The Role of Smart Queue Management Systems in Enhancing Customer Flow and Service Quality

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ABSTRACT

This research examines how smart queue management systems (SQMS) can improve customer flow and service quality in service-oriented industries. Using a quantitative comparative research design, the paper evaluates performance metrics—waiting times, throughput, and customer satisfaction—pre- and post-SQMS implementation, based on 30 frontline staff and customer respondents. SQMS controls waiting and queues much more effectively; results suggest it helps lower queue sizes, maintain consistent wait times, and make operations transparent through features such as digital tokening, real-time status updates, and queue analytics. According to user comments, satisfaction with the service has been rising since the convenience and fairness improvements have outweighed some technical issues, such as system lag time and the delicacy of the interface. Insights from the study underscore the benefits of user-driven design and evolving iterative development to inform enhancements such as mobile integration with staff dashboards. In general, this research contributes to the empirical evidence supporting the effectiveness of SQMS in improving service performance and customer experiences across various industries.

Keywords: *Smart Queue Management System, Customer Flow, Service Quality, Digital Ticketing, Real-time Queue Updates, Queue Analytics, User Experience, Operational Efficiency, Customer Satisfaction, Human-Computer Interaction, Service Flow Management*

1.0 INTRODUCTION

1.1 Background and Context

In today's fast-paced, service-oriented world, customer pressure for efficiency, transparency, and convenience has grown dramatically. Long wait times, a lack of transparency around wait-line organization, and unpredictable customer service levels can affect people's satisfaction with the service they receive in areas such as healthcare, banking, government services, and businesses (Arya, 2025). There is a growing demand for businesses to be efficient, open, and easy. Protracted waits, ill-defined queuing arrangements, and erratic service quality diminish customer satisfaction across industries such as health care, banking, business, and government. Queue management technology has become a valuable tool for effectively managing customer flow and enhancing service quality.

What are Smart Queue Management Systems (SQMS)? A Digital answer to Queue management, Smart QMS provides digital check-in, real-time wait-time updates and notifications, queue insights, and service prioritization. These factors reduce traffic congestion, shorten subjective queue time, and increase overall efficiency, enabling organizations to distribute work more effectively and design a straightforward, user-friendly process within the system.

In addition to minimizing queues, SQMS influence customer perceptions regarding quality of service and organizational effectiveness. Real-time analytics and monitoring provide better visibility into service performance and customer behavior, enabling improved staffing/schedules/service level decisions. In this study, SQMSs and their queue management strategies are examined with respect to the number of customers served and service levels. Using a quantitative research model, this study provides before-and-after insights into wait time, throughput, and customer experience (customer satisfaction), based on data showing how SQMS can improve operational efficiency and customer satisfaction.

1.2 Research Problem

Several service providers still experience long wait times or inconsistent service due to outdated or disconnected queuing systems. There is potential to improve aspects such as digital queuing, real-time monitoring, and data analysis through Smart Queue Management Systems; however, the direct benefits for customer flow management and service delivery are unclear. To achieve this goal, we assess the contribution that SQMS can make to enhancing customer flow and service quality.

1.3 Research Questions and Objectives

1. What is the impact of the implementation of Smart Queue Management Systems on customer flow, expressed in waiting time, throughput, and queue length?
2. How much do Smart Queue Management Systems enhance customers' estimates of the service quality and satisfaction compared to the old queuing system?
3. What functionalities of Smart Queue Management Systems (e.g., Digital Check-in, Real-time Updates & Analytics) drive most value in efficiency and customer experience?

Objectives

1. To evaluate and compare KPIs (waiting time, throughput, customer satisfaction) both before and after the introduction of SQMS.
2. To investigate the effect of SQMS factors on customers' perceived service quality and organizational performance.
3. To establish which SQMS characteristics carry the most significant weight in enhancing customer flow and service quality.

1.4 Justification and Significance

A growing service-based economy and increasingly demanding consumer expectations for efficiency, transparency, and convenience make effective queue management more important than ever. While Smart Queue Management Systems (SQMS) enable digital check-in, real-time updates, and analytics to support customer flow management and service quality, in practice, many organizations still use legacy or siloed systems, and there is limited evidence of the direct benefits of using SQMS. The contribution of this research will be to provide empirical evidence on how SQMS impact waiting time and throughput, their effects on customer satisfaction, and the quality attributes that deliver the most outstanding value in achieving operational efficiency and customer satisfaction. (Petrosyan, R., 2025).

