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DEFECT REDUCTION STRATEGY: SELECTING THE RIGHT MANAGEMENT TOOLS

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Abstract

This research aims to improve product quality by applying the Total Quality Management (TQM), Supply Chain Management (SCM) and Six Sigma (SS) analysis approach as an effective improvement strategy to reduce the number of defects in the production process. This research method uses a quantitative method involving field surveys, data collection, and statistical analysis to identify the factors that cause dominant defects in the hydrogel production cycle in Wook Global Tecknology, PT using SmartPLS through an outer model tester, inner model and hypothesis testing. The sample used is a saturated sample, namely all employees in the quality control, totaling 83 employees. By identifying deviations from predetermined quality standards, this research aims to increase accuracy and consistency in the process production. The research results show that TQM and SCM does not have a significant effect on reducing product defect (RPD), but SS has a significant effect on reducing defective product.

Keywords: Total Quality Management; Supply Chain Management;Six Sigma;Defective Products.

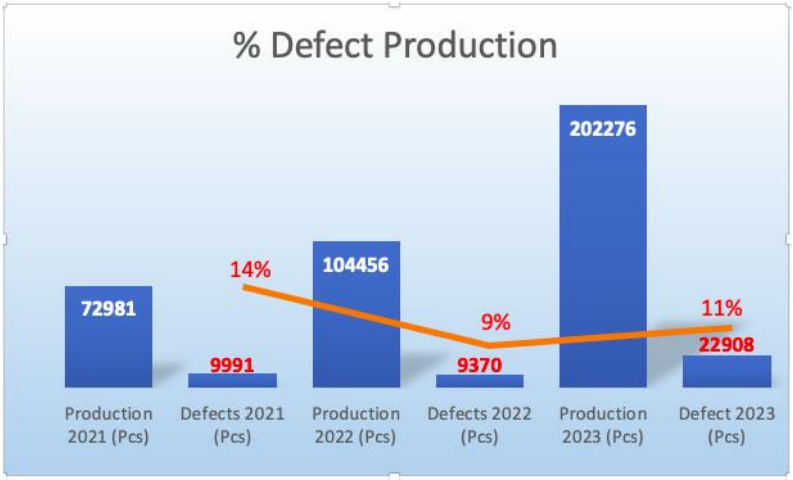
INTRODUCTION

In the current digital era, smartphone use has become an integral part of people's daily lives. The presence of smartphones is not only as a communication tool, but also as a tool to access information, entertainment, and even as a work tool. Therefore, the quality and reliability of smartphones are crucial factors that manufacturers and consumers need to pay attention to, (Purwanto, 2023).

TQM is an important aspect of management in ensuring product quality. With a systematic approach, TQM focuses on improving the quality of products or services through efforts that involve all levels of the organization, from top management to employees. Wook Global Technology is a leading cross-border export e-commerce company in China, relying on high-quality supply chain integration and digital business management capabilities, as well as high-level local retail capabilities and multi-brand operations that have entered the industries of digital accessories, home appliances, smart home, personal care, and clothing. A new ecological export e-commerce platform, which continues to push high-quality products to overseas markets, by empowering local retailers.

Based on the results of production performance, management feels that the quality produced by the company is still not optimal because the rejection rate is still above 10%. From the results of observations, product damage mostly occurs due to manpower errors; where the types of product defects include poor trimming results, bubble stains, and cutting results that don't fit on the cellphone, (Setiyo Purwanto, 2023). The following is data on production losses that occurred over three years, which can be seen in Graph 1 below.

