

## Assessment of Public Sector Service Readiness in Implementing Six Sigma Methodology in an Indonesian Context

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**Abstract** - *Implementing Six Sigma in the public sector, particularly in emerging countries, presents challenges and opportunities for improving service quality. This study assesses the readiness of the Surabaya City Office for Population Administration and Civil Registration (COPACR) to adopt Six Sigma to enhance operational efficiency. Using a framework derived from existing literature, the assessment focused on four key areas: upper management ability, middle management commitment, organisational capability, and change readiness. Data were collected through interviews, direct observation, and questionnaires. The findings indicate that while COPACR shows strong leadership and adequate organisational systems, it lacks readiness in middle management's awareness of customer-related performance and in managing rapid organisational change. Addressing these gaps is essential for ensuring successful and sustainable Six Sigma implementation. This study contributes a structured approach to evaluating Six Sigma readiness in the public sector and offers practical insights for similar institutions in developing countries aiming to improve service delivery through quality management methodologies.*

**Keywords** - *Critical Success Factor, Developing country, Public services, Readiness assessment, Six Sigma*

### I. INTRODUCTION

The concept of Six Sigma is well-established and successfully implemented in mass manufacturing industries and large corporations [1], [2], [3], [4]. However, applying this methodology in service settings presents greater challenges, as service organizations often struggle to develop and implement effective quality measures [5], [6], [7], [8], [9]. One key challenge is that service organizations, unlike manufacturing, cannot always control or pre-select their inputs. This means that even defective or problematic inputs—such as incomplete documents or unqualified requests—must still be processed, potentially affecting service outcomes [5], [6], [7]. Despite these challenges, Six Sigma has been applied

in various public service sectors. Among 121 reviewed publications, 20 focus on Six Sigma implementation in fields such as healthcare, education, local and central government, and other public sector contexts [2], [6], [7]. This demonstrates the method's potential applicability beyond manufacturing.

Indonesia represents a compelling case study for examining these challenges in a developing country context. With its vast geographical diversity and large population, ensuring consistent service delivery and effective governance remains a significant hurdle. Despite previous implementation barriers in this study, the Surabaya City Office for Population Administration and Civil Registration (COPACR) is observed as a public service organization exploring Six Sigma adoption.

According to the Surabaya Strategic Development Plan, not all residents of Surabaya possess official documents. Online services remain difficult to access for many, and some districts/cities process population administration documents without adhering to Standard Operating Procedures (SOP) [10], [11]. Additionally, the quality and quantity of human resources are still insufficient. These issues have prompted the upper management of COPACR to pursue the implementation of the Six Sigma methodology to address deficiencies in existing processes. To assess the agency's readiness for Six Sigma implementation, this study adopts the approach proposed by Rosa et al. (2024) and Costa et al. (2023), which examined Lean Six Sigma and quality performance improvements in Italian public healthcare organizations [12], [13]. This framework was selected to evaluate COPACR's readiness, as Six Sigma has yet to be implemented in the Indonesian public service sectors.

To improve service quality and accessibility, Surabaya COPACR have implemented several innovations in its business processes. The most widely used application by Surabaya COPACR to serve its

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Published by Unit Research and Knowledge-School of Business and Management-Institut Teknologi Bandung

customers is KLAMPID. KLAMPID is an online website portal where customers can request and receive services from Surabaya COPACR. A broad array of services is provided through the KLAMPID platform, such as applications for birth certificates, applications for e-legalization of documents, applications for e-KTP (Identification Card), and so on. In addition to being a platform where customers can request services and interact with the agency, KLAMPID also collects all applicant data within its database.

There are several problems with the current online KLAMPID system. The beginning of 2020 was a transitional period for the COPACR's system, from offline to online services, where applicants can apply online using the KLAMPID platform. The KLAMPID platform issues can be seen in Figure 1.

The KLAMPID system's online functions, such as account registration, data validation, and application submission, contributed to 80% of the total 11,292 complaints reported from customer and user interactions with the online system. Several customer complaint data points have not been analyzed to identify root causes, making it difficult for the management of COPACR to address these customer complaints, leading to decreased customer satisfaction. Online data should be generated automatically, making analysis easier. Unfortunately, data from customer complaints shows many problems in the current online system of the Surabaya COPACR.

