving product or service quality. The importance of focusing on customer value in implementing Six Sigma has a positive impact on the production process (Basu, 2009). By applying this method, companies can systematically identify, measure, analyze, improve, and control variability in their processes. The result is increased efficiency, reduced defects, and more consistent service (Antony & Banuelas, 2002).

What differentiates Six Sigma is its ability to provide concrete evidence of successful quality improvement. By using a data-driven approach and focusing on measurable results, Six Sigma has proven itself to be a reliable tool in solving problems that arise in companies, especially those related to improving quality. Therefore, the application of Six Sigma not only provides clear direction in improving quality, but also provides concrete solutions to overcome the challenges faced by the company.

METHOD

This research uses a qualitative descriptive approach with the main aim of uncovering and explaining phenomena, events, facts and circumstances that occurred during the research. The focus is on presenting the true reality (Gerring, 2017). The data used comes from secondary literature, such as journals, previous research, scientific articles, and other sources of information. Data analysis follows the Miles and Huberman (1994), which includes data collection, data reduction, data presentation, and drawing conclusions and data verification. The data analysis process begins with collecting data from various sources, followed by a data reduction stage to filter and summarize the main relevant points. The reduced data provides a more focused picture. Next, the data is presented and arranged based on the previous process to facilitate understanding of research findings. This research concludes the results and verifies the findings, ensuring interpretations and conclusions are in accordance with existing data.

RESULTS AND DISCUSSION

Six Sigma is a comprehensive and flexible system that aims to achieve, provide support, and maximize business processes. The focus lies on understanding customer needs by utilizing facts, data, statistical analysis, and a continuous commitment to adjustment, improvement, and re-evaluation of business processes (Yang et al., 2003). The "zero defect" concept applied by Six Sigma refers to efforts to overcome errors that arise due to lack of knowledge by utilizing modern techniques. Additionally, errors stemming from lack of adequate facilities can be addressed through regular surveys of plant and equipment. The role of Six Sigma in controlling and improving product quality is as follows.

Process Variability Reduction

Six Sigma applies a very strong focus to controlling and reducing process variability in a production context. By identifying the factors that cause variation in a production process, Six Sigma seeks to increase the consistency of the products produced. In essence, variability can create uncertainty in production results and lead to products that do not meet desired quality standards. Through detailed analysis steps, Six Sigma allows companies to better

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understand the sources of variability in processes. By knowing and understanding these aspects, companies can take concrete actions to reduce or eliminate the causes of this variability. This includes close monitoring of every step in production and correction at any point where variations may occur.

Tighter control of quality specifications is one of the main results of the Six Sigma approach to variability. By reducing variation, companies can ensure that the products they produce comply with predetermined quality standards. This not only increases customer confidence in the product, but also helps achieve the goal of "zero defects" which is the basic principle of Six Sigma. Furthermore, the reduction of defects as a result of well-managed variability has a positive impact on overall production efficiency. More consistent and predictable processes help companies avoid wasting resources and optimize productivity. Thus, Six Sigma's contribution to control and reduction of variability in production processes not only leads to improved product quality, but also to increased efficiency and operational excellence.

Orientation to Customer Satisfaction

Six Sigma, by implementing the concept of "zero defects," pursues the goal of creating products without defects. The main focus is not just on quality control, but furthermore on in-depth understanding of customer needs. By understanding customer desires and expectations, Six Sigma strives not only to achieve predetermined quality standards, but also to exceed customer expectations. Through this approach, Six Sigma not only becomes a system for ensuring that products meet quality specifications, but also becomes a tool for increasing customer satisfaction. A deep understanding of customer needs allows companies to tailor products and services in a more precise manner, creating a positive experience for customers.

