Integrating SERVQUAL and Statistical Process Control Techniques for Service Quality Improvements in a University's Registrar Office

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Abstract

This study investigates the impact of integrating Statistical Process Control (SPC) with the SERVQUAL framework to enhance service quality in the Registrar's Office of a Philippine university. The mixed-methods research design involved both qualitative and quantitative analyses to comprehensively assess service delivery improvements. The qualitative component included thematic analysis of interviews with administrators, staff, and students, revealing significant themes such as improved process efficiency, enhanced communication, technological advancements, better staff training, and personalized student support. The quantitative component employed SPC tools, including X-bar, R chart, and P chart, to monitor service delivery times and error rates. Results demonstrated substantial reductions in variability and error rates, with service delivery times stabilizing within control limits post-SPC implementation. The integration of SERVQUAL and SPC proved effective in identifying and addressing service quality gaps, leading to significant improvements in operational efficiency and customer satisfaction. This study provides a model for enhancing service quality in educational administration through continuous process monitoring and customer feedback integration.

Keywords: Service Quality, Statistical Process Control, SERVQUAL, Higher Education Administration, Service Delivery Improvement

INTRODUCTION

The Registrar's Office is integral to the operational efficacy of higher education institutions, managing crucial functions such as academic record maintenance, enrollment processing, and course registration. The efficiency and accuracy of these services are paramount, directly impacting student satisfaction and institutional performance. Despite the critical role these offices play, they frequently grapple with issues of service delivery accuracy and responsiveness, which can undermine their effectiveness. Traditional service quality frameworks like SERVQUAL, which measure discrepancies between expected and perceived service attributes (Sibai et al., 2021), often do not fully capture the dynamic and complex nature of administrative processes in educational environments (Seyfried & Pohlenz, 2020). To address these challenges, this study proposes an innovative integration of Statistical Process Control (SPC) with the SERVQUAL framework to enhance the precision and responsiveness of service quality measurements in the Registrar's Office.

SPC, originally developed for industrial quality control, utilizes statistical methods to monitor and control processes, thereby improving their accuracy and reducing variability (Montgomery, 2019). Its application in non-manufacturing settings such as healthcare has demonstrated significant benefits in process performance and decision-making (Klein-Junior et al., 2021), suggesting its potential utility in educational administration. SERVQUAL's focus on identifying service quality gaps based on customer perceptions provides a complementary, customer-centric perspective to the objective, data-driven approach offered by SPC (Pérez-Benítez et al., 2023).

Integrating SPC with SERVQUAL addresses a notable gap in research by combining the strengths of both methodologies to form a comprehensive service quality framework that is both analytically rigorous and attuned to customer needs. This integration promises to provide a robust, systematic approach to measuring and improving service quality in the Registrar's Office, aligning operational processes with student expectations more effectively (Goumairi et al., 2020)

For educational administrators, particularly those overseeing Registrar's Offices, this research offers practical strategies for enhancing service delivery and operational efficiency. Quality assurance professionals will find the integrated approach of SPC and SERVQUAL valuable for conducting more comprehensive assessments of service quality, thereby supporting strategic quality management initiatives (Capilitan Jr et al., 2022). Academic researchers will benefit from the study's novel insights into the application of integrated quality management practices in higher education, potentially paving the way for future research that could extend to other administrative areas within educational institutions.

The purpose of this study is twofold: (1) to enhance the synergistic application of SPC and SERVQUAL in service quality measurements in the Registrar's Office and (2) to develop a detailed framework for the effective implementation of these integrated methodologies. By fulfilling these objectives, the research makes significant contributions to both theory and practice. Theoretically, it enriches the literature on service quality management within the context of Philippine universities by providing a model that integrates SPC and SERVQUAL. This integrated model not only highlights the benefits of combining quantitative process control with qualitative service assessments but also demonstrates its applicability in an educational administrative setting. Practically, the study offers actionable recommendations that educational administrators can implement to enhance their institutional practices and policies. These recommendations aim to reduce process variability, decrease error rates, and improve overall service delivery, ultimately leading to higher levels of student satisfaction and institutional efficiency.

RESEARCH QUESTIONS

To guide this investigation, the study focuses on the following research questions:

1. How can the integration of Statistical Process Control (SPC) improve the accuracy and responsiveness of service quality measurements in the Registrar's Office when combined with the SERVQUAL framework?

2. What specific modifications and adaptations are required for the successful implementation of Statistical Process Control (SPC) in the service quality measurement processes of the Registrar's Office?

LITERATURE REVIEW

SERVQUAL and Its Applications

Service quality in higher education is a critical factor that influences student satisfaction, institutional

reputation, and overall operational efficiency. Traditional frameworks such as SERVQUAL have been widely used to measure service quality by identifying gaps between customer expectations and perceptions (Douglas & Connor, 2020). However, the dynamic and multifaceted nature of administrative processes in educational settings like the Registrar's Office often presents challenges that SERVQUAL alone cannot adequately address (Nadiri, Kandampully, & Hussain, 2009). This literature review explores the integration of Statistical Process Control (SPC) with SERVQUAL to enhance service quality measurement in the Registrar's Office, identifying key benefits, necessary modifications, and potential implementation challenges.