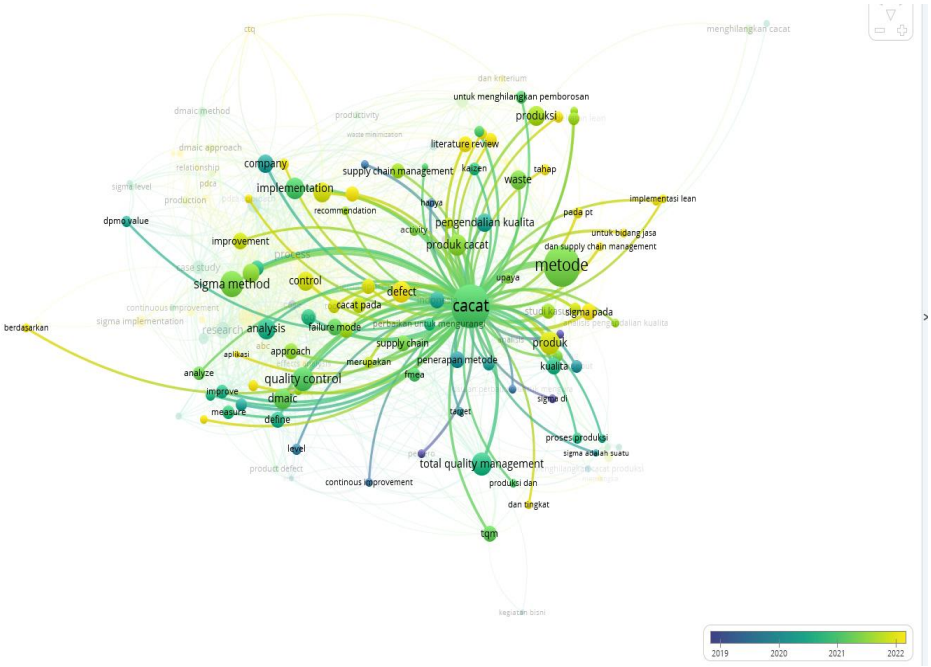
Graph 1. Rejection rate product



Source: Quality Control of Wook Global Technology, PT

In an effort to find the right management tools to reduce product rejection rates, researchers conducted a meta-analysis of data from 200 articles published in journals. Next, a research bibliometric network was formed to determine variables that are still trending in research. The following is a bibliometric network formed from research articles related to product defects. The research network that was formed can be seen in Figure 1. Bibliometic Analysis.

Figure 1. Bibliometric Analysis



Source: Vos Viewer Visualization

Several previous studies have conducted research on the effect of TQM on reducing defective products, including: (Nurdiansah et al., 2023). According to Nurdiansah, TQM has a significant influence by involving leadership models, employee participation, continuous improvement, and data-based decisions. When leaders and employees have a strong commitment to quality, product defects can be reduced.

According to research (Puri & Lisiantara, 2023) explains that the role of SCM has a positive effect on reducing defective products. To be able to implement SCM effectively, companies must be able to provide and manage an adequate data base, as well as build partnerships with selected suppliers and distributors. In the end, SCM as a whole can create synchronization through coordinating activities related to the flow of materials both inside and outside the company.

2. Literature Review and Hypothesis Development

This research uses the Juran Trilogy Quality Trilogy theory formulated by Joseph Moses (1951) which views quality as the result of good planning, effective control, and continuous improvement. then developed by Aaker (1991) who assessed quality perceptions from the customer's perspective regarding the suitability of the expected quality of a product. This theory focuses on waste and increasing efficiency. Perceived quality is explained by Elstner (2018) as an assessment of product quality as expected by customers.

2.1. Reducing Product Defect

According to (Yusuf & Supriyadi, 2020), a defective product is a product that does not comply with specifications so that it does not meet the specified quality standards, and it cannot be reworked. The defective product has a low selling value as a residual value and usually the company will not want to sell it as a second quality product, because it will damage the main product brand.

Researcher (Wisnubroto et al., 2018) explained that, products made in the production process have defects that cause their value or quality to be poor. Seven tools are a quality control tool used by middle management for its sub-ordinates, consisting of Check Sheet, Histogram, Scatter Diagram, Control Chart, Pareto Diagram, Cause and Effect Diagram / Fishbone Diagram, and Stratification.

2.2. Total Quality Management

TQM literally comes from the word "total" which means whole or integrated, "quality" which means quality, and "management" has been equated with management in Indonesian which means management. So TQM can be interpreted as integrated quality management. Instilling a TQM culture in an organization is not easy, considering that the backgrounds of organizational members vary, including education, experience, culture/tradition. Therefore, cultivating a TQM culture requires quite a long time. However, if this can be achieved it will have a positive impact on improving quality, productivity and competitiveness to survive in local and regional competition, (Yulihardi, n.d.).

(Nurdiansah et al., 2023) complements with his opinion that, TQM is a management approach that focuses on improving product quality with a process that involves all members of the organization. TQM implemented in companies seeks to reduce the number of defects by implementing practices such as strict quality control, employee training, and empowering team members to identify problems and address the root causes of defects.

