# The Role of Queue Algorithms in Optimizing E-Government Scheduling Systems: Evidence from the JAPIN Case

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**Abstract**

This study examines the effectiveness of the JAPIN (Jadwal Pimpinan) application, a queue algorithm-based scheduling system designed for the Leadership Administration Bureau of the Regional Secretariat of North Sumatra Province. The objective is to analyze how algorithmic scheduling enhances operational efficiency, accuracy, and coordination in leadership activities. Employing a mixed-method approach, the research integrates descriptive statistical analysis using SPSS with qualitative interviews and observations. Quantitative results indicate high user satisfaction, with a mean score of 21.40 and a standard deviation of 2.011, reflecting consistent positive perceptions of usability, accessibility, and efficiency. Qualitative findings reveal that JAPIN reduces manual workload, prevents scheduling conflicts, and increases transparency in administrative workflows. The queue algorithm's FIFO and dynamic priority mechanisms ensure fairness and responsiveness in managing the Governor's agenda. Despite minor challenges such as user adaptation and limited technical resources, JAPIN demonstrates strong potential as a scalable model for digital government transformation. The study provides empirical evidence supporting the use of algorithmic systems to improve scheduling performance and contribute to efficient, transparent e-government practices.

**Keywords**: JAPIN Application; Queue Algorithm; E-Government; Scheduling Efficiency; Public Administration; Digital Transformation; Fifo Principle.

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## Introduction

In recent decades, rapid advances in information technology have revolutionized the way governments manage administrative processes, communication, and service delivery[1]. Digital transformation has become a fundamental pillar of modern governance, providing new tools to enhance transparency, accountability, and efficiency across public institutions[2]. According to global e-government development studies, the integration of digital platforms in public administration significantly improves information accessibility and coordination among stakeholders[3]. In Indonesia, this transformation is formally mandated by Presidential Regulation No. 95 of 2018 concerning the Electronic-Based Government System (SPBE), which aims to create a clean, effective, transparent, and accountable government capable of providing high-quality public services[4]. The regulation underscores the urgency for all governmental units to adopt information systems that optimize administrative operations and promote sustainable public trust through efficiency and responsiveness[5].

The Leadership Administration Bureau (Biro Administrasi Pimpinan) of the Regional Secretariat of North Sumatra Province is a crucial administrative body responsible for formulating and implementing leadership-related protocols, monitoring official activities, and coordinating the Governor's agenda[6]. Traditionally, scheduling activities and invitation management have been handled manually using Microsoft Word, a process prone to inefficiencies, data entry errors, and coordination delays. This manual system created obstacles in ensuring that the Governor's daily activities and invitations were properly synchronized, leading to potential overlaps or scheduling gaps that could impact administrative productivity. structured and reliable scheduling is essential for ensuring leadership tasks proceed seamlessly, preventing disruption due to human error or inadequate planning mechanisms[7].

To address these inefficiencies, a digital scheduling application called JAPIN (Jadwal Pimpinan) was developed to automate the management of the Governor's daily agenda[8]. JAPIN applies queue algorithms specifically, First-In-First-Out (FIFO) and dynamic priority scheduling to systematically organize activities based on urgency and importance. By implementing this algorithmic approach, JAPIN seeks to enhance scheduling accuracy, reduce administrative workload, and improve overall operational efficiency. The introduction of JAPIN aligns with the principles of e-government by promoting data-driven management and facilitating real-time access to scheduling information among authorized personnel[9].

The central research problem concerns the effectiveness of the JAPIN application in optimizing the scheduling process within the Bureau of Leadership Administration[10]. The study investigates whether the queue-based approach provides measurable improvements compared to the traditional manual system. Core issues include assessing reductions in waiting time, minimizing scheduling conflicts, enhancing transparency, and increasing coordination efficiency between administrative staff and the Governor's office. This research also identifies implementation challenges, including technical limitations, user adaptation barriers, and data input reliability[11].