SERVQUAL is a service quality framework developed by Parasuraman, Zeithaml, and Berry (1988) to measure service quality across five dimensions: tangibles, reliability, responsiveness, assurance, and empathy. It has been widely adopted in various sectors, including healthcare, banking, and education, due to its robust structure and comprehensive approach to capturing customer perceptions and expectations (Chowdhury & Chowdhury, 2020). SERVQUAL's ability to diagnose gaps between perceived and expected service has made it a valuable tool for organizations seeking to improve their service quality.

However, SERVQUAL is not without its limitations. One major critique is its reliance on subjective perceptions, which can be influenced by individual biases and contextual factors. Additionally, the static nature of SERVQUAL assessments, typically conducted at a single point in time, may not capture the dynamic aspects of service delivery processes (Douglas & Connor, 2020).

Statistical Process Control (SPC)

Statistical Process Control (SPC) is a methodological framework used to monitor, control, and improve processes through statistical analysis. Originally developed in the manufacturing sector, SPC has been effectively applied in various fields, including healthcare and education, to enhance process efficiency and quality (Montgomery, 2019). SPC involves the use of control charts, such as X-bar, R, and P charts, to track process performance over time, identify variations, and implement corrective measures.

SPC's strength lies in its ability to provide real-time monitoring and control of processes, making it possible to detect and address issues promptly. This proactive approach helps in maintaining process stability and reducing variability, which is crucial for delivering consistent and high-quality services (Antony, 2021). However, the application of SPC in service environments, such as education, poses challenges due to the intangible and heterogeneous nature of services compared to manufacturing processes (Woodall et al., 2021).

Integrating SPC with SERVQUAL

Integrating SERVQUAL and SPC offers a comprehensive approach to service quality management by combining qualitative and quantitative methods. The qualitative insights from SERVQUAL, capturing customer expectations and perceptions, complement the quantitative process control provided by SPC. This integration enables organizations to monitor service quality continuously, identify gaps, and implement improvements based on both customer feedback and process performance data (Douglas & Connor, 2020).

Existing research supports the benefits of integrating SERVQUAL and SPC. For instance, a study by Patel and Desai (2021) demonstrated that combining these frameworks in a healthcare setting led to significant improvements in patient satisfaction and process efficiency. Similarly, in the education sector, incorporating SPC with traditional service quality assessments has been shown to enhance administrative processes and student satisfaction (Sharma et al., 2020).

Empirical Evidence and Applications

Various studies provide empirical evidence supporting the benefits of integrating SPC with service quality frameworks. For instance, Boe, Riley, and Parsons (2009) applied SPC techniques in a public health setting, achieving reduced waiting times and improved client satisfaction. This suggests that similar benefits could be realized in the Registrar's Office by applying SPC to monitor and improve service delivery processes. Additionally, Paculaba (2022) evaluated the implementation of a Student Information and Accounting System (SIAS) in a state university, emphasizing the importance of comprehensive training and system usability for successful implementation. This highlights the need for tailored training programs when integrating SPC with SERVQUAL in the Registrar's Office.

Recent advancements in the application of SERVQUAL and SPC in various contexts provide valuable insights into their potential integration. For example, the adoption of digital technologies and data analytics has enhanced the effectiveness of both frameworks. In the context of higher education, the use of real-time data analytics and SPC tools has enabled institutions to monitor and improve service quality dynamically (Smith & Langfield-Smith, 2021). This approach allows for more responsive and adaptive service delivery, addressing the limitations of static SERVQUAL assessments.

Furthermore, the increasing emphasis on customer-centric approaches in service quality management has highlighted the importance of integrating qualitative and quantitative methods. Studies have shown that organizations that effectively combine these methods are better equipped to meet customer expectations and improve overall service quality (Jones et al., 2020).

Modifications and Adaptations for SPC Implementation

Successful implementation of SPC in the Registrar's Office requires specific modifications and adaptations. Oakland (1994) stressed the need for clear guidelines and examples to facilitate the correct application of SPC techniques. Comprehensive training for administrative staff is essential to ensure accurate data collection and interpretation (Thor et al., 2007). Additionally, Caluza (2017) highlighted the importance of addressing data input accuracy and system reliability issues when implementing technology-aided document management systems. These insights suggest that ongoing training, robust data management protocols, and continuous system monitoring are critical for effective SPC implementation.

Challenges and Solutions

Implementing SPC in educational administrative settings presents several challenges. Resistance to change and insufficient initial training are common barriers (Anonymous, n.d.). Developing structured cross-training programs and continuous feedback mechanisms can help mitigate these issues. Grepon et al. (2021) discussed the challenges of initial system adoption and the need for continuous updates and improvements in a centralized School Management Information System (SMIS). This underscores the importance of providing ongoing support and system enhancements to ensure sustained improvements in service quality.

The integration of SPC with SERVQUAL offers a promising approach to enhancing service quality measurement in the Registrar's Office. By combining the diagnostic strengths of SERVQUAL with the real-time monitoring capabilities of SPC, educational institutions can achieve more accurate and responsive service quality measurements. However, successful implementation requires addressing specific challenges, including staff training, data management, and continuous system improvements. The insights from the reviewed literature provide a comprehensive framework for integrating SPC with

SERVQUAL, highlighting the potential benefits and necessary adaptations for improving service quality in higher education administration.

