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Business Process Improvement in Call Center Operations at XYZ Malaysia Using Lean Six Sigma

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Abstract
Purpose: This study explores the application of Lean Six Sigma methodologies to improve the business process in call center operations at XYZ Malaysia to enhance service quality and increase customer satisfaction. This study emphasizes the importance of adopting Lean Six Sigma.
Research Methodology: This study employed a mixed-method approach that utilized both qualitative and quantitative data. Qualitative data explores challenges and customer satisfaction levels, while quantitative data assesses the impact of Lean Six Sigma on specific metrics used by the call center.
Results: The findings suggest that Lean Six Sigma methodologies can provide a structured approach to problem-solving and process enhancement, enabling call centers to achieve higher performance standards. The findings underscore the potential of Lean Six Sigma to drive continuous improvement, ensuring that call center operations not only meet but also exceed customer expectations. Ultimately, this approach is expected to set new standards for customer care and call center management, particularly in the English-speaking market, contributing to XYZ Malaysia's vision of delivering outstanding customer experiences through exceptional service quality.
Conclusions: The study concludes that XYZ Malaysia's call center operations have significant potential to improve performance by focusing on Average Handling Time (AHT), Customer Satisfaction Scores (CSAT), and Resolution Rates (RR) using Lean Six Sigma's DMAIC framework.
Limitations: This study is limited to data from Q1–Q2 2024 and focuses primarily on three key performance indicators without deeper analysis of workforce behavior, system constraints, or customer demographics.
Contributions: This research demonstrates how applying Lean Six Sigma and process capability analysis can identify inefficiencies and guide strategic improvements in a call center environment.

Keywords: *Average handling time (AHT), Business Process Improvement, Call Center Operation, Customer satisfaction (CSAT), DMAIC framework, Lean Six Sigma, Root Cause Analysis.*
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1. Introduction

In today's business environment, customer service or support plays an increasingly crucial role in call centers. Call centers serve as customers' primary points of contact across various industries. The efficiency of call center operations significantly influences customer satisfaction, brand reputation, and overall business success. To excel in this field, call centers must consistently improve their processes, provide outstanding service quality, and effectively manage costs (Khan & Hossain, 2021). However, call centers often need to help achieve these goals. Common issues include long wait times, high call

abandonment rates, inconsistent service quality, low first-call resolution rates, and rising operational costs, which lead to decreased customer satisfaction. Ensuring customer satisfaction is essential for call centers to sustain profitability and stability. In the last ten years, businesses have been pressured to enhance productivity, quality, and customer service while maintaining or lowering operational expenses (Akbulut-Bailey, Motwani, & Smedley, 2012). Ultimately, customer satisfaction depends on the quality and effectiveness of the product in meeting customer needs (Afshar Jahanshahi, Hajizadeh Gashti, Mirdamadi, Nawaser, & Khaksar, 2011). Additionally, a strong link exists between customer satisfaction and loyalty, which drives profitability (Afshar Jahanshahi et al., 2011). Improving call center performance and customer satisfaction is crucial for business success.

Lean Six Sigma (LSS) has become a pivotal methodology for enhancing operational efficiency and service quality in call centers. By systematically mapping existing processes, identifying root causes of inefficiencies, and implementing targeted solutions, the call center achieved reductions in average handling time and enhancements in customer satisfaction. This underscores the efficacy of LSS in driving structured, data-driven improvements in service environments (Laureani, Antony, & Douglas, 2010).

Furthermore, the adaptability of LSS in service sectors is evident in various implementations. For instance, a study highlighted in iSixSigma detailed how a call center's first-call resolution rate improved from 50% to 90% after LSS interventions. Such outcomes demonstrate LSS's versatility in addressing diverse operational challenges, making it a valuable strategy for organizations aiming to elevate service quality and efficiency (Lameijer, de Vries, Antony, Garza-Reyes, & Sony, 2024).

In addition to operational improvements, LSS contributes to financial benefits by reducing costs associated with inefficiencies. The same study reported an estimated annual savings of approximately $200,000 due to decreased call volumes and better resource utilization. These financial gains, coupled with enhanced customer satisfaction, highlight the comprehensive value LSS brings to call center operations (Tissir et al., 2024).

Moreover, the integration of LSS with digital technologies, often referred to as LSS 4.0, offers a structured framework for organizations to achieve operational excellence. A 2024 study proposed a 15-step DMAIC-based framework that guides managers in seamlessly incorporating LSS 4.0 into their processes, ensuring purposeful digitalization and continuous improvement. This approach aligns with the evolving needs of modern call centers, emphasizing the importance of data-driven decision-making and process optimization (Saragih, Marie, & Mubarani, 2021).

Call centers adopt Lean Six Sigma methodologies to address these challenges and drive improvements. These methods have been demonstrated to be effective for optimizing processes and reducing waste across different industries. Lean Six Sigma merges two robust strategies: lean, which aims to remove waste and enhance workflow, and Six Sigma, which focuses on minimizing defects and variations in processes.

2. Literature Review

2.1 Lean Six Sigma

Lean Six Sigma seeks to maximize shareholder value by enhancing customer satisfaction, reducing costs, improving quality, increasing process speed, and optimizing invested capital as efficiently as possible (George & George, 2003). Since the 1980s, when the terminology was established and hard coded, Lean and Six Sigma have pursued separate paths: While Six Sigma started in the US (at the Motorola Research Center), Lean originated in Japan (in the Toyota Production System). *Leans* are a process improvement methodology that delivers better, faster, and cheaper products and services. According to Womack and Jones (1996), it is "a technique to define value, organize value-creating actions in the optimal sequence, execute these activities seamlessly upon request, and continuously improve their efficiency." Lean thinking provides a way to achieve more using less time, space, human effort, and equipment, while better meeting clients' exact needs. *Six Sigma* is a methodology that uses data for process improvement and reduces errors and process variation while producing consistent and

reliable results. According to Snee (1999), business strategy focuses on outputs that are critical to customers. Identify and investigate the root cause of errors, defects, or failures in business processes." Six Sigma focuses on accuracy and precision, whereas Lean emphasizes speed and efficiency. Leans ensure that resources are allocated to the appropriate tasks, whereas Six Sigma ensures that these tasks are performed correctly on the first attempt. Lean Six Sigma combines tools from both methodologies to enhance speed and accuracy (Sakib, Kawsar, & Bithee, 2025).