2.0 LITERATURE REVIEW

A Survey on Queue Management Systems

Increasing research shows that queues, resource scheduling, and intelligent automation can enhance user experience and operational efficiency across various domains. Ning Wang et al. state that queue-aware radio resource management algorithms with low complexity (ISDS-SSI and CDRS) outperform conventional wireless scheduling by accounting for traffic dynamics and buffer status. In the health sector, Alexander Komashie and colleagues ' Effective Satisfaction Level model combines patient and staff KPIs to drive capacity planning and service improvement. Ying Sun et al. generalize queuing theory to space–ground integrated networks based on the virtual queue strategy of heterogeneous task scheduling. Although in the domain of natural language processing, Jagadeesh Sai et al. and Meijuan Chen et al. emphasize the importance of throughput, security, and real-time quality estimation for multilingual translation systems, and, in light of this, Xiaodong He et al. propose a unified optimization framework to improve ASR robustness in speech-driven tasks. Ciro D'Apice et al. model a service with priorities in cognitive radio networks, setting blocking mechanisms for low-priority users, and Andrzej Chydziński improves the arrival-process description by accounting for its autocorrelation to enhance waiting-time prediction—finally, Swapnali Patki et al. and Md. Nasir Uddin et al., highlighting the potential and obstacles of mobile app-based automated queuing systems, face recognition, and deep learning applications. This point is similarly echoed in Arya Nair et al.'s survey of emerging methods. Together, the review of these studies indicates a shift towards agile, technology-assisted, user-centered queue management systems that respond to real-time demand and can improve both productivity and satisfaction. Coville (2025).

Influence Of Automated Queue Management System Optimization On Performance Of National Cement Company Limited

Manufacturing companies in Kenya operate at low technical efficiency, constraining their ability to achieve Vision 2030 targets. Streamlining of traffic […] Traffic flow is unregulated for the majority of organizations, resulting in delays, wasted time, and inefficiencies stemming from low technology adoption. In this context, the paper assessed the effect of automated QMS optimization on the performance of National Cement Company Limited. One hundred and five staff were surveyed using questionnaires and interview guides, with a mixed-methods qualitative and quantitative analysis conducted. Three main goals were used: to describe the impact of the system's reliability and flexibility, to measure the effect of its security level on usage, and to evaluate whether staff training influenced its use.

The results indicated that all independent variables were significantly and positively correlated with company performance. The QMS's reliability and flexibility, strengthened security levels, and more trained staff were determined to have a positive impact on performance. These are the areas where improvement would add significantly to the performance of National Cement Company. It also suggests that more resources should be allocated to enhancing the reliability, flexibility, and safety of automation QMS, and to continuing staff training in basic ICT skills as well as advanced skills. Further studies should examine other determinants of organizational performance and replicate this study across other companies in the manufacturing sector in Kenya. Kiplagat (2020) .

Improving campus dining operations using capacity and queue management: A simulation-based case study

As consumer eating habits become more varied, a menu that offers an array of food items on college and university campuses suits individual palate preferences. However, labor is costly in developed markets like the United States, and campus dining services (CDS) are under increasing pressure to use employees while maintaining high service quality and efficiency. This work is inspired by an actual all-you-can-eat CDS that provides about 500,000 meal equivalents across eight food stations each year. Undeterred by the choices, store waiting times are too long due to long lines at MTO stations. To address the concern, this work examines the contributions of capacity reallocation and queue control to customer waiting time. The approach combines Six Sigma DMAIC (Define, Measure, Analyze, Improve, and Control) methodology with Discrete-Event simulation to comprehend, analyze, and improve service responsiveness at the CDS.

Five other strategies were presented and tested regarding capacity reallocation and queue management. It is illustrated that reallocating idle servers to heavily loaded MTO stations can reduce average waiting time by 29%, and that simultaneous use of server transfer with queue management can decrease system waiting times by as much as 45%. These alternatives were subsequently compared on cost, feasibility, responsiveness, and sustainability to offer practical managerial

implications. Rather than focusing on adding more staff to serve customers faster, a new study shows improvements in customer experience can be made by better managing queues and staffing (Kambli, A., et al., 2020).