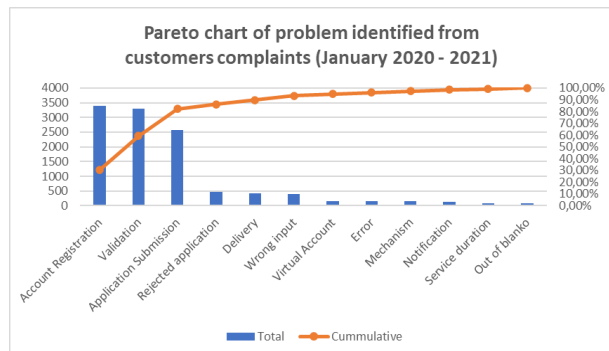


Figure 1 Problem identified from customers complaints (2020-2021)

Sources: Previous research is processed, 2020

Implementing Six Sigma is a complex and challenging process, especially in a public sector service. Critical Success Factors (CSF) in their application must be a top priority for the organization [14], [15], [16]. Upper management commitment and involvement [4], [17], cultural change [18], customer focus [19], precise performance metrics and organizational understanding of work process [20] apply to both services and manufacturing organizations.

After identifying the CSF, the organization must assess its readiness to implement the Six Sigma methodology by considering several variables and

estimating the time and effort required for successful implementation [12], [13]. This study assesses whether Surabaya COPACR can implement Six Sigma in its online platform. The objectives of this study are to identify the parameters in Surabaya COPACR that will affect the implementation of Six Sigma, evaluate the existing conditions of Surabaya COPACR regarding the readiness of the organization to apply Six Sigma methodology, and formulate recommendations based on the results of the assessment.

## II. METHODOLOGY

The study began with data collection and developing a checklist to evaluate processes and identify service defects at Surabaya COPACR. Key requirements included defining defects, standardizing service times, recording process cycle times, and establishing performance measurement mechanisms. The checklist was validated through interviews and direct observation. The assessment phase involved distributing questionnaires to employees and classifying management into upper and middle tiers to reflect the organizational hierarchy typical of public service institutions. The evaluation can be seen in Table 1.

The readiness assessment covered four areas (see Figure 1): (A) upper management ability, evaluated through interviews with the Head of Agency; (B) middle management's intention and commitment, assessed via questionnaires distributed to 3 division heads, three field heads, and 8 section heads; (C) organizational ability, evaluated using interviews and questionnaires involving upper and middle management, as well as 35 civil servants and 147 outsourced employees; and (D) organizational change readiness, assessed through similar methods with input from top and middle management and the same group of employees.

Questionnaire results were processed and analyzed, with outliers—such as uniform responses—identified and removed. Validity was tested using Pearson correlation ( $\alpha = 0.05$ ), and statements meeting the criteria were further tested for reliability using Cronbach's alpha (threshold  $> 0.60$ ). Normality was assessed via the Kolmogorov-Smirnov test to determine appropriate hypothesis testing methods—parametric (t-test, F-test) or non-parametric (Spearman correlation). All analyses were conducted using SPSS 15.0. Based on the validated data, readiness for Six Sigma implementation was assessed, supported by cross-tabulations of respondent roles and experience. Conclusions guided recommendations for COPACR and future research directions.

### III. FINDINGS AND DISCUSSION

Several respondents were interviewed to comprehensively understand the existing conditions of the Surabaya City Office of Public Administration and Civil Registration (COPACR) processes. The findings are shown in Table 2.

Surabaya COPACR lacks a standardised definition of process defects, leading to inconsistent stakeholder interpretations. The current database cannot automatically identify or record defects, relying instead on indirect indicators such as customer complaints or repeated data entries, which are unreliable methods. Key metrics like process completion and cycle time are not directly available and must be calculated manually. Data collection, though continuous, is done manually and inconsistently across processes.

Performance measurement is also limited. Only KLAMPID validators' activity is traceable (e.g., daily submission counts), while broader metrics like workload, task complexity, and overall performance remain untracked. Civil workers use the e-Performance system to log daily tasks and earn periodic incentives, but outsourced workers lack such mechanisms and receive sanctions only for underperformance. Although a Work Instruction Letter defines duties, it does not assess performance. A former KPI system was discontinued due to its complexity and incompatibility with the agency's service-based nature. Given that COPACR handles citizen-driven requests, with a legal processing window of seven working days, performance comparison across roles—especially non-validator staff—is impractical without tailored metrics.