According to (Nurdiansah et al., 2023), the indicators for measuring TQM are: (1) Defect Rate (DR): measures the number of defective products in a certain period compared to total production in that period. The lower the defect rate, the better the product quality. (2) Fist Pass Yield (FYP): measures the percentage of products that pass quality tests in the first round of production without requiring additional improvements or reprocessing. The higher the FPY, the more efficient and effective the production process. (3) Cost of Poor Quality (COPQ): measures the costs resulting from defective products, including testing costs, reprocessing, product returns, and reputation loss. Reducing COPQ is an important goal in TQM. (4) Customer Complaints (CC): measures the number and type of customer complaints related to defective products, this indicator can also be directly used to measure customer satisfaction with product quality. The fewer complaints received, the better the product quality.

(5) Process Capability (PC): measures how well the production process can meet specification standards. A higher PC will produce fewer defective products. (6) Employee Involvement (EI): measures the active involvement of employees in quality improvement efforts through improvement team training, this activity will have a positive impact on reducing the number of product defects. (7) Supplier Quality Performance (SQP): measuring the quality of raw materials and components from suppliers is important in controlling production defects. (8) Lead Time (LT): measures the time required from the start to the end of the production process. If the production process is rushed, errors may occur. Developing a realistic/not rushed production schedule and reducing lead time is also an important factor in controlling the number of defects.

2.3. Supply Chain Management

SCM is a further development of product distribution management to meet consumer demand. This concept emphasizes an integrated pattern involving the product flow process from suppliers, manufacturers, retailers to consumers. From here, the activities between the supplier and the final consumer are in one unit without large barriers, so that the information mechanism between the various elements takes place transparently. SCM is a concept that concerns optimal product distribution patterns, production schedules and logistics, (Puri & Lisiantara, 2023).

At first glance, the SCM concept has similarities with logistics management in terms of increasing the efficiency and effectiveness of goods management, because both manage the flow of goods and services through purchasing, movement, storage, administration and distribution of goods. The difference between SCM and logistics management lies in its orientation. SCM seeks relationships and coordination between processes from other companies in the business line, from suppliers to customers and also prioritizes the flow of goods between companies, from the most upstream to the downstream. Meanwhile, logistics management focuses on planning and frameworks that produce a single plan, focusing on the flow of goods and information within the company, (Purwanto, 2019).

2.4. Six sigma

SS is a new management tool that focuses on quality control by exploring the company's production system as a whole, (Salsabila et al., 2022). The fundamental capabilities of the SS philosophy aim to reduce/eliminate defects, cut product manufacturing time, and reduce costs. Apart from that, SS is also called a strategy because it focuses on customer satisfaction, prioritizing scientific disciplines and tools to achieve/support business success. The formal model built is DMAIC (Define, Measure, Analyze, Improve, Control) which is used in conjunction with others, such as

the Pareto Chart and Histogram. Success in improving quality and business performance depends on the ability to identify and solve problems, (Hidayati, 2017)

According to (Farach & Prasetyani, 2021), SS indicators include: (1) Defects per Million Opportunities (DPMO): measuring the main metric in SS which measures the number of defects in a process per one million opportunities. The lower the DPMO value, the higher the product quality level. (2) Sigma Level (SL): measures the level of process capability in producing products that meet specifications. The higher the SL, the fewer defects produced by the process. (3) Process Capability Index (PCI): measures the extent to which the process meets quality specification limits. The higher the PCI indicates that the process has a good ability to produce products according to specifications.

RESEARCH METHOD

In the current digital era, smartphone use has become an integral part of people's daily lives. The presence of smartphones is not only as a communication tool, but also as a tool to access information, entertainment, and even as a work tool. Therefore, the quality and reliability of smartphones are crucial factors that manufacturers and consumers need to pay attention to, (Purwanto, 2023).