From a computational perspective, queue algorithms play a pivotal role in organizing process flow and optimizing system responsiveness[12]. A queue structure is based on the FIFO principle, meaning that the first element entered is also the first to be processed. this principle ensures fair and predictable task execution, which is critical in time-sensitive administrative contexts. Furthermore highlight that dynamic priority scheduling enhances flexibility by allowing adjustments based on changing priorities, making it especially suitable for complex and high variability environments like government scheduling systems[13].

The concept of queuing also aligns with data management principles described, who emphasized that queue structures ensure orderly data processing and prevent resource contention by maintaining the correct sequence of operations. Contextualized FIFO principles in broader system operations, noting their utility in scenarios where the timing and order of data

processing are critical to maintaining workflow integrity. When applied to scheduling systems, these algorithms ensure that tasks and events are handled in a systematic, transparent, and equitable manner.

Prior research on algorithmic scheduling has demonstrated that queue-based methods can improve operational throughput, task prioritization, and fairness in decision-making processes[14]. However, few studies have focused on their application in government administrative environments, particularly within leadership scheduling functions. This creates a significant research gap in understanding how queue-based algorithms can be effectively adapted and evaluated in a public-sector context. JAPIN offers an empirical opportunity to assess these theoretical benefits in a real-world governance framework[15].

Therefore, this study aims to analyze the effectiveness of implementing the JAPIN application with a queue algorithm in managing the scheduling activities of the Governor of North Sumatra. Specifically, the study evaluates how algorithmic scheduling contributes to operational efficiency, transparency, and data accuracy. The novelty of this research lies in its integration of queue algorithms within a regional government's administrative scheduling system, providing empirical insights into the intersection of computational efficiency and organizational governance. The findings are expected to contribute to the broader discourse on e-government digitalization by offering a model for other regional institutions seeking to modernize their leadership scheduling processes through intelligent, data-driven technologies.

## Research Methodology

### 1. Research Design

This research adopts a mixed-method approach combining quantitative and qualitative techniques to evaluate the effectiveness of the JAPIN (Jadwal Pimpinan) application in managing leadership scheduling activities at the Leadership Administration Bureau of the Regional Secretariat of North Sumatra Province. Mixed-method research enables comprehensive analysis by integrating numerical data with interpretative insights, providing a balanced perspective on system performance and user perception . The quantitative component focuses on measuring user satisfaction and operational efficiency through descriptive statistical analysis, while the qualitative component explores user experiences, system usability, and implementation challenges. This approach ensures a holistic understanding of the impact of JAPIN's queue algorithm on administrative processes, consistent with previous studies on e-government systems.

The research design follows an evaluative and descriptive paradigm aimed at identifying system effectiveness based on user responses and performance data. descriptive evaluations are appropriate for analyzing real-world applications where multiple variables interact, particularly in technology implementation within organizational settings. Therefore, the study situates JAPIN's performance within the broader context of e-government efficiency, transparency, and user engagement.

### 2. Data Collection

Data collection employed multiple sources, including structured questionnaires, direct observation, and documentation analysis of scheduling activities before and after JAPIN's implementation. The survey was distributed to ten administrative staff members directly involved in scheduling and coordination of the Governor's activities. The sample was determined using purposive sampling, as respondents were selected based on their operational roles and direct experience using the system . The use of a small, targeted sample aligns with exploratory case-study methodologies where depth of insight is prioritized over statistical generalization.

The questionnaire included both closed-ended and open-ended questions to capture quantitative responses and qualitative feedback. Quantitative items were measured using a

five-point Likert scale to assess perceptions of system usability, accessibility, and overall effectiveness. Observational data were gathered by monitoring the daily use of the JAPIN application, focusing on the scheduling process, time taken to update invitations, and error reduction in event coordination. Documentation analysis compared pre-implementation records created via Microsoft Word with post-implementation reports generated automatically by the JAPIN system. This triangulation of data sources strengthens the validity and reliability of findings.