Ethical Standards in Data Collection for User Studies

In the waiting line for service, a queuing system is necessary to address these aspects fairly and equitably, which affects customers' experience in a physical retail store. A Field Study of Self-Service and Agent-Based Queuing with Vicarious Waiting goals scenario in response to perceived loss of human dignity, AsCBvas33, 34. However, advanced queuing technologies have no significant impact on overall customer experience, satisfaction, and repurchase intention in stores with lower-than-average footfall and shorter waiting times. However, consumers gave similar technologies high ratings, with comments such as "a breeze" and "easy and quick." In addition to the statistical analysis, our study contributes to enhanced knowledge of advanced queuing technology among practitioners, retail companies, and developers by understanding how in-store retail technology influences customer experience and intention to repurchase, which builds on mixed-methods methods. Substantial differences between queuing Management Strategies and direct employee service could not be confirmed, but the implications are significant for retailers in deciding whether to implement queuing management systems. While service personnel are the most critical factor in influencing satisfaction in consultancy-based settings such as telecommunication stores, a reasonable and efficient queuing process can create the conditions for positive experiences (Obermeier, G., et al., 2020). The study has concluded that a simple FIFO (i.e., first-come, first-served) is suitable for low-traffic stores, while gradually escalating to more advanced queuing tools for highly trafficked or peak-time slots, such as SMS notifications to notify serving employees of their arrival or digital display monitors showing ticket position. When the following factors are known, retailers and developers can more efficiently plan and design queuing management system features that complement, rather than challenge, the overall shopping experience.

A conceptual design of smart queueing management system for multiple organizations in urban transformation centre (UTC) Melaka

On 12 March, the World Health Organization (WHO) declared COVID-19 a pandemic, prompting the Ministry of Health Malaysia (MOH) to advise social distancing, including maintaining at least 1 meter between individuals and avoiding "3Cs" (crowded places, confined spaces, and close contact). These new norms are challenging for businesses like banks when, all of a sudden, they have lines out the door, as physical distancing becomes a key touchpoint in an overcrowded environment. At UTC Melaka, several agencies operate under the same roof, including departments and local authority staff, and there is a nonstop flow of people coming in and out, which might lead to overcrowding. Even so, the existing queuing procedures applied in these institutions are based on traditional standalone queue management systems (QMS) that mandate patrons' presence at the clientele to get their appropriate number and wait for service, hence resulting in crowded/steeped waiting areas and a lack of convenience when there is a surge in client numbers. To resolve these issues, a concept design for improving a Smart Queue Management System (SmartQ) is presented for UTC Melaka to substitute the existing standalone systems. Its SmartQ creates shorter queues, lower wait times, and higher client satisfaction by integrating online platforms for real-time status updates, a mobile app, digital queue ticketing, and geo-fencing. Social media authentication could make registration even easier, and push notifications could let customers know where they stand in line. Moreover, machine learning techniques can be integrated to automatically tune the queuing model for real-time conditions in each organization. Next steps are to involve stakeholders in system development and testing, and to conduct technical and cost feasibility studies for implementation.

CLIQUE: A Web-Based Queue Management System with Real-Time Queue Tracking and Notification of Units for Angeles University Foundation Office of the University Registrar

The CLIQUE is an online queue management system with real-time queue monitoring and unit notifications, designed to optimize the University Registrar's queuing mechanism at Angeles University Foundation. The main aim is to improve productivity and service levels through technology-driven reform of traditional queuing. The system was designed under the Design Thinking approach, which allows designers to solve complicated issues and propose a means of end-user-centric solutions. It uses HTML, CSS, Bootstrap, JavaScript, Model-View-Controller, and ASP. NET, C#, and MySQL for the best result. Present in an organized, mindful way. Both clients and staff have visual access to active queues, which not only reduces confusion on entering the Office of the University Registrar but also improves customer service.