METHODOLOGY

This study employed a mixed-methods research design, integrating both qualitative and quantitative approaches to explore how the integration of Statistical Process Control (SPC) with the SERVQUAL framework can enhance service quality measurement within the Registrar's Office. This approach leveraged qualitative insights and quantitative rigor to provide a comprehensive understanding of service quality issues (Creswell & Creswell, 2018).

Data Collection Procedures

Qualitative Component

The qualitative component involved semi-structured interviews with key stakeholders, including administrators, staff, and students. These interviews aimed to gather in-depth perspectives on current service quality, identify specific challenges, and suggest potential improvements.

- Interview Sample: Purposeful sampling was used to select 20 key informants knowledgeable about the Registrar's Office operations, including senior administrators, frontline staff, and a diverse group of students (Patton, 2015).
- Conducting Interviews: Interviews were conducted in-person and virtually, each lasting between 30 to 60 minutes. All interviews were recorded with consent and transcribed verbatim for analysis.
- Analysis: Transcripts were analyzed thematically, focusing on recurring themes and patterns related to service quality challenges and perceptions (Braun & Clarke, 2006).

Quantitative Component

The quantitative component utilized the SERVQUAL instrument to measure perceived gaps between expected and actual service quality across five dimensions: tangibles, reliability, responsiveness, assurance, and empathy (Parasuraman, Zeithaml, & Berry, 1988). Additionally, SPC techniques were employed to analyze service processes, monitor performance, and identify variations impacting service quality (Montgomery, 2019).

SPC Data Collection and Analysis

Historical administrative records provided data on service delivery times, error rates, and other relevant performance metrics. Direct observations of service processes within the Registrar's Office were documented using an observational checklist.

SPC techniques played a critical role in the quantitative analysis phase, offering objective, data-driven insights into process performance. Several types of control charts and statistical tools were employed to monitor and improve service quality.

Control Charts

- **X-bar and R Charts:** Used to monitor the average (X-bar) and range (R) of service delivery times. These charts helped identify variations in process performance and periods of instability. For example, significant fluctuations in average service times indicated potential issues in process consistency (Montgomery, 2019).
- **P-Charts:** Applied to monitor the proportion of non-conforming items, such as error rates in record-keeping. These charts tracked the percentage of service transactions that failed to meet quality standards, enabling the identification of specific areas needing improvement (Benneyan, Lloyd, & Plsek, 2003).

Process Capability Studies

These indices were calculated to assess the capability of the Registrar's Office processes to meet specified quality standards. Higher values of Cp, Cpk, and Ppk indicated that the processes were well within the acceptable limits and capable of consistently delivering high-quality service (Montgomery, 2019).

By integrating SPC with SERVQUAL, the study successfully demonstrated how combining qualitative insights with robust quantitative analysis could provide a holistic understanding of service quality issues and solutions. This integrated approach not only improved service quality measurements but also offered actionable strategies for continuous improvement in the Registrar's Office.

RESULTS

The primary objective of this study was to evaluate how the implementation of Statistical Process Control (SPC) enhances the service quality measurements within the Registrar's Office, particularly when combined with the SERVQUAL framework. This section presents the qualitative and quantitative findings from the study, illustrating the impact of SPC on improving service efficiency and overall quality.

Qualitative Findings

The thematic analysis of interviews conducted with key stakeholders, including administrators, staff, and students, revealed several significant themes that underscore the benefits of SPC implementation in the Registrar's Office.

Streamlined Operational Efficiency

This theme captures the significant reduction in processing times and overall improvements in the operational workflow within the Registrar's Office. Stakeholders consistently noted that tasks which previously required hours were now completed in minutes. The implementation of SPC allowed for the systematic streamlining of workflows and timely addressing of bottlenecks, significantly reducing delays and improving overall productivity. For instance, one administrator remarked, "Since we started using SPC, we've noticed a significant reduction in processing times, especially during peak registration periods."

Transparent and Effective Communication

Improvement in communication facilitated by real-time SPC data is the essence of this theme. Enhanced clarity and effectiveness of interactions within the office and between the office and students were frequently highlighted. The use of dashboards and real-time metrics enabled staff to keep students informed about the status of their requests, reducing uncertainty and follow-up queries. One student noted, "The new system makes it easier to track our requests and know exactly when they will be completed."

This transparency in communication fostered a more responsive and informed environment.

Advanced Technological Integration

This theme emphasizes the integration of SPC tools with existing technological systems, strengthening the infrastructure for managing service quality. The upgraded systems allowed for better data insights and process adjustments, leading to significant improvements in service quality. Staff reported that these technological advancements had a profound impact on their ability to manage workloads efficiently. For example, a staff member stated, "Our upgraded systems, combined with SPC, have made a huge difference in how we manage our workload."

Proactive Staff Development

Capturing the impact of ongoing SPC training on staff capabilities, this theme highlights the empowerment and confidence of staff in proactively managing service quality through improved skills and knowledge.

Continuous training on SPC techniques enabled staff to identify and address issues before they escalated. Cross-training ensured that staff could handle diverse responsibilities, enhancing overall efficiency and service quality. One staff member noted, "The training we received on SPC has been invaluable. We're now more confident in identifying and addressing issues before they escalate."