2.2 DMAIC steps for the services industry

George and George (2003) noted that Lean and Six Sigma employ the "DMAIC methods" (Define, Measure, Analyze, Improve, Control). These methods provide a crucial framework for quality improvement, offering a structured approach that guides the improvement team in each phase. The "DMAIC methods" effectively support the team with tools and techniques designed to achieve the objectives of each phase, thereby enhancing the overall quality improvement process (Mohan, Kaswan, & Rathi, 2025).

According to Six Sigma (SS) methodologies, management, customers, and employees should be involved in discovering and understanding problems. There are two service-related concerns: obtaining and applying customer feedback and having a comprehensive understanding of service procedures to pinpoint and contextualize issues. The comprehension of such processes can be aided by several SS tools, including cause and effect diagrams (fishbones), tree diagrams, brainstorming, and process flowchartsh . This may also be suitable because Quality Function Deployment depends on user feedback during the design phase. Additionally, there are several methods to obtain client feedback, such as focus groups and customer surveys.

Many service processes are monitored more closely than manufacturing processes. Variations in process execution can be caused by employee or customer factors. Customer surveys and check sheets for tracking process performance are examples of the recommended SS tools (Pande & Holpp, 2002). In many cases, the service must look beyond its current customers and consider the expectations of other stakeholders whose opinions influence it. One example of a public service is the public, whose taxes fund the services provided.

The initial data analysis can encompass techniques such as process flow analysis, identifying value-added versus non-value-added activities, and utilizing tools such as Pareto charts, histograms, run charts, and scatter plots. Further analysis may involve performing tests for statistical significance, examining correlations, or applying regression analysis (Pande & Holpp, 2001). Additionally, it could be beneficial to explore patterns or trends within the data to identify potential areas for improvement.

Among the recommended tools are project management techniques, force field diagrams, balanced scorecards, failure mode and effects analysis, stakeholder analysis, and process documentation (Pande & Holpp, 2001). These tools serve various purposes such as identifying potential risks, evaluating performance, and ensuring comprehensive stakeholder engagement. By integrating these methodologies, organizations can enhance their efficiency and effectiveness, leading to better project outcomes and overall operational success (Afriyani, Indrayani, Indrawan, Wibisono, & Ngaliman, 2023).

Process modifications must be monitored and assessed. Feedback is crucial in determining how well the modification works. Doing more customer surveys is one approach to achieve this goal. In addition, the company can create metrics based on the procedure and conduct routine data analysis. The control process also includes an ongoing search for methods to improve it.

2.3 The benefit of applying Lean Six Sigma in Call Centre

Some benefits of lean six sigma in a call center are given below (Omar & Mustafa, 2014):
Enhancing call center operations can be achieved by implementing lean strategies. Lean strategies focus on increasing efficiency by eliminating waste and nonessential activities within the process. This streamlining of operations ensures that only value-adding tasks are performed, leading to smoother and

more productive workflow. Reducing the number of missed calls is crucial for call center efficiency. Six Sigma techniques, such as hypothesis testing and root cause analysis, can be instrumental in this regard. By analyzing the data, these methods help determine the optimal allocation of time for various types of calls, thus providing operators with a clear and effective framework for managing their time and resources.

The optimal utilization of both technological and human resources can lead to significant cost reductions in call center operations. Efficient resource management ensures that technology and personnel are used to their fullest potential, minimizing waste and unnecessary expenses, thereby lowering the call centers' overall operational costs. Identifying and addressing the underlying reasons for customer calls, often referred to as unveiling the 'hidden factory,' can lead to substantial improvements in customer service and support. By tracing the root causes of the issues that prompt customer calls, organizations can implement solutions that prevent these issues from occurring in the first place, enhancing the overall customer experience.

Mitigating staff attrition and turnover is essential in the high-stress environments of call centers. The demanding nature of a job often leads to high employee turnover. However, by making operations more efficient and reducing operators'stress levels, call centers can create a more supportive and less stressful work environment, which can help retain employees for longer periods.

2.4 Conceptual Framework

This study uses the Lean Six Sigma methodology, integrating the DMAIC framework as its foundational approach. The DMAIC framework offers a structured approach to problem-solving and process improvement. DMAIC is an abbreviation for Define, Measure, Analyze, Improve, and Control. It also helps in identifying issues, measuring performance, analyzing root causes, implementing targeted plans, and establishing controls to sustain the gains achieved, making it ideal for addressing inefficiencies and enhancing performance in call center environments. The conceptual framework is illustrated in Figure II.2:

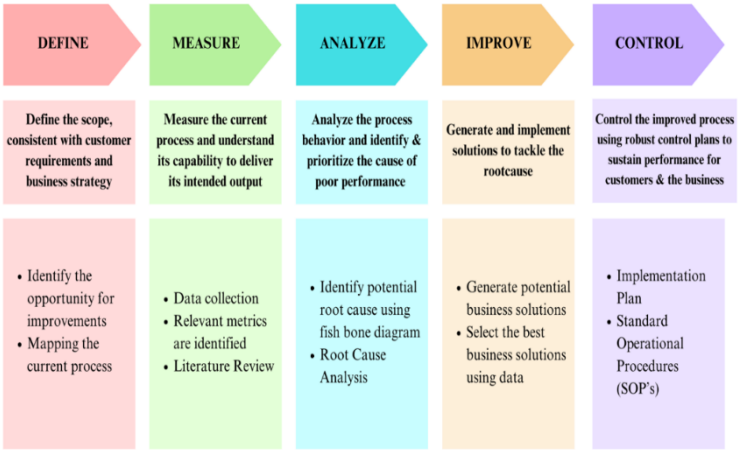

Figure 1. DMAIC Conceptual Framework
Source: Author

Each phase of DMAIC is critical to ensuring that the improvements are data-driven, sustainable, and aligned with XYZ's operational goals. The explanation for each step is as follows:

2.4.1 Define Phase

Define the initial phase that involves identifying improvement opportunities that align with XYZ Malaysia call center operations and mapping the current process issues to understand the existing processes and workflows in detail. This is performed using process maps to visually represent the current operations.

2.4.2 Measure Phase

In the measurement phase, data collection is essential for establishing baselines and quantifying the current performance of the call center processes. This involves gathering quantitative and qualitative data on various metrics, such as Quality Score (QA) and Key Performance Indicators (KPIs), that align with business objectives and customer expectations. During this phase, a comprehensive review of the research and best practices related to the DMAIC concept was conducted.