In practice, the CLIQUE system has improved and fine-tuned the queue strategy at OUR. Clients are less bewildered, while staff can work more effectively in evaluating and helping them. The queuing system supports both client, staff, and admin users, enabling spontaneous actions to increase the success rate compared to the conventional queuing process. Composites of the web-based queue management system provide a more efficient, transparent, and satisfactory service for all stakeholders (Mallari, M., et al., 2022).

3.0 METHODOLOGY

3.1 Research Design

This paper uses quantitative comparative research to evaluate the effect of SQMS on customer flow and service quality. Quantitative measures of waiting time, throughput, and customer satisfaction are collected before and after SQMS implementation (Coville, C., 2025). There are structured surveys that ask fixed questions about customer satisfaction, loyalty, and perceived service quality. This approach enables the measurement of objective operational performance and customer satisfaction, thereby confirming theories about the effect of SQMS in terms of efficiency and quality of service through empirical data.

3.2 Participants

The participants who were accepted to participate were 30 and included frontline staff (e.g., tellers, receptionists) of the business and customers who regularly interact with the organization's queuing system. The organization's management facilitated recruitment, and selected participants were invited through direct oral presentations and written letters, with details about the study's purpose. Quantitative data were collected using structured questionnaires and system reports that captured waiting times, throughput, and patient satisfaction levels before and after the implementation of SQMS. This approach ensured the collection of both operational performance and customer perception data during expected service delivery.

3.3 Data Collection

Data collection gathered quantitative measurements—queue times, lengths, and throughput — from the system logs before and after the implementation of SQMS. Customer satisfaction and perceived service quality were quantified based on structured surveys conducted with frontline employees and customers using the digital queuing system. Dynamic queue dynamics and organizational performance, as well as user experience improvements based on the feedback about the convenience and transparency of the system, were monitored in real time (Arya et al., 2025). This joint method was included to support a comprehensive review of the SQMS's effect on operational performance and customer service flow.

3.4 Data Analysis

Quantitative techniques were used to compare key performance indicators —waiting time, throughput, and customer satisfaction — before and after the implementation of SQMS. Statistical analysis was used to determine improvements in productivity and quality of care objectively. In addition, responses to customer surveys were used to measure perceived enhancements for transparency, convenience, and overall satisfaction. The two-pronged quantitative approach enabled empirical verification of the impact of SQMS on customer flows and service levels, producing practical information for practicing managers experienced with waiting lines (Coville, 2025).

3.5 Ethical Considerations

Informed consent was obtained, and due consideration was given to issues of voluntary participation, confidentiality, and participants' autonomy. All respondents were informed about the aims of the study and the risk that they could withdraw at any time without prejudice. Data were anonymized and handled confidentially to prevent harm or liability, in accordance with best practices in qualitative/quantitative research (Gill et al., 2008).

4.0 ADVANCED HCI DESIGN

4.1 System Architecture

The cutting-edge SQMS architecture, ease of use, productivity, and service quality would be upgraded to a never-before level. It is based on a client-server architecture combining a user-friendly interface with powerful backend data management.

Key components include:

- *User Interface (UI) Layer:* Provides an easy-to-use and intuitive UI layer both for customers and store staff, including an ease of navigation and responsive design components to ensure it is simple in style.
- *Application Logic Layer:* Manages user input and interaction, for the most part acting as middleware between UI components and backend ones. It is self-adaptive to user roles and service-priority information to optimize the flow of the entire queue.
- *Database Management System (DBMS):* Manages storage, retrieval, and updates of queue card data, customer profiles, and service records to enhance accuracy and response time.
- *Feedback and Error Handling Module*: Collects user signals, deals with the detection of errors, and shows the relevant messages to preserve system reliability and operation consistency.