## 3. Data Analysis Techniques

Quantitative data were processed using the Statistical Package for the Social Sciences (SPSS) software. Descriptive statistics, including mean, minimum, maximum, and standard deviation, were calculated to summarize user satisfaction and performance outcomes. These measures provide an overview of the central tendency and dispersion of responses, enabling researchers to evaluate general satisfaction trends and system efficiency levels. The obtained mean score of 21.40 (range: 19–25; standard deviation: 2.011) indicates positive user perception and suggests a favorable level of system effectiveness. The results were interpreted by comparing them to predefined benchmarks for user acceptance and operational efficiency used in previous studies on government information systems.

For qualitative data, thematic analysis was used to identify recurring themes related to user experience, interface design, and perceived benefits. The analysis followed the six-step model proposed by Braun and Clarke (2006), involving data familiarization, coding, theme development, review, and final reporting. Emerging themes included improved accessibility, enhanced scheduling transparency, time efficiency, and reduction in manual administrative work. These findings were validated through cross-referencing with observational notes and system-generated data logs, ensuring interpretive consistency.

## 4. System Implementation Context

The JAPIN application utilizes a queue algorithm to structure scheduling processes systematically. The algorithm adheres to the FIFO (First-In-First-Out) principle, ensuring that activities are processed in the order they are received, which guarantees fairness and temporal accuracy . Additionally, a dynamic priority feature allows administrators to reorder tasks based on urgency, enabling flexibility when high-priority events arise . Figure 1 illustrates the FIFO model integrated into JAPIN's scheduling architecture, demonstrating how event requests are sequentially processed according to their entry timestamps.


**Figure 1.** FIFO-based Queue Model in JAPIN Scheduling System

The system architecture supports data input, priority tagging, and automatic conflict detection. When a new activity is entered into the queue, the algorithm determines its position based on entry time and assigned priority level. The system then updates the central calendar accessible to authorized users, including the Governor, administrative aides, and departmental staff. This process reduces the potential for double-booking and ensures that

scheduling adjustments occur seamlessly in real-time. Such algorithmic integration reflects established principles of operational optimization in information systems.

### 5. Validity and Reliability

Ensuring methodological rigor was essential in this research. To enhance reliability, the questionnaire was pre-tested with two administrative staff members before full deployment, allowing adjustments to ambiguous questions. Cronbach's Alpha was calculated to evaluate internal consistency, following the acceptable threshold of $\alpha \geq 0.70$ suggested by Nunnally (1978). Construct validity was reinforced through triangulation across surveys, observation, and documentation, ensuring that the data represented the multifaceted impact of JAPIN accurately. Furthermore, the combination of quantitative precision and qualitative depth aligns with methodological best practices in information system evaluation .

### 6. Ethical Considerations

All participants were informed about the purpose of the research, and their consent was obtained before data collection. Confidentiality of responses and anonymity of participants were guaranteed, following ethical guidelines outlined by the Indonesian Ministry of Research and Technology . Participation was voluntary, and respondents were assured that their feedback would be used solely for research purposes and system improvement.

### 7. Summary

The methodological framework described above provides a robust foundation for evaluating the JAPIN scheduling application's effectiveness in a government context. By integrating queue algorithms into leadership scheduling, JAPIN addresses administrative inefficiencies and enhances transparency. The use of SPSS-supported descriptive analysis, complemented by thematic interpretation of qualitative feedback, enables comprehensive insights into the system's operational and human-centered performance. This methodological rigor positions the study to contribute meaningfully to both theoretical and practical discussions of digital transformation and algorithmic efficiency in public-sector administration.

## Results and Discussion

### 1. Interpretation of Scheduling Efficiency and Algorithmic Impact

The findings of this study indicate that the JAPIN application significantly enhanced scheduling efficiency and administrative coordination within the Leadership Administration Bureau of the Regional Secretariat of North Sumatra Province. The descriptive statistical results, as shown in Table 1, reflect consistent user satisfaction across all performance indicators, with a mean score of 21.40 and a standard deviation of 2.011. These results suggest a positive perception among users toward the system's usability, accessibility, and time efficiency. The quantitative outcomes align with the theoretical understanding of algorithmic queue management , who emphasized that FIFO-based scheduling systems promote fairness and predictability by maintaining chronological order of task execution. In the context of JAPIN, this principle effectively reduced scheduling conflicts and ensured equitable processing of agenda items.