2.4.3 Analyze Phase

Root causes were identified during the analysis phase using tools such as the Ishikawa (fishbone) diagram. This diagram helps visualize and pinpoint the underlying reasons for problems by grouping possible causes into categories, such as People, Processes, Technology, and Environment. This classification aids in methodically locating all potential root causes.

2.4.4 Improve Phase

The improvement phase concentrates on discussing and determining possible solutions that aim to address the identified root causes. This could include revamping workflows and offering extra training to call center agents to enhance their performance and service quality.

2.4.5 Control Phase

The final phase ensures the sustainability of the improvements by establishing control mechanisms and monitoring systems. This includes creating a well-structured implementation plan to ensure a smooth transition from the old to the new process and developing Standard Operating procedures (SOPs).
Document detailed guidelines, checklists, and performance standards for the latest methods to standardize improved processes and ensure consistent application and sustainability. This documentation helps to maintain improvements over time and provides a reference for training and performance evaluation. By following this detailed framework aligned with the Six Sigma DMAIC methodology, XYZ Malaysia can systematically identify, analyze, and improve its processes, enhancing efficiency, customer satisfaction, and overall performance (Udodiugwu, Eneremadu, Obiakor, Okeke, & Njoku, 2023).

3. Research Methodology

3.1 Research Design

Qualitative and quantitative methods are frequently used. In quantitative research, analysis entails running statistical tests to determine the statistical significance of the data and summarizing the frequencies of the variables. Differences across variables. It compares a single measurement and counts the frequency of each item in the data. At the end of the analysis, we have a mass of results, which we call the big picture or, in other words, significant findings.

This study also aimed to discover a big picture using different techniques in qualitative research. It uses data to describe a phenomenon, articulate its meaning, and understand it. Therefore, qualitative research relates to meanings, concepts, definitions, traits, metaphors, symbols, and descriptions. The primary advantage of the qualitative approach is the thorough analysis of the data, which offers a broad understanding of the phenomena under study. In this study, a mixed-methods research strategy was employed. The process of gathering, evaluating, and "mixing" quantitative and qualitative research and methodologies in a single study to comprehend a research problem is known as the mixed method.
"Mixed methods research is one type where a researcher or team combines the quantitative and qualitative approaches (such as perspectives, data collection, information, assessment, and inference techniques) for multiple reasons of breadth and depth of understanding and corroboration." (Schonenboom & Johnson, 2017)

Quantitative data were used to assess the impact of Lean Six Sigma on specific metrics used by the call center in XYZ Malaysia. The researcher then used qualitative data to explore the call center's challenges and analyzed the customer satisfaction levels and service quality in the call center of XYZ Malaysia. A mixed-method approach for Lean Six Sigma in a call center combines qualitative and quantitative

research techniques to improve processes, reduce defects, and enhance customer satisfaction. It is used to identify and eliminate defects in processes to achieve a near-perfect level of performance.

3.2 Data Collection Method

This study used a mixed-methods methodology that incorporates quantitative and qualitative data from XYZ Malaysia's internal sources and activities. The data collection method is defined as follows:

3.2.1 Define Phase

During this phase, improvement opportunities are identified by mapping the current workflow of the call center operation to obtain customer feedback and by using an internal report from the Quality Assurance Team.

3.2.2 Measure Phase

In this phase, the data collected are focused on the Operational Metrics. Key performance indicators (KPIs) include Quality Score (QA), Average Handling Time (AHT), Customer Satisfaction Scores, Resolution Rate (RR), and Service Level Agreements (SLAs).

3.2.3 Analyze Phase

The primary data collection method during the analysis phase was to conduct interviews to support root cause analysis (RCA) using fishbone analysis to determine the possible root cause of the problems. The participants of this interview were Senior Operation Managers, Quality Assurance Analysts, Trainers, and SMEs, and were defined as follows; Senior Operation Managers (SOMs): To gain high-level insights into call center performance and significant challenges. The interviews focused on operational challenges and strategic goals. Quality Assurance Analysts (QAs) seek to identify daily operational pain points and improve efficiency. Interviews explored areas of quality improvement. Trainers: Trainers aim to ensure that training programs effectively support the process changes. They must adapt training materials to the Lean Six Sigma principle. Interviews covered current training effectiveness and skill gaps. Subject Matter Experts (SMEs): SMEs provide specialized knowledge to optimize technical processes. The interviews focused on technical challenges and best practices.

3.2.4 Improve Phase

In this phase, a possible solution is generated and selected. The data in this phase were collected using pilot testing, where the proposed solutions were implemented on a small scale and data on their impact were collected.

3.2.5 Control Phase

During the control phase, data collection relies primarily on secondary data, as improvement solutions are implemented. The results of this implementation can be monitored through performance dashboard reports and new processes and standard operating procedures can be documented to ensure consistency.

3.3 Data Analysis Method

All data gathered through data collection must be processed methodically using the DMAIC framework. The various data analysis techniques employed in each stage of this study are listed below.

3.3.1 Define Phase

Process mapping graphically depicts the workflow's current conditions during the fine phase. The objective was to obtain feedback from customers. This visual representation provides data required for Quality Analysts to audit the process efficiently, guaranteeing that every facet is carefully examined for performance and quality problems. Process mapping thus establishes the groundwork for in-depth and precise analysis, allowing Quality Analysts to formulate well-informed suggestions for process enhancements.

3.3.2 Measure Phase

In the measurement phase, operational metrics focusing on key performance indicators (KPIs) were calculated and extracted from XYZ Malaysia's internal system. The metrics measured were as follows.