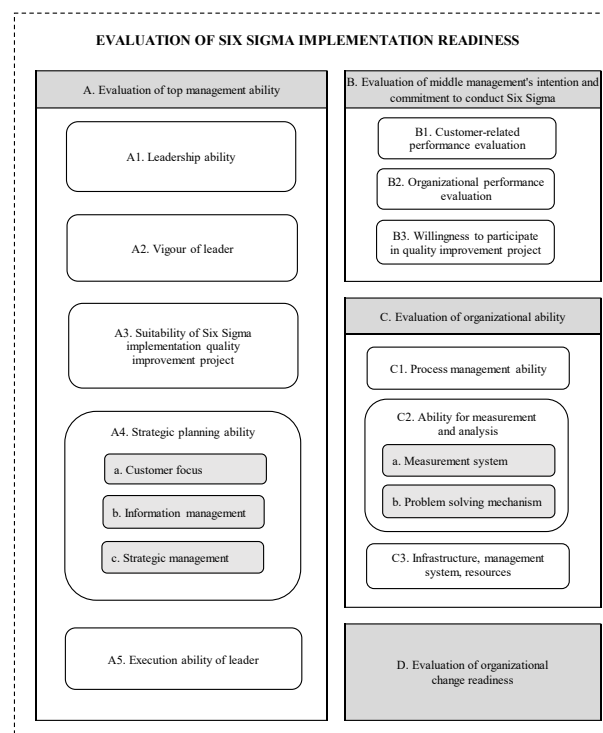


Figure 2 Evaluation item in the readiness assessment

Internal problem-solving at Surabaya COPACR follows a bottom-up approach, starting with peer-level staff and escalating to senior employees if unresolved. However, no standardised procedure exists for internal issues. External complaints from applicants are handled through established Standard Operating Procedures (SOPs). Training is not conducted regularly and occurs mainly during policy or system updates. While SOPs, process monitoring, and information dissemination mechanisms are in place, their application varies. Supervisors and internal systems like KLAMPID and e-Performance perform monitoring. Communication, including policy updates, is typically delivered via WhatsApp groups due to the absence of a Knowledge Management System.

The PDCA cycle is reflected in five-year strategic and annual work plans, though not always documented as PDCA explicitly. Respondents agreed that process and output data are routinely recorded. Following interviews, COPACR's innovation efforts—comprising various digital tools such as KLAMPID and its extensions—were documented. KLAMPID remains the primary service platform, supported by several purpose-specific applications.

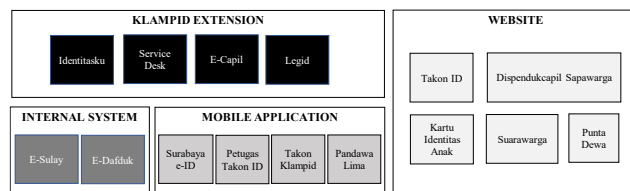


Figure 3 Surabaya COPACR's Innovation Mapping

A Six Sigma readiness questionnaire was distributed to all stakeholder groups at Surabaya COPACR, including upper management (Kepala Dinas), middle management (division, sub-division, and section heads), and civil and outsourced employees. Although the Agency Secretary holds an upper management role, this position was classified as middle management for assessment purposes due to limited involvement in the Six Sigma initiative. Data collection involved in-person interviews with upper management and online questionnaires (via Google Forms) for middle management and employees.

Initial analysis revealed several questionnaire responses with uniform answers, indicating low engagement. These were treated as outliers and excluded. Validity testing was conducted using Pearson Product-Moment Correlation ( $\alpha = 0.05$ ) for variables B, C, and D. In contrast, variable A (based solely on an upper management interview) was excluded from this step. Reliability testing confirmed all valid statements had Cronbach's alpha values above 0.60, indicating strong internal consistency. Normality of residuals was tested using the Kolmogorov-Smirnov method; significance values above 0.05 confirmed normal distribution, guiding the choice of hypothesis tests. SPSS 15.0 was used for all analyses. Results showed that all upper management parameters (A1–A4) scored above 3, with no score of 1 for A5. This reflects a strong readiness among upper management, supported by confidence in their leadership, strategic planning, and belief in the suitability of Six Sigma to improve service quality.