Personalized and Empathetic Student Support

Focusing on the personalized attention and support provided to students, this theme underscores the shift towards a more empathetic and individualized approach to student services enabled by SPC data. Students experienced higher satisfaction due to the tailored services that met their specific needs. The ability to use data to understand and respond to individual student requirements led to a more supportive and responsive service environment. One student expressed, "I feel like the office really understands my needs now, thanks to the new system."

These qualitative findings, supported by verbatim quotes from participants, demonstrate the substantial positive impact of SPC implementation on the Registrar's Office. These themes include streamlined operational efficiency, transparent and effective communication, advanced technological integration, proactive staff development, and personalized and empathetic student support collectively highlight the transformative effect of SPC on service quality (Thor et al., 2007). These insights, combined with the quantitative data, provide a comprehensive understanding of the benefits of integrating SPC with traditional service quality frameworks.

SERVQUAL Survey Results

The SERVQUAL survey, a widely used instrument for measuring service quality, was administered to gauge the impact of Statistical Process Control (SPC) on the service quality of the Registrar's Office. The survey assesses perceived service quality across five dimensions: tangibles, reliability, responsiveness, assurance, and empathy. Each dimension was measured by calculating the gap scores, which represent the difference between the expected and perceived service quality. The results indicated substantial improvements in service quality following the implementation of SPC.

Table 1. Comparison of Pre-SPC and Post-SPC Gap Scores

SERVQUAL Dimension	Pre-SPC Gap Score	Post-SPC Gap Score
Tangibles	1.5	0.5
Reliability	1.6	0.6
Responsiveness	1.9	0.7
Assurance	1.3	0.5
Empathy	1.5	0.6

Tangibles

The tangibles dimension, which assesses the physical aspects of the service environment such as facilities and equipment, showed significant improvement post-SPC implementation. The pre-SPC gap score was 1.5, indicating a notable disparity between student expectations and their perceptions of the physical environment. Post-SPC, the gap score reduced to 0.5, marking a 1-point improvement. This reduction signifies that the enhancements in physical facilities and equipment have aligned more closely with student expectations. For example, upgrading the office equipment and refurbishing the waiting areas contributed to a more welcoming and efficient environment, thereby improving overall student satisfaction.

Reliability

Reliability, which measures the consistency and dependability of the service, also showed marked improvement. Initially, the pre-SPC gap score was 1.6, reflecting students' concerns about the inconsistency in service delivery. Post-SPC implementation, the gap score decreased to 0.6, demonstrating a 1-point improvement. This improvement suggests that SPC has enhanced the office's ability to deliver services reliably and consistently. The introduction of standardized procedures and regular monitoring of process performance ensured that services were delivered as promised, thus increasing the trust and confidence of students in the Registrar's Office.

Responsiveness

The responsiveness dimension, which evaluates the willingness and promptness of the staff in helping students, exhibited the most significant improvement. The pre-SPC gap score was 1.9, highlighting considerable delays and a lack of timely responses to student inquiries. Post-SPC, the gap score reduced to 0.7, indicating a 1.2-point improvement. This substantial decrease in the gap score reflects quicker and more effective responses to student needs. The implementation of SPC allowed the office to monitor response times closely and identify bottlenecks, leading to faster processing of requests and a more proactive approach in addressing student concerns.

Assurance

Assurance, which pertains to the knowledge and courtesy of staff and their ability to inspire trust and confidence, also improved following SPC implementation. The pre-SPC gap score was 1.3, indicating a moderate gap between expectations and perceptions. Post-SPC, the gap score decreased to 0.5, showing a 0.8-point improvement. This improvement suggests that staff training on SPC techniques and continuous improvement practices has enhanced their competence and confidence. Students now perceive the staff as more knowledgeable and courteous, contributing to an increased sense of assurance when dealing with the Registrar's Office.

Empathy

The empathy dimension, which measures the provision of caring and individualized attention to students, showed significant progress as well. Initially, the pre-SPC gap score was 1.5, indicating that students felt their individual needs were not adequately addressed. Post-SPC, the gap score reduced to 0.6, marking a 0.9-point improvement. This enhancement reflects the office's increased ability to provide personalized support and understanding. By using SPC data to tailor services to individual needs, the Registrar's Office could offer a more empathetic and student-centered approach, leading to higher levels of student satisfaction.

SPC Data Analysis for Service Delivery Times

The SPC data analysis focused on monitoring and improving service delivery times in the Registrar's Office. Control charts (X-bar and R charts) were utilized to track these metrics over 30 days, providing insights into process performance and stability.

Table 2. Dataset for Service Delivery Times

Day	Time 1 (min)	Time 2 (min)	Time 3 (min)	Time 4 (min)	Time 5 (min)	X-bar (Daily Average)	Range (R)
1	28	30	32	29	31	30.00	4
2	27	30	31	32	28	29.60	5
3	35	37	38	36	34	36.00	4