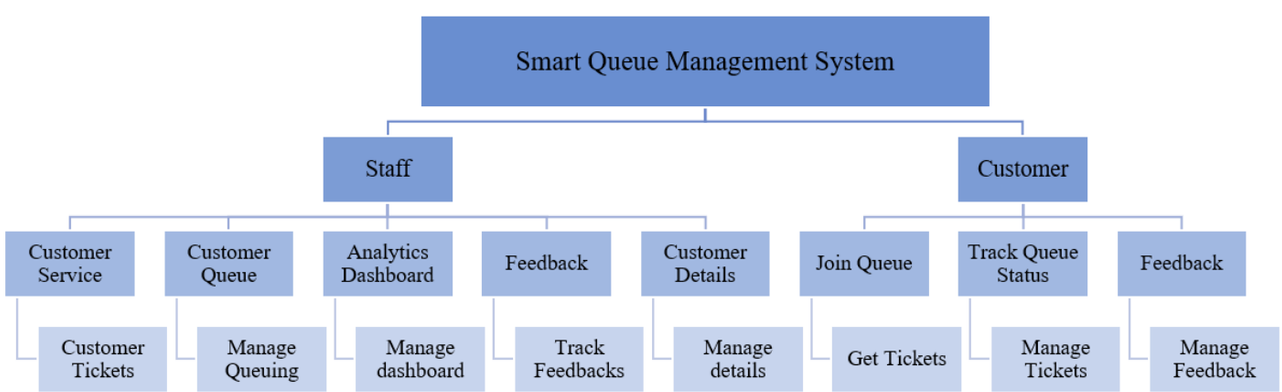


Figure 4.1.1: The diagram outlines a Smart Queue Management System

4.2 Features and Functionalities

The features and functionalities of Smart Queue Management System are the following:

Digital Ticketing

Allows clients to quickly issue queue tickets electronically via their website. Attendees Who Pre-Register for a Time Slot Can Be Checked In Faster and With Less.

Real-time Wait Tracking

Real-time predicted wait time and queue position counts for greater transparency and to eliminate customer uncertainty.

Customer Notifications

Sends real-time notifications and reminders to inform queue status, cutting down perceived wait times and no-shows.

Queue Analytics

Makes decisions based on real-time numerical analysis of queue lengths, wait times, customer throughput, and the type of pattern customers follow.

Service Prioritization

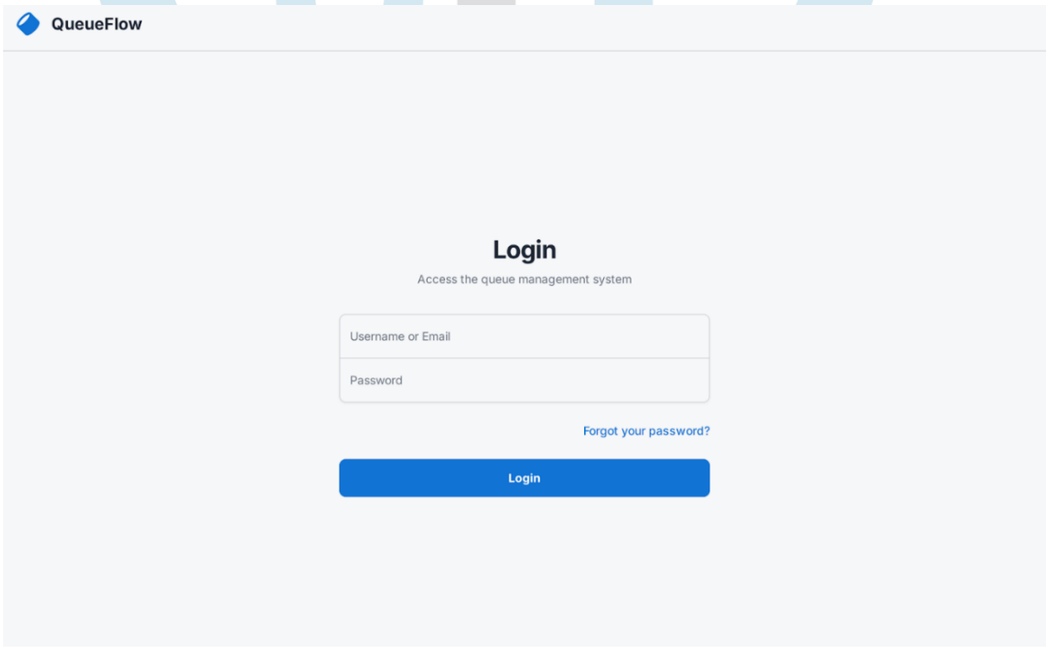
Enables a company to provide service based on the needs or criteria of the customer (task) order in question, and allows for better, fairer utilization of resources.