The results show that middle management is generally satisfied with customer service and operational performance, which may hinder motivation to adopt quality improvement initiatives like Six Sigma. However, some respondents noted that customer complaints remain high despite KLAMPID implementation. Specific concerns in parameter B2 include limited management engagement in quality, low employee satisfaction, imbalance between civil servants and outsourced workers, and issues with maintaining the KLAMPID system.

In evaluation C, all average scores were above 3, indicating a generally positive perception of organizational capabilities across areas such as

process management, infrastructure, and problem-solving systems. Nonetheless, some respondents highlighted recurring system downtimes and called for clearer procedures, better training, and system improvements.

Only one item in evaluation D (statement D20) was marked as "Not Ready," reflecting concern over the rapid pace of organizational change. Many respondents recommended completing and reviewing existing innovations before launching new ones. These insights were further supported through cross-tabulation of stakeholder responses, summarized in Table 4.

The assessment framework utilized in this study was adapted from the works of Rosa et al. (2024) [12] and Costa et al. (2023) [13]. These frameworks are based on the theoretical concepts of public institutions' organizational change readiness and quality management maturity. They heavily draw from Lewin's Change Management Theory and the Capability Maturity Model (CMM), which posits that readiness is a staged process influenced by leadership, structural systems, and cultural alignment. In the case of the Surabaya COPACR, strong support from upper management indicates that the initial unfreezing stage is progressing well [12], [13]. However, inconsistent engagement from middle management and a lack of standardized performance definitions suggest that the organization is still in transition and has not yet reached the refreezing stage, where changes become institutionalized. This reinforces the idea that partial readiness, while positive, is inadequate for sustainable Six Sigma implementation without cultural integration and aligned metrics across all organizational levels.

Based on the assessment, the author identifies three key areas requiring improvement: (1) customer-related performance evaluation (B1), (2) operational-level performance evaluation (B2), and (3) the pace of change within the organization (D20). Most respondents, 39 strongly agree, 67 agree, and 50 somewhat agree—indicated that too many changes have been implemented quickly. Respondents emphasized the need to finalize and evaluate existing innovations before introducing new ones, ensure routine assessments of ongoing initiatives, and assess available resources before further implementation.

The first step is to compile a complete list of all innovations developed by Surabaya COPACR, including their operational status. For inactive innovations, the organization must determine whether associated apps or websites remain accessible and whether to retain or deactivate them to avoid user confusion.