Improved customer satisfaction through the implementation of Six Sigma has a wider impact, namely forming customer loyalty. Customers who are satisfied with a product or service tend to remain loyal to the brand or company. Customer loyalty creates long-term relationships that provide benefits both in terms of customer retention and product recommendations to others. By achieving zero defects and focusing on customer satisfaction, Six Sigma builds a strong foundation for building customer loyalty. Customer loyalty, in turn, not only creates a stable customer base but also helps companies in maintaining and increasing market share. In this way, Six Sigma becomes more than just a quality method; it becomes a strategic tool for achieving competitive advantage through deep understanding and responsiveness to customer needs.

Use of Statistical Methods

By integrating statistical methods in process analysis, Six Sigma is transformed into an approach that allows companies to make decisions based on facts and data that can be measured accurately. The use of statistical methods in the context of Six Sigma provides a powerful analytical framework for analyzing various aspects of the production process. Through this approach, Six Sigma facilitates more thorough identification of the root causes of problems. Statistical analysis allows companies to look deeper into data and identify patterns or trends that may not be immediately apparent. In this way, companies can

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determine the root cause of problems more accurately, minimize speculation, and focus on more targeted improvements.

Decisions taken based on facts and measurable data ensure that quality improvement strategies are based on reliable information. This reduces the risk of making wrong or inappropriate decisions, thereby increasing the effectiveness of implemented corrective measures. Additionally, this data-driven approach provides a strong foundation for evaluating the impact of implemented changes on overall product quality. By using statistical methods, Six Sigma empowers companies to not only address problems as they arise, but also prevent similar problems from arising in the future. The use of strong data helps companies to better understand the dynamics of production processes and make smarter decisions in optimizing operations and improving product quality in a sustainable manner. Thus, the integration of statistical methods in Six Sigma is not only an analytical tool, but also the foundation for making smarter and more measurable decisions in the context of quality improvement.

Continuous Improvement Cycle

The DMAIC (Define, Measure, Analyze, Improve, Control) concept in Six Sigma provides a structured framework for continuous improvement in business processes. This approach provides step-by-step guidance that allows companies to systematically increase efficiency, reduce variability, and improve product or service quality. The first step in DMAIC is “Define,” where the company determines specific goals for improvement and identifies important constraints and parameters. This creates a clear understanding of the improvement project to be undertaken. Then, the “Measure” step involves collecting data to evaluate the current performance of the process. By measuring and analyzing data, companies can get a clear picture of the extent to which the quality of existing products or services meets standards.

Moving on to the “Analyze” step, companies explore the data further to identify the root cause of the problem or potential improvements. In-depth analysis helps Six Sigma teams understand the factors that influence process performance. The “Improve” step involves implementing the solutions and improvements identified during the analysis. This action is aimed at improving the process and achieving the stated improvement goals. Finally, the "Control" step includes developing a control system that ensures that implemented improvements remain sustainable and consistent. This involves creating guidelines and procedures to ensure that improvement results can be maintained over the long term.

By conducting repeated evaluations using the DMAIC approach, companies can not only identify areas that require improvement, but can also implement corrective actions systematically. Additionally, this approach allows companies to continuously monitor and measure improvement results, creating a continuous improvement cycle that supports achieving quality and efficiency goals. Thus, DMAIC becomes a powerful instrument for companies committed to achieving operational excellence and quality through the Six Sigma approach.

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Understanding Data and Facts

Six Sigma, with its emphasis on careful data collection and analysis, presents an approach that is highly focused on facts and measurable information. By carefully mining and analyzing data, companies can gain a deep understanding of process performance, variability, and other key aspects that influence product or service quality. The importance of careful data collection is that companies can make decisions based on accurate and objective information. Valid and measurable data allows companies to evaluate process performance clearly and objectively, identify areas that require improvement, and measure the impact of improvements that have been implemented.

By utilizing careful data, Six Sigma helps avoid making decisions based solely on intuition. Data-driven decisions provide a stronger basis for measuring the effectiveness of improvement measures, preventing speculation and reducing the risk of error. This is especially important because the decisions made have a direct impact on product quality, operational efficiency, and customer satisfaction. Additionally, careful data collection allows companies to identify trends or patterns that may not be immediately apparent. With this deeper understanding, companies can take more targeted and strategic actions to improve quality and efficiency. In the context of Six Sigma, data collection and analysis is not just an analytical tool per se, but rather the foundation for wise decision making, continuous improvement, and achievement of established quality goals. In this way, Six Sigma leverages data as a critical tool to achieve operational excellence and sustainable quality.