1. Quality Score (QA): Measures adherence to predefined quality standards during customer interactions. Collected through quality monitoring systems (QMS) and evaluated based on specific criteria: Customer Experience Skills (CX), Process Adherence (PA), and Risk Mitigation (RM).
   QA Score (%) = Average of (CX, PA, RM)
2. Average Handling Time (AHT): This metric indicates the typical length of time required to manage a customer call from beginning to end. It encompasses the duration of the conversation, any time spent holding the conversation, and any subsequent actions needed to address the issue.

$$\boldsymbol{AHT = \frac{Total\ talk\ time + Total\ hold\ time + total\ after - call\ work\ time}{Total\ number\ of\ Interactions}}$$

3. Customer Satisfaction Scores (CSAT): Gauge customer satisfaction through post-interaction surveys. Provide direct customer feedback about their experiences and the quality of the service received.

$$\boldsymbol{CSAT\% = \frac{Total\ number\ of\ satisfied\ responses}{Total\ number\ of\ responses} x\ 100}$$

4. Resolution Rate (RR): RR is measured by the number of issues resolved. Higher resolution rates indicate greater efficiency and effectiveness in addressing customer concerns.

$$\boldsymbol{RR\% = \frac{Total\ Solved\ Tickets}{Total\ Ticket\ Received} x\ 100}$$

5. Service Level Agreements (SLAs)**:** Establish criteria that specify the anticipated quality of service, including response times and availability. They ensure that the call center consistently meets or surpasses the service levels agreed upon by clients**.**

$$\boldsymbol{SLA = \frac{Number\ of\ interactions\ resolved\ within\ SLA}{Total\ number\ of\ interactions} x\ 100}$$

6. Capability Process: In the measurement phase, we calculated the process capabilities of the existing processes in call center operations in XYZ Malaysia. This involves evaluating the performance of the current call center processes to determine how well they meet specified customer service standards and operational requirements. To calculate the process capability, the following formula was used**:**

$$\mathbf{1)}\ \boldsymbol{\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{the\ total\ of\ every\ data\ value}{total\ amount\ of\ data}}$$

$$\mathbf{2)}\ \boldsymbol{\sigma = \sqrt{\frac{\sum |x - \bar{x}|^2}{n}}}$$

$$3)\ Cp = \frac{USL - LSL}{6\sigma}$$

$$\mathbf{4)}\ \boldsymbol{Cpk = Min\left(\frac{USL - \bar{x}}{3\sigma}, \frac{\bar{x} - LSL}{3\sigma}\right)}$$

$$\mathbf{5)}\ \boldsymbol{Sigma\ Level = \left|\frac{USL - \bar{x}}{\sigma}\right|}$$

$\boldsymbol{\bar{x}}$: Mean
$\boldsymbol{\sigma}$: Standard Deviation
$\boldsymbol{Cp}$: Process Capability
$\boldsymbol{Cpk}$: Process Capability Index

A Cp value above 1 indicates that the process has the potential to meet specifications without considering the process shift, whereas a Cpk value above 1 indicates that the process is well-controlled and capable of meeting specifications (Mohamed & Farahat, 2019; Tarigan, Lubis, Rini, & Sembiring, 2020).

3.3.3 Analyze Phase

The analysis phase focuses on determining the root cause. The root causes of this issue were discovered through fishbone diagram analyses. A diagram was created using interview data, as explained in the data collection section.

3.3.3.1 Fishbone Diagram

Fishbone diagrams, also referred to as Ishikawa or cause-and-effect diagrams, are visual tools used to depict various causes of a specific event or phenomenon. A fishbone diagram, commonly utilized for cause-and-effect analysis, helps identify the intricate network of factors contributing to a specific problem or event. Its appearance resembled that of a fish skeleton. Ishikawa (1990) developed a causal diagram for management research (Coccia 2017).

3.3.4 Improve Phase

In the improvement phase, the proposed solution was generated and implemented after determining the root cause of the problem in the previous stage. This phase uses pilot testing to bridge solution development and full-scale implementation. The primary objective of pilot testing is to validate the effectiveness of the proposed solutions on a smaller controlled scale before committing to a comprehensive rollout. This approach identifies and mitigates potential issues in a manageable setting, thereby ensuring that the solution performs as expected when fully implemented.

The proposed improvements were introduced during pilot testing in a limited number of call center operations. This controlled setting allows for close observation of how the changes affect important performance metrics, such as Quality Score (QA), Average Handling Time (AHT), Customer Satisfaction Scores (CSAT), Resolution Rate (RR), and Service Level Agreements (SLAs).

3.3.5 Control Phase

During the Control phase, implementation strategy and standard operating procedures are essential for maintaining progress. The implementation strategy, which includes a timeframe and real-time audit, will help implement new procedures smoothly. SOPs offer a standardized task method that guarantees compliance, quality, and consistency. Combined, they enable ongoing process improvement and help preserve progress achieved during the improvement phase. XYZ Malaysia may maintain operational excellence in its call center operations by sticking to SOPs and the implementation strategy.

4. Results and discussion

4.1 Define Phase

This phase will show and explain the actual operation of XYZ Malaysia's call center and how the Quality Team report can help determine opportunities for improvement. XYZ Malaysia’s call center supports three main channels to help customers: email, chat, and outbound calls. Email channels allow customers to send questions, complaints, or requests for help at any time, providing flexibility without being tied to specific operating hours. The call center representatives (CSR) then respond to the email according to the established service standards, ensuring that each customer request is handled promptly and effectively (Jemal, 2022; Putra, Ahadiyat, & Keumalahayati, 2023). Chat channels provide real-time communication between customers and call center representatives through a platform integrated into a company's website or application. This service allows customers to obtain help quickly without leaving the platform. At an advanced level, XYZ Malaysia’s call center also supports outbound calls. These outbound calls allow companies to communicate proactively with customers, ensuring that their needs and expectations are effectively met. By supporting these three channels, XYZ Malaysia can provide flexible and effective services to meet various customer needs.

4.1.1 Business Process Map of XYZ Malaysia

The process begins with the client submitting a ticket to the platform. The ticket is then handled by a Customer Service Representative (CSR) according to the language preference and communication channels (e.g., Email or Chat). CSR then offers an outbound call to the client to explain the solution to the reported problem. After the issue is resolved, clients are asked to fill out a survey or provide feedback regarding their experiences with the resolution provided. The Quality Assurance (QA) team audits

representative customer service performance using an internal scorecard to ensure compliance with established service standards. Feedback from the Quality Team is sent to the Operations Team, which is responsible for assessing the achievement of CSR's Key Performance Indicators (KPI) and providing coaching to improve service quality. This process is designed to ensure that the quality of customer service is well maintained and sustainable and to continuously improve customer satisfaction through systematic evaluation and effective Customer Service Representative Improvement (Bora, Fanggidae, & Fanggidae, 2023).