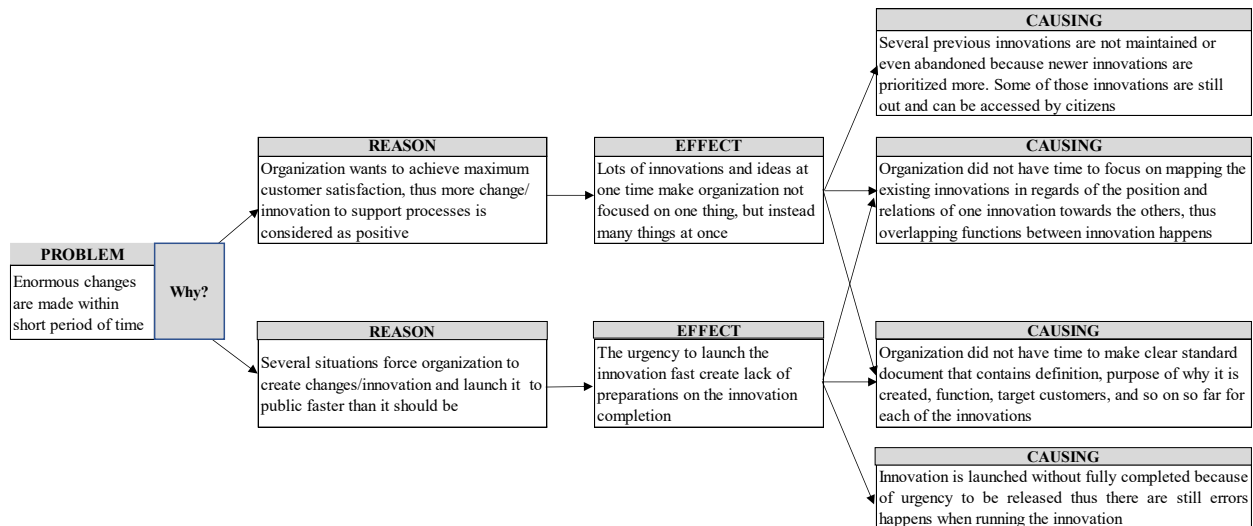


Figure 4 Problem Identification Decision Tree

Table I Evaluation Item, Specification, And Target Respondents

Code	Evaluation Item	Specification	Method	Target Respondent
A	Evaluation of upper management ability	General	Interview	Upper Management - Head of Agency
B	Evaluation of middle management's intention and commitment to conduct Six Sigma	General	Questionnaire	Middle Management - 3 Division Head - 3 Field Head - 8 Section Head
C	Evaluation of organizational ability	Six Sigma	Interview/ Questionnaire	<ul style="list-style-type: none"> <li>Upper Management</li> <li>Middle Management</li> <li>Employees (35 civil workers and 147 outsource workers)</li> </ul>
D	Evaluation of organizational change readiness	General	Interview/ Questionnaire	<ul style="list-style-type: none"> <li>Top Management</li> <li>Middle Management</li> <li>Employees (35 civil workers and 147 outsource workers)</li> </ul>

Table II Checklist of System Existing Conditions

No	Data Needs to Implement Six Sigma	Observation	No	System Needs to Implement Six Sigma	Observation
1	Standard of defect definition	✗	1	Performance measurement mechanism	✗
2	Standard of process completion mean time	✗	2	Problem solving mechanism	✓
3	Recording of process cycle time	✗	3	Training needs	✗
4	Recording of defect	✗	4	Working procedure/Standard Operating Procedure	✓
5	Recording continuity	✓	5	Monitoring of process completion	✓
			6	Information distribution mechanism	✓
			7	Plan Do Check Action	✓
			8	Database of process and output recording	✓

Table III Evaluation Items

Code	Evaluation Items	Directed
A	Evaluation of upper management ability	Upper Management
B	Evaluation of middle management's intention and commitment to conduct Six Sigma	Middle Management
C	Evaluation of organizational ability	All stakeholders
D	Evaluation of organizational change readiness	All stakeholders



Table IV Final Decision

Code	Evaluation Items	Decision
A	Evaluation of upper management ability	READY
B	Evaluation of middle management's intention and commitment to conduct Six Sigma	NOT READY
C	Evaluation of organizational ability	READY

Table V Decision of Innovations

Category	Innovation	Media	User Input	Decision
Complaints	Service Desk	KLAMPID Extension	Surabaya COPACR	Keep
	<i>COPACR Sapawarga</i>	Website	Applicants	Keep
	<i>Suara Warga</i>	Website	Applicants	Delete
Tracking	<i>Surabaya e-ID</i>	Mobile Application	Applicants	Keep
	<i>Takon Klampid</i>	Mobile Application	Applicants	Combine with Takon ID
	<i>Takon ID</i>	Website	Applicants	Combine with Takon KLAMPID
Main Service	KLAMPID	Website	Applicants	Keep
	<i>Pandawa Lima</i>	Mobile Application	RT/RW	Keep

Next, a standardized document and innovation map should be created, categorizing each system—whether as a KLAMPID extension, internal tool for staff, external tool for district/sub-district offices, or customer-facing platform. This mapping helps identify functional overlaps, clarify interdependencies, and guide decisions on system consolidation or integration.

The next phase focuses on implementing Six Sigma's Define and Measure stages. At COPACR, the definition of a 'defect' is currently inconsistent, with no standardized criteria across the organization. To proceed effectively, the organization must establish a clear, shared definition of defects, categorized by service type, detailed in description, and framed from a system-based (not user-blaming) perspective.