Efficiency and Productivity

With a primary focus on reducing defects and improving quality, Six Sigma not only improves product outcomes, but also has a positive impact on a company's overall efficiency and productivity. Processes that are run more efficiently and of higher quality intrinsically provide significant benefits across various operational aspects. First of all, improving quality through the implementation of Six Sigma means less defects or failures in production. This leads to reduced levels of waste, such as a reduction in products being rejected or needing to be reprocessed. Thus, Six Sigma makes a significant contribution to operational efficiency by reducing losses and increasing production yields.

Additionally, more efficient processes and increased productivity enable companies to optimize the use of resources, including labor, raw materials and time. Cost savings resulting from operational efficiency can be allocated to other investments or increase the company's net profits. In a fiercely competitive market, the increased competitiveness brought about by operational efficiency can be a significant advantage. Improved operational efficiency through Six Sigma also provides an advantage in responding more quickly to market changes or customer needs. With a more responsive process, companies can be more agile in developing strategies and facing challenges that arise in the market. In other words, Six Sigma not only creates high quality products, but also has a holistic positive impact on company productivity and efficiency. This helps create a strong foundation for competitiveness in the market, ensure business sustainability, and achieve long-term goals.

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Employee Engagement

Six Sigma not only focuses on improving product or process quality, but also encourages employee involvement as a key element in these improvement efforts. Involving employees in Six Sigma projects opens the door to strong synergy between various cross-functional teams across the organization. Why is engaging employees so important? Employees, as key stakeholders in a production or service process, have valuable insight into daily challenges, improvement opportunities and potential for innovation. By involving them, Six Sigma can take advantage of the diverse skills and experiences possessed by each individual.

Cross-functional teams in Six Sigma projects create a collaborative platform where various departments and divisions can actively contribute. This not only enriches the conversation with different perspectives, but also allows for the exchange of ideas and knowledge that can strengthen improvement solutions. Involving employees across levels and functionalities also provides a boost to team spirit and ownership of the desired improvement outcomes. Additionally, employee participation in Six Sigma projects creates a sense of shared responsibility for the quality of the product or service. This can establish an organizational culture that is more open to innovation and continuous improvement. Employees who feel heard and empowered to contribute to improvement can be effective change agents in achieving quality goals. The importance of employee involvement in Six Sigma is not only to bring diversity of ideas and expertise, but also to build a sense of shared ownership of improvement goals. Thus, Six Sigma is not only a method of improvement, but also a catalyst for building an organizational culture that is proactive and continuously innovates.

CONCLUSION

Six Sigma is a holistic and structured quality management methodology and philosophy, focused on control, improvement and continuous innovation. This method has several key aspects that contribute to its success in improving product and process quality in various industries. First, Six Sigma emphasizes controlling process variability, with the concept of zero defects as the main goal. By reducing variability, companies can achieve higher product consistency and increase customer confidence. Second, Six Sigma places customers as the main focus, with the aim of understanding and meeting customer needs. By increasing customer satisfaction, Six Sigma not only controls quality but also builds customer loyalty, creating long-term relationships. Furthermore, Six Sigma uses statistical methods for careful data analysis, allowing companies to make decisions based on measurable facts and information. This helps avoid making decisions based solely on intuition and ensures improvement steps are supported by strong data. Additionally, the DMAIC concept provides a structured framework for continuous improvement, with iterative evaluation of the process to systematically identify and implement improvements. The importance of data collection and analysis in Six Sigma is also emphasized, providing an accurate and objective basis for decision making, avoiding speculation, and supporting continuous improvement. Finally, Six Sigma encourages employee involvement in quality improvement efforts. Engaging cross-functional teams leverages diverse skills and experiences across

the organization, creating a collaborative culture that supports continuous improvement and innovation.

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