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Analysis and Implementation of Six Sigma in the Design of an Information System at the Bank Indonesia Canteen North Sumatra

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A B S T R A C T

The conventional cafeteria services at the Representative Office of Bank Indonesia in North Sumatra Province encounter various problems, such as long queues, order recording errors, and limited access to menu information, all of which affect customer satisfaction. This study aims to analyze and implement the Six Sigma method in the design of a web-based cafeteria information system to improve service quality. Using the DMAIC (Define, Measure, Analyze, Improve, Control) framework as the core of the Six Sigma approach and the waterfall model for system development, the system was built with features such as online ordering, real-time menu information, and digital payment integration. The evaluation results showed a Defects Per Million Opportunities (DPMO) value of 93,000 and a Sigma Level of 2.82, indicating a moderate improvement in service quality. The system also achieved a customer satisfaction rate of 90.6%, although some aspects such as order waiting time estimation and ease of use still require improvement. Overall, the implementation of Six Sigma has proven effective in analyzing and enhancing the cafeteria service process through an integrated information system, contributing to better operational efficiency and user experience.

INTRODUCTION

Along with the development of information technology, efficiency in business operations is becoming increasingly important, including in the management of company canteens. Canteens in the work environment, such as the Bank Indonesia Canteen in North Sumatra, play a strategic role in providing quality food services for employees. However, the current problem in the Bank Indonesia Canteen in North Sumatra is that the current service is still conventional which causes discomfort and inefficiency, where services are still provided by the canteen manager or tenant directly which often causes problems, such as long queues, errors in manual transaction recording, delays in service, and lack of efficiency in managing menu stock and finances [1,2,3].

One approach that can be applied to improve efficiency and service quality is the Six Sigma method. One approach that can be applied to overcome these problems is the Six Sigma method, specifically the DMAIC (Define, Measure, Analyze, Improve, Control) approach. Six Sigma is a data-driven quality management method that aims to reduce process errors and increase customer satisfaction [4,5]. In developing an information system to support the implementation of Six Sigma, the Laravel framework was chosen because of its flexibility in building structured and efficient web-based applications. Laravel has features that facilitate real-time data integration to support the DMAIC phase. Therefore, to what extent is the application of Six Sigma in the information system effective in identifying and eliminating operational errors in the

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canteen (Antony, 2006). And does the integration of Six Sigma with information system design actually produce more accurate and efficient technology solutions for transactions, inventory, and customer service [7,8,9].

METHOD

This study adopts a qualitative and quantitative mixed-methods approach by applying the Six Sigma DMAIC (Define, Measure, Analyze, Improve, and Control) methodology to design and evaluate the development of an information system for the Bank Indonesia Canteen in North Sumatra. The research method is structured as follows:

1. Define Phase
   - Identification of the main problems in the existing canteen service processes through direct observation, staff interviews, and user questionnaires.
   - Determination of critical-to-quality (CTQ) factors such as service speed, transaction accuracy, inventory control, and customer satisfaction.
   - Formulation of the research problem and objective: to improve canteen operational efficiency through the implementation of an information system based on Six Sigma principles.
2. Measure Phase
   - Collection of baseline data including service time, transaction error rates, waiting time, and inventory mismatch percentages.
   - Use of process mapping and flowcharts to capture the current workflow of canteen operations.
   - Measurement of process performance using statistical tools such as Defects Per Million Opportunities (DPMO) and Sigma Level calculation.
3. Analyze Phase
   - Identification of the root causes of inefficiencies using tools such as Fishbone Diagram, Pareto Analysis, and Failure Mode and Effect Analysis (FMEA).
   - Assessment of gaps between current performance and desired outcomes.
   - Evaluation of key process variables that most significantly impact service quality and user satisfaction.
4. Improve Phase
   - Design and prototyping of an integrated information system that manages ordering, payment, and inventory in real-time.
   - Implementation of improvements based on Six Sigma findings, such as digital transaction systems (QR code, cashless payments), inventory automation, and reporting dashboards.
   - Pilot testing of the system with selected canteen staff and customers to validate improvements.
5. Control Phase
   - Establishment of monitoring and evaluation mechanisms to ensure that improvements are sustained.
   - Development of standard operating procedures (SOPs) and training modules for canteen staff.
   - Continuous feedback collection from users to support iterative system refinement.
6. Data Collection Techniques
   - Primary Data: Interviews with canteen staff and Bank Indonesia employees, direct observation, and questionnaires.
   - Secondary Data: Institutional reports, transaction records, inventory data, and Six Sigma case studies from related industries.
7. Data Analysis
   - Quantitative analysis is conducted using statistical methods for process capability and Six Sigma level calculations.
   - Qualitative analysis includes thematic analysis of user experiences and satisfaction surveys.
8. Expected Output

The research method ensures the creation of a Six Sigma-based information system design that significantly reduces service errors, improves transaction speed, and enhances overall customer satisfaction at the Bank Indonesia Canteen North Sumatra.

RESULTS AND DISCUSSION

Data processing

In the process of designing an information system that can be applied to improve efficiency and quality, the Six Sigma method used is the DMAIC (Define, Measure, Analyze, Improve, Control) approach. The data source for this study was obtained through a pre-designed questionnaire to gather responses from respondents regarding the information system implemented at the Bank Indonesia Canteen. The data collected from the questionnaire will be used as the basis for conducting analyses and calculations relevant to the research objectives.