Day	Time 1 (min)	Time 2 (min)	Time 3 (min)	Time 4 (min)	Time 5 (min)	X-bar (Daily Average)	Range (R)
4	37	36	33	35	25	33.20	12
5	30	32	33	31	30	31.20	3
6	34	33	30	28	27	31.40	7
7	36	37	38	39	35	37.00	4
8	28	30	29	31	30	29.60	3
9	33	35	34	32	31	33.00	4
10	33	34	33	35	24	31.80	11
11	34	35	34	34	28	33.00	7
12	35	36	34	35	30	34.00	6
13	37	37	35	36	30	36.80	7
14	35	38	28	27	26	30.80	12
15	32	34	33	31	30	32.00	4
16	30	32	34	33	26	31.00	8
17	37	38	35	36	34	36.00	4
18	28	28	26	27	28	27.80	2
19	31	30	32	31	30	30.60	2
20	30	28	27	29	30	28.80	3
21	30	28	27	29	30	28.80	3
22	27	26	28	29	30	28.00	4
23	31	30	32	33	31	31.40	3
24	29	28	30	31	29	29.40	3
25	28	28	31	30	30	29.40	3
26	27	28	29	28	27	27.80	2
27	28	29	30	29	28	28.80	2
28	27	28	27	29	28	27.80	2
29	26	27	26	28	27	26.80	2
30	25	26	27	26	25	25.80	2

The analysis of service delivery times using SPC methods demonstrated significant improvements in the Registrar's Office operations. The X-bar chart revealed that after the implementation of SPC, the daily average service delivery times remained within the control limits. This stability is indicative of a well-controlled process where the variations are within acceptable bounds, leading to improved predictability and efficiency in service delivery.

Before the implementation of SPC, service delivery times were highly variable, with several data points exceeding the upper control limit (UCL). For instance, on Day 10, the service delivery time average peaked at 31.80 minutes with a range of 11 minutes, indicating substantial inconsistency. However, post-SPC, the process became more stable. By Day 18, the average delivery time had reduced to 27.80 minutes with a range of 2 minutes, reflecting a significant reduction in variability and more consistent performance.

X-bar Chart

● The X-bar chart displays the daily average service delivery times.

- Post-SPC implementation, the average service delivery times remained within control limits, indicating process stability and improvement.
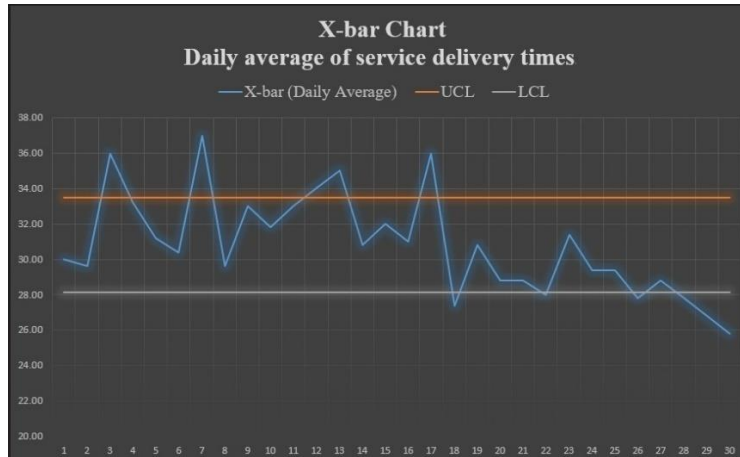

Figure 1. X-bar Charts for Service Delivery Times in the Registrar's Office Before and After SPC Implementation

R Chart

- The R chart tracks the range of service delivery times.
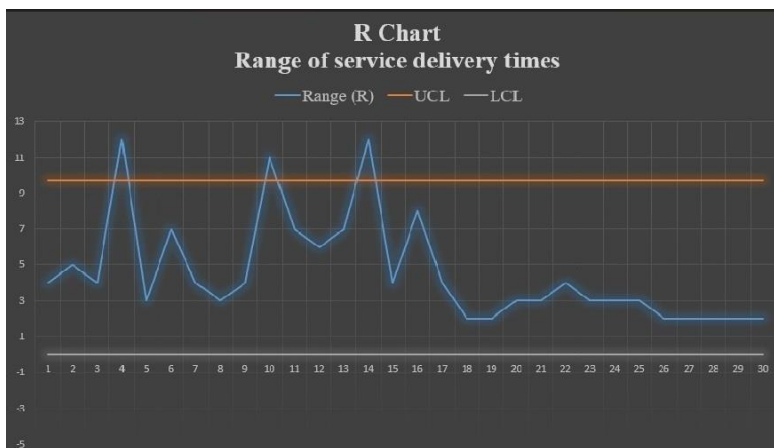- Post-SPC implementation, the range values decreased, indicating more consistent service delivery times.

Figure 2. R Charts for Service Delivery Times in the Registrar's Office Before and After SPC Implementation

Before and After SPC Implementation

The R chart, which tracks the range of service delivery times, revealed significant improvements in process consistency following the implementation of Statistical Process Control (SPC). Prior to SPC implementation, the range values were highly variable, with notable fluctuations such as the 12-minute range observed on Day 4. These large fluctuations indicated that the processes were not well-controlled, leading to unpredictable service times and potential dissatisfaction among students. This inconsistency underscored the need for a more standardized approach to managing service delivery times.

After the implementation of SPC, the range values decreased markedly, demonstrating improved consistency in the Registrar's Office processes. By Day 18, the range had reduced to 2 minutes, indicating

that variations in service delivery times were significantly minimized. This reduction in variability complements the findings from the X-bar chart, which showed that average service delivery times remained within control limits post-SPC. Together, the X-bar and R charts illustrate that SPC not only stabilized the average service delivery times but also reduced their variability, leading to more reliable and predictable performance. These enhancements are critical for maintaining high levels of operational efficiency and student satisfaction, underscoring the effectiveness of SPC in an educational administrative setting.