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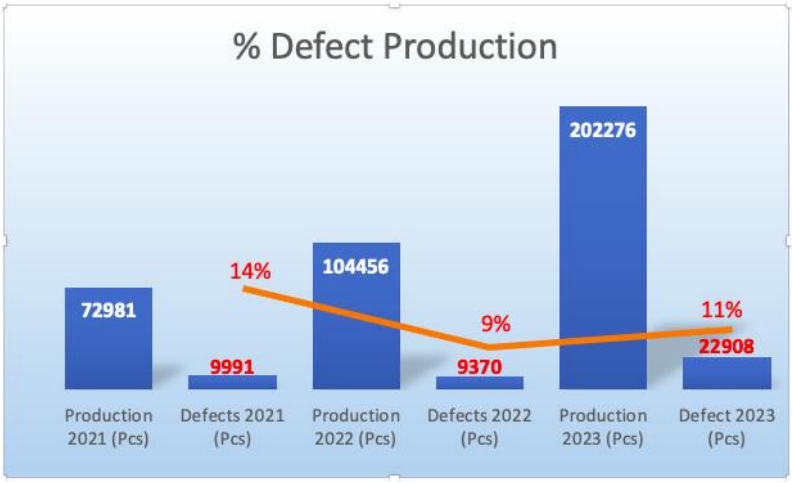

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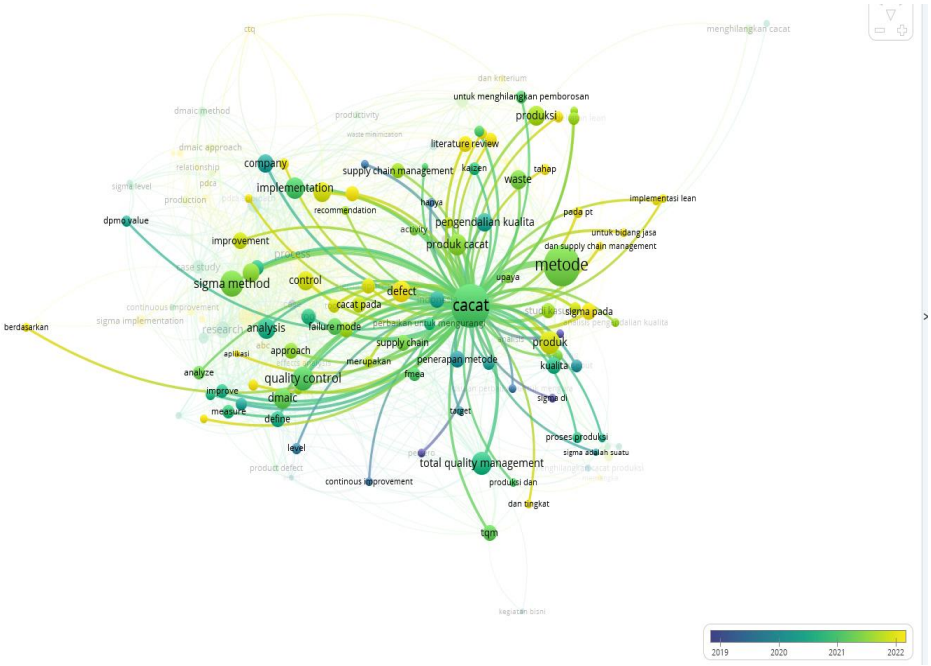

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RESULT AND DISCUSSION

Validity Test

Validity is a score that truly represents the intended variable and an assessment of various types of evidence. Meanwhile, reliability is interpreted as consistency over time, between items and between researchers, meaning that if tested repeatedly the results remain the same. Where X1 is TQM; X2 is SCM; X3 is SS and Y is RPD which can be seen in Table 1 as follows.

Table 1. Convergent Validity Test Result

Variable	Indicator	Outer Loading	Noted

TQM	X1.1	0.875	Valid
	X1.2	0.926	Valid
	X1.3	0.886	Valid
	X1.4	0.882	Valid
	X1.5	0.893	Valid
SCM	X2.1	0.802	Valid
	X2.2	0.735	Valid
	X2.3	0.754	Valid
	X2.4	0.876	Valid
	X2.5	0.921	Valid
	X2.6	0.848	Valid
SS	X3.1	0.937	Valid
	X3.2	0.899	Valid
	X3.3	0.907	Valid
	X3.4	0.918	Valid
	X3.5	0.835	Valid
	X3.6	0.907	Valid
RPD	Y1	0.781	Valid
	Y2	0.706	Valid
	Y3	0.887	Valid
	Y4	0.893	Valid
	Y5	0.900	Valid
	Y6	0.935	Valid

Source: Program SmartPLS

Based on table 1 above, it can be seen as a whole that all indicators in the four variables are valid, because they are above 0.7, (Ghozali, 2018).