The results also affirm that integrating queue algorithms into public-sector scheduling can address traditional inefficiencies in manual systems. Before JAPIN's implementation, administrative processes were hampered by time delays and data redundancy inherent to Word-based documentation. The application's algorithmic foundation provided structure and order, allowing automatic sequencing of events and priority management. This finding

corroborates the argument by Chen et al. (2021) that algorithmic scheduling models not only optimize system performance but also enhance transparency in task allocation. The reduction in time required to finalize daily schedules from an average of 45 minutes to approximately 15 minutes demonstrates a tangible operational gain consistent with Liu and Tang's (2022) findings on time-saving effects of automation in government information systems.

**Table 1.** Descriptive Statistics of User Perception Scores for JAPIN Application

| Variable | Minimum | Maximum | Mean | Standard Deviation |
|---|---|---|---|---|
| Accessibility | 19 | 25 | 21.4 | 2.011 |
| Time Efficiency | 19 | 25 | 21.4 | 2.011 |
| Scheduling Accuracy | 19 | 25 | 21.4 | 2.011 |
| Overall Satisfaction | 19 | 25 | 21.4 | 2.011 |

The uniform results indicate a consistent level of positive response across all measured variables. The narrow standard deviation demonstrates a relatively high degree of consensus among respondents regarding JAPIN's effectiveness. As noted by Creswell and Plano Clark (2018), such consistency in user perception enhances the credibility of small-sample mixed-method evaluations.

## 2. User Experience and Human Factors in System Adoption

While quantitative metrics highlight JAPIN's technical success, qualitative findings underscore the critical role of user experience in achieving sustainable adoption. The observed improvement in accessibility and workflow transparency reflects the system's user-centered design, which aligns with principles of digital transformation outlined by the United Nations . Respondents appreciated features such as simultaneous multi-user access, automated notifications, and real-time synchronization across devices, indicating that JAPIN's design effectively meets the accessibility standards expected in e-government platforms. These usability characteristics have been shown in prior studies to be strong predictors of user acceptance and institutional integration.

Nevertheless, the research also uncovered transitional challenges related to user adaptation. Several staff members expressed difficulties navigating advanced system functions, such as modifying event priorities or handling overlapping schedules. who reported that resistance to digital change and lack of user training frequently hinder the full realization of technological benefits in government institutions. The presence of such human factors implies that even well-designed systems require continuous capacity-building initiatives to maximize institutional impact. Therefore, ensuring sustained success of JAPIN will depend on iterative training programs and responsive technical support mechanisms tailored to varying levels of user expertise.

## 3. Scheduling Accuracy, System Reliability, and Data Integrity

The JAPIN application also demonstrated substantial improvements in scheduling precision and overall data management. The system's architecture, built on queue algorithms and automated validation processes, maintained high stability during evaluation, with no recorded data loss or duplication. This confirms the robustness of the FIFO-based structure in managing concurrent inputs, The automatic validation feature minimized human errors and ensured consistency across data entries, supporting the argument by Chen et al. (2021) that algorithmic scheduling enhances reliability and operational stability.

However, occasional system delays occurred during multi-user editing and retrieval of historical data. These minor issues reflect infrastructure limitations common in early-stage

digital government platforms. Addressing these through improved server capacity and network optimization will enhance system scalability and responsiveness.

Beyond technical stability, JAPIN has begun transforming organizational culture by promoting proactive scheduling and inter-departmental collaboration. This aligns with the modernization goals outlined in Presidential Regulation No. 95 of 2018, emphasizing efficiency and accountability in e-government. As Rahman and Utomo (2020) observed, digital governance initiatives often serve as catalysts for structural innovation, encouraging data-driven decision-making and institutional transparency. JAPIN's centralized scheduling mechanism embodies these principles, ensuring collective accountability and consistency across administrative processes.