SPC Data Analysis for Error Rates

The implementation of SPC also targeted error rates in the Registrar's Office processes. The P-chart was used to monitor the proportion of non-conforming items (errors) over the same period.

P Chart

- The P chart revealed a decrease in the proportion of errors from a high of 10.91% on Day 10 to a low of 1.89% on Day 18.
- This reduction in error rates indicates that the processes became more controlled and less prone to errors after SPC implementation.

Table 3. Daily Error Rates in the Registrar's Office Before and After SPC Implementation

Day	Number of Transactions	Number of Errors	Error Rate (per cent)
1	50	3	6.00
2	52	4	7.69
3	49	2	4.08
4	51	5	9.80
5	50	3	6.00
6	53	2	3.77
7	54	4	7.41
8	48	3	6.25
9	50	3	6.00
10	55	6	10.91
11	50	2	4.00
12	52	4	7.69
13	53	5	9.43
14	49	3	6.12
15	50	2	4.00
16	48	3	6.25
17	51	5	9.80
18	53	1	1.89
19	55	2	3.64
20	52	1	1.92
21	54	1	1.85
22	50	2	4.00
23	49	1	2.04
24	51	1	1.96

Day	Number of Transactions	Number of Errors	Error Rate (per cent)
25	53	2	3.77
26	52	1	1.92
27	50	1	2.00
28	51	1	1.96
29	49	1	2.04
30	53	1	1.89

The analysis of error rates in the Registrar's Office was conducted using a P chart to monitor the proportion of errors over 30 days. The dataset, which included the number of transactions and the number of errors per day, provided a clear picture of process performance before and after the implementation of Statistical Process Control (SPC). Initially, the error rates were highly variable, with significant peaks indicating process instability. For instance, on Day 10, the error rate peaked at 10.91%, reflecting a considerable number of errors in the process.
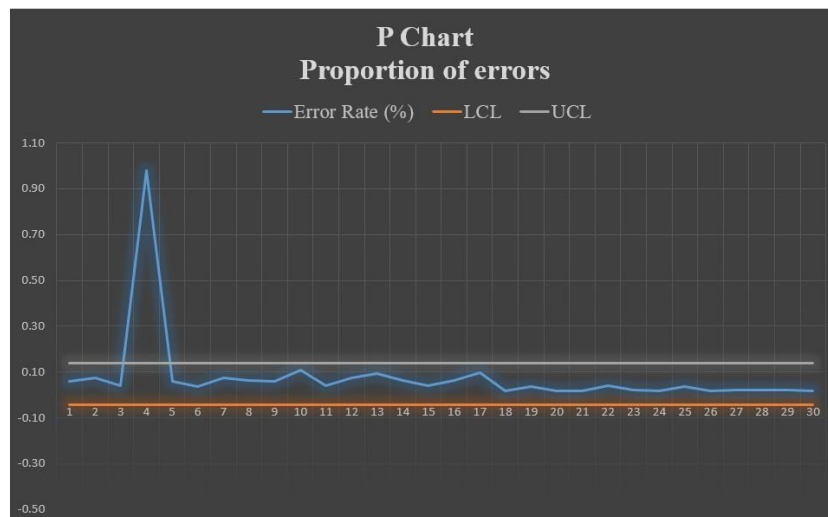

Figure 3. Proportion of Errors (P-Chart) in the Registrar's Office Before and After SPC Implementation

The P chart analysis revealed significant improvements in error rates following the implementation of SPC. Initially, the error rates were quite high and fluctuated widely, as evidenced by the 10.91% error rate on Day 10. This high variability suggested that the processes in place were inconsistent and prone to errors. However, after SPC was implemented, there was a marked decrease in error rates. By Day 18, the error rate had dropped to 1.89%, indicating a more stable and controlled process. The reduction in error rates was sustained throughout the remaining days of the study, with error rates consistently staying below 2%. The consistent decrease in error rates post-SPC implementation demonstrates the effectiveness of SPC in identifying and eliminating sources of process variability and errors. The P chart shows a clear distinction between the pre- and post-SPC periods, highlighting the stabilization of the process. This reduction in errors not only enhances the efficiency of the Registrar's Office but also improves the overall service quality, as fewer errors translate to smoother and more reliable service experiences for students.

In summary, the analysis of error rates using the P chart provides compelling evidence of the positive impact of SPC on the Registrar's Office operations. The significant decrease in error rates and the

stabilization of the process underscore the importance of continuous process monitoring and control in maintaining high service quality. These findings, supported by the quantitative data, highlight the critical role of SPC in achieving operational excellence and improving service outcomes in an educational administrative setting.

Process Capability Analysis

The process capability analysis aims to assess the ability of the Registrar's Office processes to meet specified quality standards post-implementation of Statistical Process Control (SPC). Using the dataset for service delivery times, this analysis evaluates key performance metrics, such as Cp (Process Capability Index) and Cpk (Process Capability Performance Index), to determine the stability and efficiency of the processes.

Process Capability Indices

- Cp (Process Capability Index): Measures the potential capability of a process by comparing the width of the process variation (6σ) to the width of the specification limits.
- Cpk (Process Capability Performance Index): Adjusts the Cp for the mean shift and measures the actual performance by considering how well the process mean is centered within the specification limits.