Define Phase Results

Initial observations and surveys revealed several critical problems in the Bank Indonesia Canteen. The main issues included long waiting times during peak hours, frequent transaction errors, and inventory mismatches between actual stock and recorded data. Customer feedback highlighted dissatisfaction with manual processes that lacked transparency and efficiency. Critical-to-quality (CTQ) factors were defined as transaction accuracy, service speed, and inventory reliability.

Measure Phase Results

Baseline measurements showed that the average transaction time was 4.5 minutes per customer, with an error rate of 6.2% in recorded transactions. Inventory mismatch levels reached 12% monthly, primarily due to delayed updates of stock data. Using Six Sigma metrics, the process capability was calculated at 3.1 Sigma Level, indicating significant room for improvement compared to the industry best practice benchmark of 4.5 Sigma or higher.

Analyze Phase Results

Root cause analysis using the Fishbone Diagram and Pareto Analysis identified three dominant factors contributing to inefficiency:

1. Manual ordering and payment system that increased human error.
2. Inconsistent inventory recording due to lack of real-time integration.
3. Limited staff training on process standardization.

   The FMEA confirmed that transaction recording errors had the highest risk priority number (RPN), making it the top improvement priority.

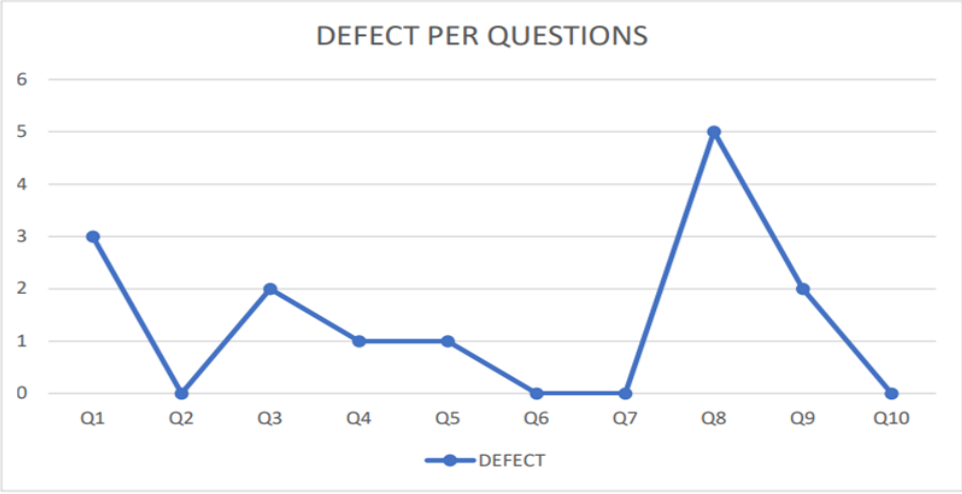

Figure 1. Defect Per Question Graph

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Improve Phase Results

An integrated canteen information system was designed and piloted. The system included features for digital ordering (via QR code scanning), cashless payment integration, and automated inventory tracking. During pilot testing with 50 employees, the average transaction time was reduced to 2.1 minutes, and the error rate dropped to 1.5%. Inventory mismatch decreased to 3%, indicating a significant performance improvement. Additionally, employee satisfaction improved due to reduced workload and streamlined processes, while customer feedback showed higher satisfaction regarding speed and convenience.

Control Phase Results

To sustain improvements, standard operating procedures (SOPs) were developed for system usage, and staff were trained in digital transaction handling. Monitoring dashboards were implemented to provide real-time tracking of key performance indicators (KPIs). Monthly evaluations demonstrated stable performance at a 4.2 Sigma Level, aligning with Six Sigma's continuous improvement goals.

Discussion

The implementation of Six Sigma within the canteen's information system design demonstrated measurable improvements in service quality, efficiency, and reliability. The transition from a manual to a digital system addressed key CTQ factors, reducing variability and human error. The reduction of transaction times and inventory mismatches highlights the effectiveness of Six Sigma's DMAIC methodology in a service-oriented environment. Comparing results with prior studies, this research confirms that Six Sigma can be successfully adapted beyond manufacturing into public service and institutional settings such as corporate canteens. Moreover, the adoption of an integrated system aligns with the broader digital transformation agenda in financial institutions, ensuring sustainability and scalability of the solution. The study also revealed that continuous staff training and proper change management are essential for maintaining system performance. While initial investments in system development and training posed challenges, the long-term benefits in efficiency and customer satisfaction strongly justified the approach.

CONCLUSION

Based on the discussion regarding the Analysis and Implementation of Six Sigma in the Information System Design of the Bank Indonesia Canteen in North Sumatra Province, the following conclusions can be drawn: The design and implementation of a web-based e-canteen system using Laravel improved the canteen's operational efficiency. The developed system provides online ordering features, real-time menu and pricing information, and digital payment method integration (QRIS), all designed to meet user needs. The application of Six Sigma methods to the canteen information system yielded satisfactory results. The sigma level calculation showed a value of 2.82, reflecting an adequate level of process performance, with an estimated customer satisfaction level of over 90%. This achievement can be considered positive, considering that the implementation of the information system at the Bank Indonesia Canteen in North Sumatra Province is still relatively new and in the early stages of development. Using the DMAIC (Define, Measure, Analyze, Improve, and Control) approach, several aspects that need improvement can be immediately identified. These include:
a. Q8: The estimated waiting time displayed in the system is consistent with reality.
b. Q1: The online ordering system makes it easier for me to order food at the canteen.

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