Following the definition, the organization should measure performance using Defects Per Unit (DPU) and Defects Per Million Opportunities (DPMO) to determine its sigma level (see Table 6). Analyzing trends across periods, supported by tools like Pareto charts and fishbone diagrams, will help identify root causes and target process improvements, ultimately enhancing service quality and reducing recurring issues.

Table VI Sigma Levels

Sigma Level	DPMO	Sigma Level	DPMO
1.0	697,672	3.5	22,750
1.5	501,350	4.0	6,210
2.0	308,770	4.5	1,350
2.5	158,687	5.0	232.67
3.0	66,811	5.5	31.69
3.5	22,750	6.0	3.40

## IV. CONCLUSION

The Six Sigma readiness assessment at Surabaya COPACR examined four areas: Upper Management Ability, Middle Management's Intention and Commitment, Organisational Ability, and Organisational Change Readiness. Key factors included leadership capacity, performance evaluation, infrastructure, and adaptability to change.

Findings show that COPACR is ready in most aspects—especially leadership and organisational capability—with moderate support from middle management. However, change readiness emerged as a weakness due to rapid and frequent organisational shifts. Recommendations emphasise pacing change and aligning new initiatives with resource capacity.

This study provides insights that extend beyond Indonesia. Many developing nations share similar administrative structures and face comparable challenges in service improvement. As such, this readiness model and its findings offer a practical reference for other public agencies aiming to implement Six Sigma. Broader application of this framework across different countries can support the development of adaptable, evidence-based strategies for quality improvement in the public sector.

This study's robust data triangulation (interviews, observation, questionnaires) has several limitations. First, it focuses on a single public institution, limiting the generalizability of findings due to differing digital infrastructures and leadership dynamics in other agencies. Second, response bias may occur, particularly in self-assessments by middle management who might exaggerate readiness under hierarchical pressures. Third, the data collection was confined to a specific period, potentially missing long-term readiness changes due to political or leadership

shifts. Lastly, post-implementation data is not included, which is vital for validating the readiness assessment's predictive power.