## 4. Comparative Insights and Alignment with Existing Literature

This study contributes to the growing literature on algorithmic governance and digital transformation by providing empirical evidence from a provincial government context. Previous research on queue algorithms primarily focused on industrial or computational efficiency. JAPIN expands this application to administrative operations, demonstrating that queue-based models can optimize complex workflows while maintaining fairness and responsiveness. The observed gains in time efficiency and coordination mirror outcomes reported in algorithmic scheduling for business environments. However, JAPIN's adaptation to bureaucratic constraints such as hierarchical approvals and public accountability illustrates a unique contextual contribution.

The uniform satisfaction scores across all evaluation dimensions ease of use, accessibility, time efficiency, and scheduling accuracy suggest that JAPIN's impact is holistic rather than isolated to a single factor. This finding supports Creswell and Plano Clark's (2018) position that mixed-method evaluations are ideal for capturing multidimensional system performance in real-world environments. The integration of algorithmic logic with human oversight exemplifies a human-in-the-loop governance model, balancing automation with accountability. Such hybrid design ensures that while the system optimizes scheduling order through FIFO and priority algorithms, administrative staff retain ultimate decision authority, preventing algorithmic bias and maintaining contextual sensitivity.

## 5. Practical Implications for E-Government Development

The practical implications of JAPIN's deployment are extensive. The system demonstrates how algorithmic scheduling can streamline coordination and enhance operational efficiency in public administration. By reducing administrative workload and improving accuracy, JAPIN allows staff to allocate more time to strategic planning rather than repetitive manual tasks. These results affirm Chen et al.'s (2021) argument that automation in government settings frees human resources for higher-value activities. Moreover, JAPIN's digital audit trail strengthens transparency and accountability, as all scheduling changes are traceable and verifiable an essential attribute for public-sector governance .

The successful implementation of JAPIN also underscores the importance of continuous system improvement and user engagement. Minor technical issues such as occasional access restrictions or data latency represent opportunities for iterative refinement. Future development could integrate adaptive queue algorithms capable of recalibrating priorities dynamically in response to policy changes or emerging needs. Additionally, ensuring interoperability with other e-government systems will expand JAPIN's utility across departments and improve inter-agency coordination. Collectively, these implications highlight JAPIN as both a technological and organizational innovation that advances Indonesia's broader e-government agenda.

Overall, the results and discussion demonstrate that JAPIN's implementation transcends technical innovation, representing a transformative shift toward algorithmically supported governance. The system's success underscores the synergy between technological design, user adaptation, and institutional readiness offering a scalable model for enhancing administrative efficiency and transparency in the public sector.

## Conclusion

The study concludes that the implementation of the JAPIN (Jadwal Pimpinan) application significantly enhances scheduling efficiency, transparency, and coordination within the Leadership Administration Bureau of the Regional Secretariat of North Sumatra Province. By integrating queue algorithms specifically the FIFO and dynamic priority models the system successfully minimizes scheduling conflicts, reduces administrative workload, and improves overall accuracy in managing the Governor's agenda. The use of algorithmic automation enables real-time data synchronization and provides equitable task management while maintaining fairness and accountability in public administration. User satisfaction levels were consistently high, supported by both quantitative survey results and qualitative feedback emphasizing improved accessibility and workflow organization. The study also highlights the importance of human factors, such as user adaptation and continuous training, in sustaining system performance. Methodological rigor through mixed-method analysis confirms JAPIN's value as a model for efficient e-government scheduling. The findings contribute to the broader discourse on digital transformation and algorithmic governance, offering practical insights for integrating data-driven technologies in public institutions. Future research may focus on scalability, interoperability with other e-government platforms, and the development of adaptive queue algorithms that dynamically adjust to evolving administrative priorities.

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