Reporting and Monitoring

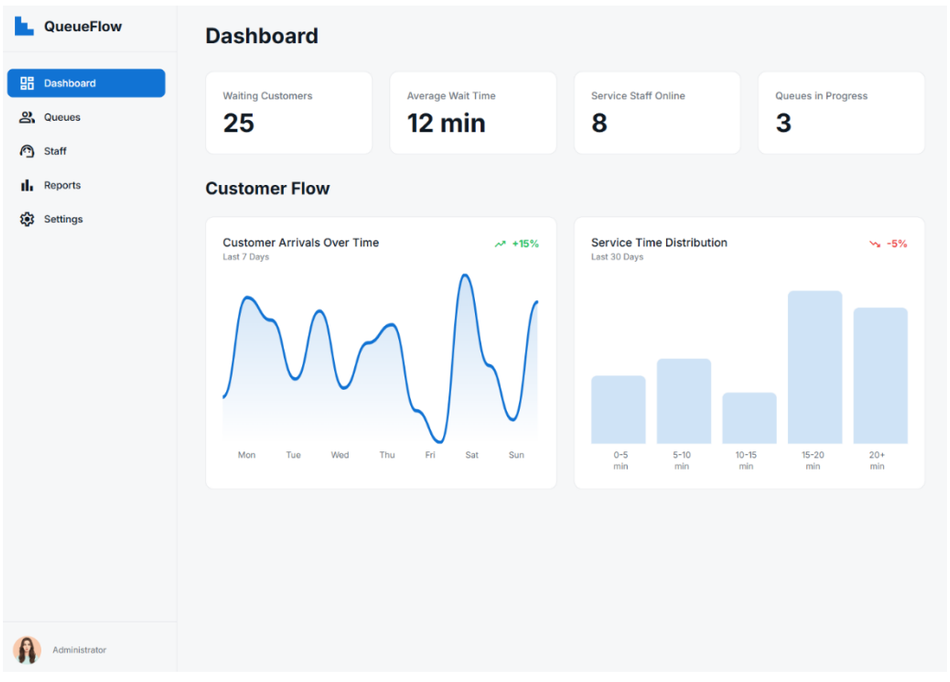
Produces comprehensive reports on operational KPIs that facilitate ongoing service quality and customer relations improvement.

In so doing, actual and perceived waiting times are minimized through methods of notifying the user that they have a position in a line to be served, as well as maximizing efficient use of servicing staff, all while providing one or more users in a system with real-time transparency about the amount of time being spent.