Reliability Test

Composite Reliability and Cronbach's Alpha testing aims to test the reliability of instruments in a research model. If all latent variable values have Composite Reliability and Cronbach's Alpha values ≥ 0.70, (Savitri et al., 2021: 35).

Table 2. Composite Reliability and Cronbact's Alpha Test Result

	Cronbach's alpha	Composite Reliability (rho_c)	Noted
TQM	0.923	0.941	Reliable
SCM	0.907	0.927	Reliable
SS	0.953	0.963	Reliable

RPD	0.924	0.941	Reliable

Source: Program SmartPLS

Based on table 2 above, it can be seen that the results of the Composite Reliability and Cronbach's Alpha tests show satisfactory values, namely that all latent variables are reliable because all values have a value of ≥ 0.70. So it can be concluded that the questionnaire used as a research tool is reliable or consistent.

Hypothesis Test

Hypothesis testing or what is called path analysis testing in structural models is carried out using a bootstrapping procedure. The condition for an independent variable to have an influence on the dependent variable is if the t statistical coefficient results > t table and the significance value is < 0.05. Where the t table for the sample size determined with a significance of 0.05 is 1.96. So if you compare the results of the t-statistical test of the bootstrapping algorithm in Table 3, it shows that the variables X1 and X2 < t table and the significance value is > 0.05. However, this is not the case with X3, the statistical t test results are > 1.96 and the significance value is < 0.05. This means that the TQM and SCM variables have no effect on reducing product defects. Meanwhile, the Six Sigma variable has a significant effect on reducing product defects.

Table 3. Hypothesis Test Result

	Original Sample (O)	Average Sample (M)	Standard deviation (STDEV)	T statistic (|O/STDEV|)	P (values)
SS -> RPD	0.604	0.583	0.149	4.058	0.000
SCM -> RPD	0.119	0.12	0.143	0.836	0.403
TQM -> RPD	0.252	0.269	0.182	1.379	0.168

Source: Program SmartPLS

Discussion

The Effect of Total Quality Management on Reducing Product Defects

Based on the results of testing the effect of TQM on reducing product defects, it has an original value of 0.252 and has a t-statistic value < t-table (1.379 < 1.96) so it can be concluded that the first hypothesis (H1) is rejected. This means that TQM has no effect on reducing defective products. The results of this research are strengthened by previous research conducted by (Setyaningrum dan Dwiyanti, 2015). This research conducted a case study on an automotive company in Indonesia to determine the

effect of TQM on product quality, and the results of this research show that TQM has a significant effect on product quality. According to(Sari & Firdaus, 2018) also stated in his research findings that TQM had no significant effect on reducing product defects.

The Influence of Supply Chain Management on Reducing Product Defects

Based on the results of testing the effect of SCM in reducing product defects, it shows an original value of 0.119 and a t-statistic value < t-table (0.836 < 1.96) so it can be concluded that the second hypothesis (H2) is rejected. This means that in this study SCM also had no effect on reducing product defects. The results of this research turned out to be the same as previous research conducted by (Miladinovic et al., 2022) and (Amentae & Gebresenbet, 2021).

The Influence of the Six Sigma Method on Reducing Product Defects.

However, in contrast to the results of testing the effect of SS in reducing product defects, it has an originality value of 0.604 and a t-statistic value > t-table (4,058 > 1.96) so it can be concluded that the third hypothesis (H3) is accepted. This means that SS has a significant influence in reducing product defects and at the same time increasing productivity. The results of this research are in line with previous research conducted by (Yusuf & Supriyadi, 2020) and (Khulda et al., 2018) which states that SS has an effect in reducing product defects.

CONCLUSION

1. TQM has no effect on reducing product defects. After being studied in more depth, TQM focuses more on applying concepts on how to implement quality throughout management lines, not specifically building the concept of reducing product defects in operational lines.
2. SCM also has no effect on reducing product defects. It turns out that after studying it in more depth, the SCM concept focuses more on distribution management, the quality limitation is only on how to keep the goods distributed to customers well. does not always result in a drastic reduction in the number of product defects. So SCM is not a concept or methodology specifically how to reduce product defects.
3. This is different from the results of testing the effect of SS in reducing product defects, where the results state that SS has a significant effect in reducing product defects. Based on scientific literacy, this is because SS has a data driven method known as DMAIC for product manufacturing control.

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