4.1.2 Areas of Opportunities

A report from the Quality Assurance Team is essential in providing an in-depth evaluation of call center performance based on established quality standards. As explained above, the first step in this approach is collecting data from the tickets received. Once the data are collected, these tickets are analyzed to identify trends and patterns that indicate areas that need improvement. The Quality Department evaluates the interaction results to determine the quality score of CSR and analyze the resolution rate (RR).

Based on evaluations carried out by the Quality Assurance Team (QA), several areas of process operations require special attention to improve quality and efficiency. These areas include:

1. Quality Score (QA) is a key metric used to assess the quality of services provided by a company. This assessment ensures that the services offered meet the customer expectations. A high-quality score indicates that service procedures and protocols follow well, whereas a low score suggests gaps that must be corrected to improve service quality.
2. Average Handling Time (AHT): This represents the average duration an agent needs to finish a customer interaction or request. A high AHT usually suggests inefficient in-process handling, which can lead to customer dissatisfaction. Consequently, it is crucial to identify the reasons for the high AHT and to create effective strategies to decrease it. This could involve retraining agents, streamlining processes, or improving the technology systems.
3. Customer Satisfaction Scores (CSAT): Customer Satisfaction Scores (CSAT) measures customer satisfaction levels based on surveys conducted after an interaction. This metric provides direct feedback from customers regarding their experience and quality of service received. CSAT is important because it provides insight into how customers rate the services provided and which areas need improvement to increase their satisfaction. High levels of customer satisfaction usually correlate with greater customer loyalty and a better company reputation.
4. Resolution Rate (RR): The Resolution Rate is the percentage of customer problems or requests successfully resolved in the first interaction. A high-resolution rate shows efficiency in handling issues and the agent's ability to provide appropriate solutions. Improving RR can increase customer satisfaction, reduce the agent workload, and increase productivity. Identifying the factors that hinder problem resolution in the first interaction is critical for developing effective corrective actions.
5. Service Level Agreements (SLAs): SLAs are formal contracts between service providers and clients that outline anticipated service standards, such as response times, resolution times, and overall service quality. Compliance with SLAs is essential for maintaining customer trust and ensuring that the service is promised. Violations of SLAs can cause customer dissatisfaction and damage a company's reputation. Therefore, monitoring and managing SLAs are crucial aspects of service operations.

4.2 Measure Phase

As mentioned in Chapter 2, this phase measures the operational metrics, focusing on key performance indicators (KPIs) extracted from XYZ Malaysia's system to evaluate the capability of the current process. The data used in this study are based on data retrieved from Q1-Q2 2024 (January – June 2024), and below is the current KPI target for 2024.

Table 1. KPI Target of XYZ for Q3

KPI	Target
Quality Score (QA)	90%

Average Handling Time (AHT)	25 Min
Customer Satisfaction (CSAT)	65%
Resolution Rate (RR)	65%
Service Level Agreements (SLAs)	75%

Source: Internal

Quality Score (QA): Measures adherence to predefined quality standards during customer interactions. Collected through quality monitoring systems (QMS) and evaluated based on specific categories: Customer Experience Skills (CX), Process Adherence (PA), and Risk Mitigation (RM).

QA Score (%) = Average of (CX, PA, RM)

Table 2. QA Score Period January – April 2024

Month	WoW	CX Skills Score	PA Score	RM Score	QA Score
January	1	97,62%	93,86%	99,75%	97,08%
	2	97,20%	94,21%	100,00%	97,14%
	3	96,87%	94,44%	99,78%	97,03%
	4	97,65%	93,96%	100,00%	97,20%
February	5	96,80%	94,23%	100,00%	97,01%
	6	95,95%	92,94%	99,74%	96,21%
	7	96,32%	93,57%	100,00%	96,63%
	8	96,67%	94,38%	100,00%	97,02%
March	9	96,00%	94,77%	100,00%	96,92%
	10	94,83%	93,73%	99,61%	96,02%
	11	95,51%	93,89%	99,79%	96,39%
	12	95,79%	93,91%	100,00%	96,57%
April	13	95,61%	94,39%	99,82%	96,61%
	14	95,69%	95,23%	100,00%	96,97%
	15	93,71%	92,84%	100,00%	95,52%
	16	96,62%	93,24%	99,20%	96,35%

Source: Internal

The table above shows each category's average score (CX, PA, RM) and QA Score weekly. The company determined that the Upper Specification Limit (USL) is set at 100, while the Lower Specification Limit (LSL) is set at 90.Here, we calculated Cp and Cpk of the QA Score. Before calculating the Cp, we determine the mean ($\bar{x}$) and standard deviation (σ). The formula used is as follows**:**

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{\textbf{the total of every data value}}{\textbf{total amount of data}} = \frac{1546,66}{16} = 96.67$$

$$\sigma = \sqrt{\frac{\sum |x - \bar{x}|^2}{n}} = 0,46$$

The Process Capability Index (Cp) was then calculated. The formula is:

$$Cp = \frac{USL - LSL}{6\sigma} = \frac{100 - 90}{6 \times 0.46} = 3.62$$

This value indicates that the process has excellent capabilities, as Cp values above 1.33 are generally considered good. Cpk measures the degree to which a method is within specified limits and its ability to stay within them**.** The formula is:

$$Cpk = Min\left(\frac{USL - \bar{x}}{3\sigma}, \frac{\bar{x} - LSL}{3\sigma}\right) = Min\left(\frac{100 - 96.67}{3 \times 0.46}, \frac{96.67 - 90}{3 \times 0.46}\right) = 2.41$$

The Cpk value for the QA score was 2.41. This also indicates a very good result, as Cpk values above 1.33 indicate a stable and well-centered process between the specification limits. A high Cpk value indicates that Customer Service Representatives can produce consistent scores according to the specified specifications.

Average Handling Time (AHT): This indicates the typical amount of time spent managing a customer call from beginning to end. It encompasses the time spent talking and holding, and any necessary follow-up actions to address the issue. The formula for AHT is:

$$\boldsymbol{AHT = \frac{Total\ talk\ time + Hold\ time + Total\ after - call\ work\ time}{Total\ number\ of\ interactions}}$$

$$\boldsymbol{Cpk = Min\left(\frac{USL - \bar{x}}{3\sigma}, \frac{\bar{x} - LSL}{3\sigma}\right) = Min\left(\frac{25 - 32.65}{3 \times 3.54}, \frac{32.65 - 0}{3 \times 3.54}\right) = -0.72}$$

The Cp value of 1.18 and Cpk of -0.72, indicate that the AHT capability process at XYZ call center operations has several problems that need to be analyzed. Technically, a Cp value of more than 1.0 (1.18) indicates that the process variation is within the specification limits, meaning that this process has sufficient potential to meet specifications. However, a negative Cpk value (-0.72) indicates that the process average is far from the expected specifications, with many results outside the specification limits.