## REFERENCES

- [1] M. Saroya, "Integrating Lean Manufacturing and Six Sigma: A Synergistic Approach to Enhance Quality and Operational Efficiency," *International Journal For Multidisciplinary Research*, vol. 6, no. 5, Oct. 2024, doi: 10.36948/ijfmr.2024.v06i05.29727.
- [2] J. Antony, R. Snee, and R. Hoerl, "Lean Six Sigma: Yesterday, Today And Tomorrow," *International Journal of Quality & Reliability Management*, vol. 34, no. 4, pp. 1073–1093, 2017.
- [3] L. Gutierrez-Gutierrez, S. de Leeuw, and R. Dubbers, "Logistics services and Lean Six Sigma implementation: a case study," *International Journal of Lean Six Sigma*, vol. 7, no. 3, pp. 324–342, Aug. 2016, doi: 10.1108/IJLSS-05-2015-0019.
- [4] G. C. P. Condé, J. C. de Toledo, and M. L. Martens, "Six Sigma Project Generation and Selection: An Action Research Study," *International Journal of Lean Six Sigma*, vol. 15, no. 4, pp. 865–885, 2024, doi: 10.1108/ijlss-04-2023-0070.
- [5] D. Akanmu and N. Nordin, "Six Sigma Practices Integrated With IR 4.0 for Sustainability in Malaysian Healthcare Industry," *Int J Public Health Res*, vol. 12, no. 01, pp. 1528–1535, 2022, doi: 10.17576/ijphr.1201.2022.07.
- [6] R. Rath, A. Vakharia, and M. Shadab, "Lean Six Sigma in the Healthcare Sector: A Systematic Literature Review," *Mater Today Proc*, vol. 50, pp. 773–781, 2022, doi: 10.1016/j.matpr.2021.05.534.
- [7] T. O. Kowang, L. Peidi, L. K. Yew, O. C. Hee, G. C. Fei, and B. Kadir, "Critical Success Factors for Lean Six Sigma in Business School: A View From the Lecturers," *International Journal of Evaluation and Research in Education (Ijere)*, vol. 11, no. 1, p. 280, 2022, doi: 10.11591/ijere.v11i1.21813.
- [8] O. Olutade, A. M. Adeyinka, and O. Durodola, "Exploring Lean Six Sigma: A Comprehensive Review of Methodology and Its Role in Business Improvement," *International Journal of Multidisciplinary Research and Growth Evaluation*, vol. 4, no. 6, pp. 939–947, 2023, doi: 10.54660/ijmrge.2023.4.6.939-947.
- [9] J. Murphy and T. Banks, "Reducing Wait Times in Child and Adolescent Ambulatory Mental Health," *Journal of Ambulatory Care Management*, vol. 48, no. 1, pp. 15–24, 2024, doi: 10.1097/jac.0000000000000514.
- [10] Moh. Saleh and C. S. Utomo, "Establishment of Regional Regulations DPRD in Surabaya City as a Means of Realizing a Development, Humanist and Sustainable," *International Journal of Social Science Research and Review*, vol. 5, no. 4, pp. 7–11, 2022, doi: 10.47814/ijssrr.v5i4.253.
- [11] R. Kaye, T. N. Arvanitis, S. N. L. C. Keung, D. Kalra, and D. V. Berastegi, "Implementing Digitally Enabled Integrated Healthcare," *Journal of Integrated Care*, vol. 32, no. 5, pp. 25–36, 2024, doi: 10.1108/jica-11-2023-0077.
- [12] A. Rosa *et al.*, "Assessing Lean Six Sigma and Quality Performance Improvement in Italian Public Healthcare Organizations: A Validated Scale," *The TQM Journal*, vol. 36, no. 9, pp. 392–412, 2024, doi: 10.1108/tqm-10-2023-0350.
- [13] F. Costa, A. P. Staudacher, N. Alemsan, and G. L. Tortorella, "Readiness Level Assessment for Lean Six Sigma Implementation in the Healthcare Sector," *International Journal of Lean Six Sigma*, vol. 15, no. 1, pp. 131–152, 2023, doi: 10.1108/ijlss-02-2023-0031.
- [14] E. Taraza, S. Anastasiadou, A. Μαρούρας, and C. Papademetriou, "Sustainable Development and Implementation of Quality Management Excellence Models in Public Organizations: A Systematic Literature Review," *Sustainability*, vol. 15, no. 10, p. 7971, 2023, doi: 10.3390/su15107971.
- [15] A. Singh and P. Ravi, "Lean Six-Sigma (LSS) Applications in Hospitals: A decade (2011–2020) Bibliometric Analysis," *International Journal of Productivity and Performance Management*, vol. 72, no. 8, pp. 2270–2291, 2022, doi: 10.1108/ijppm-07-2021-0432.
- [16] M. B. Francescato, A. N. Júnior, F. I. Kubota, G. E. Guimarães, and B. R. D. E. OLIVEIRA, "Lean Six Sigma Case Studies Literature Overview: Critical Success Factors and Difficulties," *International Journal of Productivity and Performance Management*, vol. 72, no. 1, pp. 1–23, 2022, doi: 10.1108/ijppm-12-2021-0681.
- [17] A. C. Zanezi and M. M. de Carvalho, "How Project Management Principles Affect Lean Six Sigma Program and Projects," *Brazilian Journal of Operations & Production Management*, vol. 20, no. 1, p. 1564, 2023, doi: 10.14488/bjopm.1564.2023.
- [18] A. S. W. Albayatey, "Critical Success Factors for Applying Six Sigma in Transformative Industries in Iraq," *International Journal of Professional Business Review*, vol. 8, no. 6, p. e01917, 2023, doi: 10.26668/businessreview/2023.v8i6.1917.

- [19] M. Samanta, N. Virmani, R. K. Singh, S. N. Haque, and M. Jamshed, "Analysis of Critical Success Factors for Successful Integration of Lean Six Sigma and Industry 4.0 For organizational Excellence," *The TQM Journal*, vol. 36, no. 1, pp. 208–243, 2023, doi: 10.1108/tqm-07-2022-0215.
- [20] E. L. de Sousa, F. V. Andretti, and M. T. G. de Castro, "Overview of Stages of Change of Lean Six Sigma Programs in Organizations From 2005 to 2021," *Gestão & Produção*, vol. 30, 2023, doi: 10.1590/1806-9649-2023v30e6522.