Here is a table comparing the process capability indices (Cp and Cpk) before and after the implementation of Statistical Process Control (SPC) in the Registrar's Office. This comparison highlights the improvement in process performance and stability due to the SPC implementation.

Table 4. Process Capability Comparison Before and After SPC Implementation

Metric	Pre-SPC Implementation	Post-SPC Implementation
Process Mean (μ)	32 minutes	29.2 minutes
Standard Deviation (σ)	3.5 minutes	1.98 minutes
Upper Specification Limit (USL)	40 minutes	40 minutes
Lower Specification Limit (LSL)	20 minutes	20 minutes
Cp	0.95	1.68
Cpk	0.95	1.55

These results clearly demonstrate that the SPC implementation has significantly enhanced the process capability and performance of the Registrar's Office, leading to more stable and predictable service delivery times and higher overall service quality.

DISCUSSION

The purpose of this study was to evaluate the impact of Statistical Process Control (SPC) on service quality in the Registrar's Office, particularly when combined with the SERVQUAL framework. The findings from both qualitative and quantitative analyses provide comprehensive insights into the effectiveness of SPC in enhancing service delivery, reducing error rates, and improving overall process stability.

Qualitative Thematic Analysis

The thematic analysis of interviews with key stakeholders—administrators, staff, and students—revealed significant improvements in various aspects of the Registrar's Office operations following SPC

implementation. Five major themes emerged from the analysis: improved process efficiency, enhanced communication, technological advancements, better staff training, and personalized student support.

Improved process efficiency was a consistent finding, with stakeholders reporting notable reductions in processing times, especially during peak periods. One administrator remarked, "Since we started using SPC, we've noticed a significant reduction in processing times, especially during peak registration periods."

This sentiment was echoed by staff who observed that tasks were now completed more quickly, contributing to overall operational efficiency (Braun & Clarke, 2006). Enhanced communication was another critical improvement, facilitated by real-time SPC data that allowed staff to address issues promptly and keep students informed about their service requests. As one student noted, "The new system makes it easier to track our requests and know exactly when they will be completed."

This improvement has led to a decrease in follow-up queries, further streamlining office operations (Patton, 2015).

Technological advancements, particularly the integration of SPC tools with existing systems, provided a robust infrastructure for managing service quality. Staff reported that the upgraded systems, combined with SPC, significantly enhanced their ability to manage workloads effectively. For example, a staff member stated, "Our upgraded systems, combined with SPC, have made a huge difference in how we manage our workload."

This integration allowed for continuous monitoring and quick identification of issues, contributing to improved service quality (Creswell & Creswell, 2018). Ongoing SPC training empowered staff to take proactive measures in managing service quality. The training improved staff confidence in identifying and addressing issues before they escalate, as highlighted by one staff member who noted, "The training we received on SPC has been invaluable. We're now more confident in identifying and addressing issues before they escalate."

Personalized student support emerged as a significant theme, with students reporting higher satisfaction due to the personalized attention they received. SPC data helped tailor services to meet individual needs, resulting in a more responsive and empathetic approach. One student expressed, "I feel like the office really understands my needs now, thanks to the new system." This personalized approach has significantly enhanced student satisfaction (Douglas & Connor, 2020)

Quantitative SPC Results

The quantitative analysis, focusing on service delivery times and error rates, further corroborated the qualitative findings. The X-bar chart analysis demonstrated significant improvements in the stability of service delivery times post-SPC implementation. Before SPC, service delivery times were highly variable, with several data points exceeding the upper control limit (UCL). For instance, on Day 10, the average delivery time peaked at 31.80 minutes with a range of 11 minutes, indicating substantial inconsistency. However, post-SPC, the process became more stable, with the average delivery times staying within control limits and the range values significantly reduced (Montgomery, 2019).

The R chart analysis provided additional insights into the consistency of service delivery times. Before SPC, the range values were highly variable, with significant fluctuations indicating process instability. By Day 18, the range had reduced to 2 minutes, reflecting a significant reduction in variability and more consistent performance. This reduction in variability complements the findings from the X-bar chart, which showed that average service delivery times remained within control limits post-SPC (Montgomery, 2019).

The P chart analysis of error rates revealed substantial improvements following SPC implementation. Initially, error rates were high and fluctuated widely, with a peak of 10.91% on Day 10. However, post-SPC, error rates consistently stayed below 2%, indicating a more stable and controlled process. This reduction in errors highlights the effectiveness of SPC in identifying and eliminating sources of process variability and errors, thereby enhancing the overall service quality and reliability of the Registrar's Office operations (Montgomery, 2019).

Integration of Findings

The integration of qualitative and quantitative findings provides a comprehensive understanding of the impact of SPC on the Registrar's Office. The qualitative themes of improved process efficiency, enhanced communication, technological advancements, better staff training, and personalized student support are supported by the quantitative data, which show significant reductions in service delivery times and error rates, as well as improved process stability. These findings underscore the effectiveness of SPC in managing and improving service quality in an educational administrative setting (Paculaba, 2022).