Although this process has a good potential to meet the specifications, the current results are far from the goal. This means that there is a significant shift in the process average such that most of the output is outside the predetermined limits. Operations need to make adjustments and improvements to increase process capabilities. The focus should be on identifying and controlling factors that cause shifts in process averages so that the results can be centered and within specification limits. With appropriate improvement measures, the potential indicated by the Cp value can be realized with better process capabilities and specifications.

Customer Satisfaction Scores (CSAT): XYZ assesses customer satisfaction scores (CSAT) using a scale from 1 to 5 to understand customer satisfaction with their products, services, or interactions. XYZ collects these CSAT scores through surveys, as explained during the operation process in the defining phase. Customers rate their experiences based on the scale, and the average of these scores is used to assess the overall level of customer satisfaction. A higher score indicates that the customer is more satisfied with the service or resolution. On this scale, a score of 1 means “Very Dissatisfied,” indicating that the customer was very dissatisfied with their experience due to a significant problem or failure. A score of 2 means “Not Satisfied,” where the customer felt that their knowledge did not meet expectations because of a notable problem. A score of 3 means "Neutral," where the customer felt that the experience was neither very good nor bad. A score of 4 means "Satisfied," indicating that the customer was happy because the service or product met expectations without significant problems. Meanwhile, a score of 5 means "Very Satisfied," where the customer feels delighted because the service or product exceeds expectations, and the interaction is very satisfying. Below is the CSAT score received in XYZ call center operations for the period January – June 2024.

To calculate the % of the CSAT score, the following formula was used:

$$CSAT = \frac{Total\ number\ of\ Score\ 4\&5}{Total\ number\ of\ survey\ received} \times\ 100\%$$

Using this formula, we determined the CSAT % score as follows:

For the CSAT, the USL given is 100, and the LSL determined by the operation is 65. Hence, the capability of the CSAT score for operations is as follows:

$$\boldsymbol{\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{the\ total\ of\ data\ value}{number\ of\ data} = \frac{429}{6} = 71.50}$$

$$\boldsymbol{\sigma = \sqrt{\frac{\sum |\, x - \bar{x}|^2}{n}} = 3.77}$$

The process capability indices (Cp) and Cpk were calculated. The formula is:

$$Cp = \frac{USL - LSL}{6\sigma} = \frac{100 - 65}{6 \times 3.77} = 1.55$$

$$\boldsymbol{Cpk = Min\left(\frac{USL - \bar{x}}{3\sigma}, \frac{\bar{x} - LSL}{3\sigma}\right) = Min\left(\frac{100 - 71.50}{3 \times 3.77}, \frac{71.50 - 65}{3 \times 3.77}\right) = 0.57}$$

The calculated Cp value was approximately 1.55. The Cp index evaluates the potential capability of a process by comparing the spread of the process (6σ) to the range of the specification limits (USL–LSL). A Cp value exceeding 1 suggests that the process is capable of consistently producing results within specified limits. A Cp value of 1.55 indicates that the process has excellent potential capability, meaning that the spread of the process data is well within the specified limits. This indicates that, theoretically, the process can produce CSAT scores within the desired range without too much variation.

Meanwhile, a Cpk value of 0.57 is considerably lower than 1, indicates that while the process spread might be adequate, the mean is not centered within the specification limits. This lower Cpk suggests that a significant portion of the process output must be within the acceptable range, highlighting potential issues with process centering. The process evaluated for CSAT scores demonstrates considerable potential to meet the specification requirements, as indicated by the high Cp value. However, the low Cpk value highlights a substantial issue with process centering, suggesting that the process, as it stands, needs to be more capable of consistently producing outputs within specification limits. This misalignment indicates a need for process improvement initiatives focused on shifting the process mean towards the center of the specification range to enhance actual performance and ensure a higher proportion of satisfactory CSAT scores. Hence, while variability management is adequate, centering adjustments are imperative to improve the overall capability and performance of the CSAT score process.

Resolution Rate (RR): RR is measured by the number of issues resolved. Higher resolution rates indicate greater efficiency and effectiveness in addressing customer concerns.

$$\boldsymbol{RR = \frac{Total\ number\ of\ Solved\ tickets}{Total\ number\ of\ Ticket\ Received} \times 100\%}$$

Below is the RR% received in XYZ call center operations for the period January – June 2024. For RR, the USL was 100 and the LSL was 65. Hence, the capability of the Resolution Rate for the operations is as follows:

$$\boldsymbol{\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{the\ total\ of\ data\ value}{number\ of\ data} = \frac{1868}{26} = 71.85}$$

$$\boldsymbol{\sigma = \sqrt{\frac{\sum |\, x - \bar{x}|^2}{n}} = 2.60}$$

The process capability indices (Cp) and Cpk were calculated. The formula is:

$$Cp = \frac{USL - LSL}{6\sigma} = \frac{100 - 65}{6 \times 2.60} = 2.24$$

$$\boldsymbol{Cpk = Min\left(\frac{USL - \bar{x}}{3\sigma}, \frac{\bar{x} - LSL}{3\sigma}\right) = Min\left(\frac{100 - 71.85}{3 \times 2.60}, \frac{71.85 - 65}{3 \times 2.60}\right) = 0.88}$$

The process capability analysis for the Resolution Rate (RR) at XYZ Call Centre, with a mean of 71.85 and a standard deviation of 2.60, shows a potential capability (Cp) of 2.24. This high Cp value suggests that if the process was perfectly centered, it could operate efficiently within the specification limits of

65 to 100, indicating low variability relative to the specification range. However, the actual capability (Cpk) was 0.88, indicating that the process was not well-centered. The process mean is closer to the lower specification limit, which results in a portion of the resolution rates potentially falling below an acceptable lower limit. This misalignment indicates a risk of failing to meet quality standards, as the actual performance does not meet the specification limits as well as it could, highlighting potential quality issues in the resolution rate process.