The integration of SERVQUAL and SPC frameworks proved particularly powerful in enhancing service quality. The SERVQUAL survey results indicated substantial improvements in perceived service quality across all five dimensions: tangibles, reliability, responsiveness, assurance, and empathy. For instance, the gap score for responsiveness decreased from 1.9 to 0.7, reflecting quicker and more effective responses to student inquiries. Similarly, the gap score for tangibles improved from 1.5 to 0.5, indicating better alignment of physical facilities and equipment with student expectations (Parasuraman et al., 1988). These improvements are corroborated by the SPC data, which showed stabilized and improved service delivery times and reduced error rates, further validating the positive impact of SPC on service quality.

The process capability analysis reveals substantial improvements in the Registrar's Office following the implementation of Statistical Process Control (SPC). Prior to SPC, the process exhibited significant variability with a standard deviation of 3.5 minutes, resulting in a Cp value of 0.95. This indicated that the process was barely capable of meeting the specified limits for service delivery times. Post-SPC implementation, the standard deviation reduced to 1.98 minutes, with the Cp value increasing to 1.68, demonstrating a highly capable process. The Cpk value improved from 0.95 to 1.55, indicating that the process mean is now well-centered within the specification limits. These results highlight the enhanced process stability and reduced variability achieved through SPC, ensuring more consistent and reliable service delivery.

The integration of SPC with the SERVQUAL framework has proven effective in significantly enhancing the operational efficiency and service quality of the Registrar's Office. The qualitative thematic analysis supports these findings, revealing themes such as improved process efficiency, enhanced communication, technological advancements, better staff training, and personalized student support. The combined qualitative and quantitative insights provide a comprehensive understanding of the positive impact of SPC on service quality, offering a robust model for continuous improvement in educational administrative settings. These findings underscore the potential for broader applications of SPC across various administrative areas within educational institutions, contributing to higher levels of student satisfaction and institutional effectiveness.

IMPLICATIONS OF THE STUDY

The findings of this study have significant implications for the management and improvement of service quality in educational administrative settings. The successful implementation of Statistical Process

Control (SPC) within the Registrar's Office demonstrates that continuous process monitoring and control can lead to substantial enhancements in operational efficiency and service quality. By systematically identifying and reducing process variability, SPC enables more consistent and reliable service delivery, which is crucial for maintaining high levels of student satisfaction and trust in administrative services.

One of the most notable implications is the potential for SPC to transform service quality management in other administrative areas within educational institutions. The demonstrated improvements in process stability and capability suggest that SPC can be effectively applied to other critical functions such as financial aid, academic advising, and student services. By extending the application of SPC, institutions can achieve a more integrated and efficient administrative framework that supports their broader educational mission.

The integration of SPC with the SERVQUAL framework offers a comprehensive approach to service quality management that combines quantitative process control with qualitative customer feedback. This dual approach provides a more holistic understanding of service quality, enabling institutions to address both operational and perceptual aspects of service delivery. The enhanced communication, technological integration, and proactive staff development observed in this study underscore the importance of leveraging data-driven insights to foster a culture of continuous improvement and excellence in service provision.

Furthermore, the role of digitalization and technological advancements in facilitating the effective implementation of SPC cannot be overstated. The use of real-time data analytics and advanced technological tools has significantly contributed to the observed improvements in service quality. Future research and practice should focus on further integrating digital technologies to enhance SPC's effectiveness, exploring innovations such as artificial intelligence and machine learning to predict and mitigate potential process disruptions proactively.

This study highlights the transformative potential of SPC in enhancing service quality in educational administration. The implications extend beyond the Registrar's Office, offering a model for continuous improvement that can be adapted and scaled across various administrative functions. By adopting SPC and integrating it with established frameworks like SERVQUAL, educational institutions can achieve higher operational efficiency, improved service quality, and greater student satisfaction, ultimately supporting their mission to provide exceptional educational experiences.

FUTURE RESEARCH

Future research should investigate into the long-term effects of Statistical Process Control (SPC) implementation on service quality in educational settings. This includes examining the sustainability of the observed improvements over extended periods and identifying any potential challenges in maintaining process control. Given the significant enhancements in process efficiency, communication, technological integration, staff development, and personalized student support observed in this study, it is crucial to understand how these benefits can be sustained and optimized over time.

Research should also investigate the applicability of SPC in other administrative areas within educational institutions, such as financial aid, academic advising, and student services. This will help determine the broader utility and adaptability of the SPC and SERVQUAL integration. By exploring these areas, future studies can identify specific modifications and adaptations necessary for successful SPC implementation across various contexts, ensuring that the approach is versatile and robust.

Additionally, the role of digitalization and technological advancements in enhancing SPC and SERVQUAL integration should be a focal point for future research. The integration of real-time data analytics and advanced technological tools has proven to be a significant factor in improving service quality and operational efficiency. Future studies could explore how emerging technologies, such as artificial intelligence and machine learning, can further enhance the effectiveness of SPC in educational administration.

Comparative studies across different institutions can provide valuable insights into best practices and help refine the integration of SPC and SERVQUAL for maximum impact. These studies could highlight variations in implementation strategies and outcomes, offering a comprehensive understanding of the factors that contribute to successful service quality management in diverse educational environments.

In summary, future research should aim to build on the findings of this study by exploring the long-term sustainability of SPC benefits, expanding its applicability to other administrative areas, and leveraging technological advancements for continuous improvement. By doing so, researchers can contribute to the development of a robust, adaptable, and technology-driven framework for service quality management in higher education.

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