Service Level Agreements (SLAs): Established benchmarks specifying the anticipated quality of service including response times and availability. These agreements ensure that the call center meets or surpasses the agreed-upon service levels with clients. The XYZ call center maintains two primary SLAs for customer inquiries. The first is email communication, and the second is chat interaction. The principal focus of both SLAs is the initial response time, which is critical for ensuring that customer needs are addressed promptly and effectively. The SLA mandates a maximum response time of 5 h for email communication. This stipulation ensures that regardless of the nature of the inquiry, the team is obligated to respond within this period. This approach aims to reassure customers that their concerns are essential and that they are managed with due diligence and efficiency.

In contrast, chat interactions require a more immediate response, owing to their real-time nature. SLA specifies that the chat messages must be addressed within 90 s. This rapid response is essential for maintaining the flow of conversation and delivering immediate support, which is pivotal in enhancing customer satisfaction. Below are the data for SLAs % for January – June 2024.

Adherence to these response times is fundamental to achieving a high standard of service and fostering customer trust. By complying with these SLAs, the team strives to ensure that customers reach out via email or chat and receive timely and professional assistance, thereby reinforcing the call center's commitment to excellence in customer service. The company has set a minimum SLA adherence rate of 80%, indicating that at least 80% of inquiries must meet the specified response times.

We calculated Cp and Cpk using the average SLA score in the XYZ call center operations. Before calculating the Cp, we determine the mean ($\bar{x}$) and standard deviation (σ). The formula used is as follows:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{\textbf{the total of data value}}{\textbf{number of data}} = \frac{531}{6} = 88.50$$

$$\sigma = \sqrt{\frac{\sum |x - \bar{x}|^2}{n}} = 2.14$$

The process capability indices (Cp) and Cpk were calculated. The formula is:

$$Cp = \frac{USL - LSL}{6\sigma} = \frac{100 - 80}{6 \times 2.14} = 1.56$$

$$Cpk = Min\left(\frac{USL - \bar{x}}{3\sigma}, \frac{\bar{x} - LSL}{3\sigma}\right) = Min\left(\frac{100 - 88.50}{3 \times 2.14}, \frac{88.50 - 80}{3 \times 2.14}\right) = 1.32$$

From the above calculation, with a Cp value of 1.56, the process has potential capability that is quite good. The process variation is small relative to the specification limits, indicating that if the process mean is perfectly centered, the output would consistently be within the limits. However, the value of Cpk is 1.32, indicating that the actual capability is slightly lower than the potential capability. This indicates a slight shift in the process mean from the center of the specification limits. However, with a Cpk of 1.32, the process can still produce an output that satisfies the specifications with high confidence. This indicates that XYZ's process can reliably meet service level agreements (SLAs) with minimal risk of producing outputs outside the specification limits. The slight difference between Cp and Cpk should be monitored; however, this is not a significant concern.

From the five categories calculated in the measurement phase, three areas of opportunity that could be the main focus for XYZ call center operations are AHT, CSAT, and RR. The Average Handle Time (AHT) must be optimized to make the operations more efficient. By reducing the AHT, call centers can serve more customers in a shorter time to increase productivity and improve the CSAT. Customer satisfaction is critical to ensuring that customers are satisfied with the service they receive. Satisfied customers tend to be more loyal and recommend services to others. The resolution Rate (RR) measures how often customer problems can be resolved on first contact. If we focus on increasing the RR, customers will no longer need to contact the call center frequently. This saves time and resources and makes customers more satisfied.

4.3 Analyze Phase

As mentioned in Chapter 3, this phase focuses on determining the root cause. After measuring the performance of the XYZ call center operations, the analysis phase focused on finding the root cause for the three main focuses: AHT, CSAT, and RR. In this phase, the operations team was interviewed to identify the possible root causes. The possible root causes are summarized in the table and mapped using a fishbone diagram. The possible root cause was determined using a case observation tracker and monthly calibration. Monthly calibration helps to identify patterns and trends. By regularly examining the results, we can identify recurring problems or trends in customer interactions, such as the same complaints or repeated service errors. Tracking metrics like AHT (Average Handling Time (AHT), Customer Satisfaction Score (CSAT), and Resolution Rate (RR) over time, can reveal patterns that point to underlying problems.

The monthly calibration involves selecting cases from CSRs, including good and bad interactions, to obtain a complete picture. We reviewed and audited sampling cases during calibration sessions using an internal scorecard. The audit scorecard contains detailed categories and attribute observations that help identify patterns and recurring issues. The Trainers, QA, SMEs, and Team Leaders collaboratively analyzed the calibration results from the form and discussed each potential root cause in detail, considering the evidence and observations recorded. If the evidence strongly supports a particular root cause, it will be marked as "Yes." If the evidence does not support it or is deemed irrelevant, it will be marked as "No." This structured process ensures that our determination of root causes is thorough and based on consistent collective insights from all relevant stakeholders.

In the Fishbone diagram shown, several factors contributed to an increase in the Average Handle Time (AHT). 1) The references or resources to which the Customer Service Representative refers are limited based on issue scoping. CSR must search for more information when required references are unavailable or inaccessible. 2) The long escalation process is an obstacle. When a problem cannot be resolved at the first level, it takes extra time to escalate to a higher level or specialist, thereby extending the service time. 3) The CSR experience also plays an important role. Less experienced CSRs tend to need more time to understand and resolve customer problems, thereby increasing the duration of handling. 4) Many CSRs frequently take leave, which affects AHT when many staff members are absent. The number of workers available to handle customer requests decreases, forcing the existing CSRs to work harder and longer. 5) Inadequate investigative tools are an obstacle. The time required to find solutions to customer problems increases if the tools used by CSRs are difficult to use. These factors interact with each other and contribute to increasing AHT; therefore, they must be improved to increase the efficiency and speed of service.

First, when customer service representatives show a lack of empathy, customers feel that the importance of their issue is ignored. Secondly long response times are often problematic. Customers who wait too long for an answer can feel frustrated and dissatisfied, especially if the problem is urgent, as it can affect their business. The third unclear user guidelines on escalating issues can create difficult situations. When customers do not know what steps to take next to get help, they feel confused and hopeless. The XYZ call center operates in an open-area layout with no soundproofing between the employees. A noisy work environment resulting from an office layout that is not ideal can also disrupt the concentration of customer service representatives. This noise can make it difficult for them to focus on and provide the maximum service. Technical errors in the systems or tools used by CSR are also a major obstacle. If

the system frequently has problems or its tools do not function properly, this can reduce work efficiency and slow down the handling of customer problems. These factors can ultimately reduce the quality of the services provided and customer satisfaction.

The unstable Resolution Rate (RR) at the XYZ call center can be explained by several root causes that influence service performance and efficiency. 1) The lack of technical skills among Customer Service Representatives (CSR) is a significant obstacle to handling problems that are complex or require special knowledge. CSRs that lack deep technical skills and knowledge often need to provide effective solutions, ultimately slowing down problem resolution. 2) The escalation process, which has a different SLA, also impacts RR because CSRs have to transfer an issue to a more competent team for difficult cases, which causes significant delays in resolving customer complaints. (3) Too complicated procedures often overwhelm CSR in finding relevant information or following the steps necessary to resolve problems. This can reduce work efficiency and increase handling time. 4) The pressure to achieve high productivity targets increases the burden on CSRs, which can impact service quality, as it can cause an increase in errors. 5) Access to certain systems or information that requires additional credentials is a significant obstacle. CSRs often have to submit access requests or wait for help from other teams, which extends their time to resolve issues.

4.4 Improvement Phase

In the improvement phase, the proposed solutions are generated based on a collaborative effort involving weekly debriefings with Subject Matter Experts (SMEs), Quality Assurance (QA) teams, Trainers, and Team Leaders (TLs). During weekly debriefings, SMEs provide insights into operational challenges and potential improvements, while the QA team shares observations from quality checks and performance audits. Trainers contribute by identifying skill gaps and training needs, and TLs offer a front-line perspective on team performance and customer interaction. This diverse input ensured that the proposed solution was comprehensive and addressed multiple aspects of the call center operations. The calibration results from the analysis phase provided an important basis for this discussion. By reviewing these results, teams can identify gaps, understand the root causes, and prioritize areas for improvement. Once the proposed solution is formulated, it is proposed to the Operation Manager (OM) and Training and Quality Manager (TQM) for approval, and introduced on a small scale in call center operations. This managed setting permits careful observation of the effects on essential performance metrics including Customer Satisfaction Score (CSAT), Resolution Rate (RR), and Average Handle Time (AHT). Small-scale deployments help validate the effectiveness of the solution and make the necessary adjustments before full-scale rollout.

5. Conclusions

Based on the results, call center operations at XYZ Malaysia have some potential challenges in optimizing their business processes, such as maintaining a good Quality Score (QA) to ensure that CSRs adhere to quality standards, managing high Average Handling Time (AHT) to prevent inefficiency and customer dissatisfaction, achieving a high Customer Satisfaction Score (CSAT) based on post-interaction surveys, ensuring a high resolution rate (RR) to resolve issues in the first interaction efficiently, and meeting Service Level Agreement (SLA) response times for email and chat interactions. The research concludes that XYZ Malaysia's call center operations can focus on Customer Satisfaction Scores (CSAT), Resolution Rates (RR), and Average Handling Time (AHT) by using process capability measurements. Average Handling Time (AHT): AHT measures the average time a Customer Service Representative (CSR) spends handling a customer call from start to finish, including talk time, hold time, and follow-up activities.

The current Cp value for AHT is 1.18, suggesting that the process has good potential to meet the specification limits. However, the Cpk value was -0.72, indicating that the process mean was significantly off-target. Customer Satisfaction Scores (CSAT): CSAT reflects how satisfied customers are with the service they receive. The Cp value for CSAT was 1.55, indicating the potential for good process capability. However, a Cpk value of 0.57 points to issues with process centering. Resolution Rate (RR): The resolution rate indicates the proportion of customer issues that are resolved during initial

contact. A high RR indicates effective and efficient problem solving. The Cp value for RR was 2.24, showing a high potential capability, but the Cpk value was 0.88, indicating a lack of centering.

Implementing Lean Six Sigma in XYZ Malaysia's call center involves a systematic approach through the DMAIC framework. By identifying the root causes of inefficiencies and implementing targeted solutions, XYZ Malaysia can improve key performance metrics, such as AHT, CSAT, and RR. Define Phase: The first step in implementing Lean Six Sigma in XYZ Malaysia's call center is to understand the existing processes and identify areas for improvement. The call center handles customer inquiries through email, chat, and outbound calls, with processes mapped using the Business Process Model and Notation (BPMN). The key metrics evaluated included Quality Score (QA), Average Handling Time (AHT), Customer Satisfaction Scores (CSAT), Resolution Rate (RR), and Service Level Agreements (SLAs).

Measure Phase: Operational metrics are measured to evaluate the current process capabilities. The data for Q1-Q2 2024 were analyzed, focusing on KPIs such as QA (target 90%), AHT (target 25 min), CSAT (target 65%), RR (target 65%), and SLA (target 75%). Statistical tools, such as Cp and Cpk, were used to assess the process capabilities. Analyze Phase: Root cause analysis uses fishbone diagrams to identify factors contributing to inefficiencies in the AHT, CSAT, and RR. The key root causes identified were as follows. AHT: Lack of experience, long escalation processes, limited references, frequent leaves, and inadequate investigation tools. CSAT: Lack of empathy, long response times, unclear escalation pathways, noisy work environments, technical bugs. RR: Lack of technical skills, long escalation processes, too many steps and information, productivity pressure, and limited access to tools.

Implementing Lean Six Sigma at XYZ Malaysia's call center can help improve service quality and customer satisfaction. Call center operations have become more efficient and effective by identifying and addressing key areas of inefficiency and dissatisfaction. The DMAIC framework's structured approach ensures continuous improvement, leading to higher customer satisfaction levels and better service quality in the long term. The overall Benefits include improved efficiency, reduced handling times, higher adherence to service standards, increased customer satisfaction and resolution rates, and an enhanced work environment and employee skills. This structured methodology highlights the substantial advantages of Lean Six Sigma in enhancing call center performance and increasing customer satisfaction.

Limitations and Future Study

This study is limited to data from Q1–Q2 2024 and focuses primarily on three key performance indicators without deeper analysis of workforce behavior, system constraints, or customer demographics. Future studies should include longer observation periods, incorporate additional metrics such as employee engagement or Net Promoter Scores (NPS), and explore the impact of automation and AI integration. Further research could also evaluate how changes in training programs or support tools affect long-term process stability and customer experience.

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