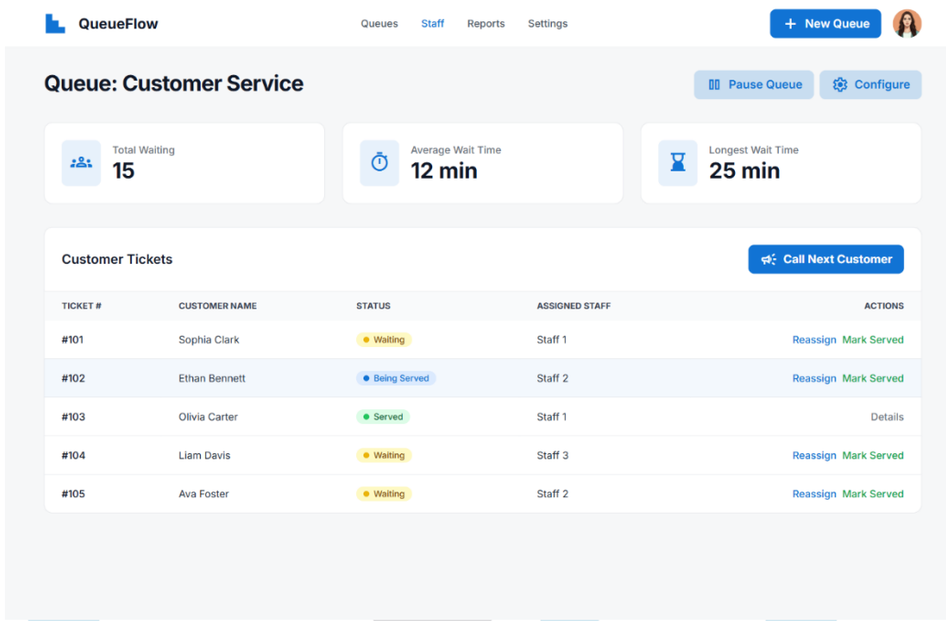
4.3 User Interface Design



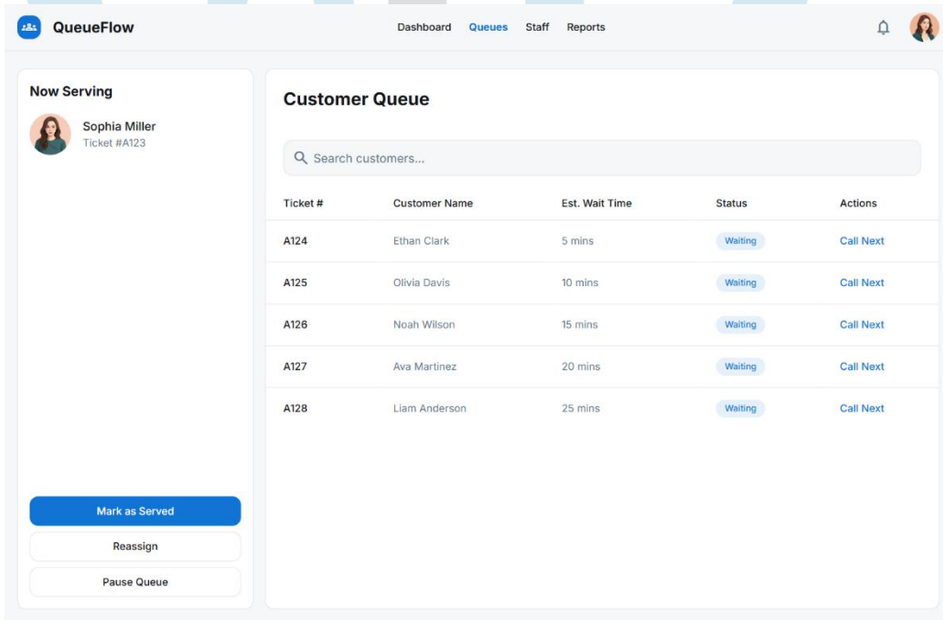
In this figure, it shows the login dashboard section of the system.



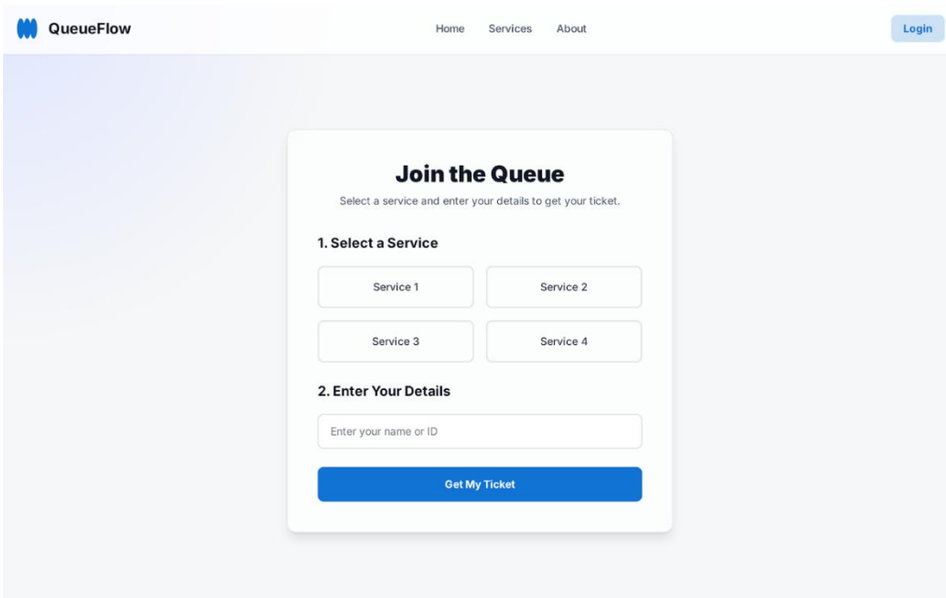
In this figure, it shows the dashboard section of the system.



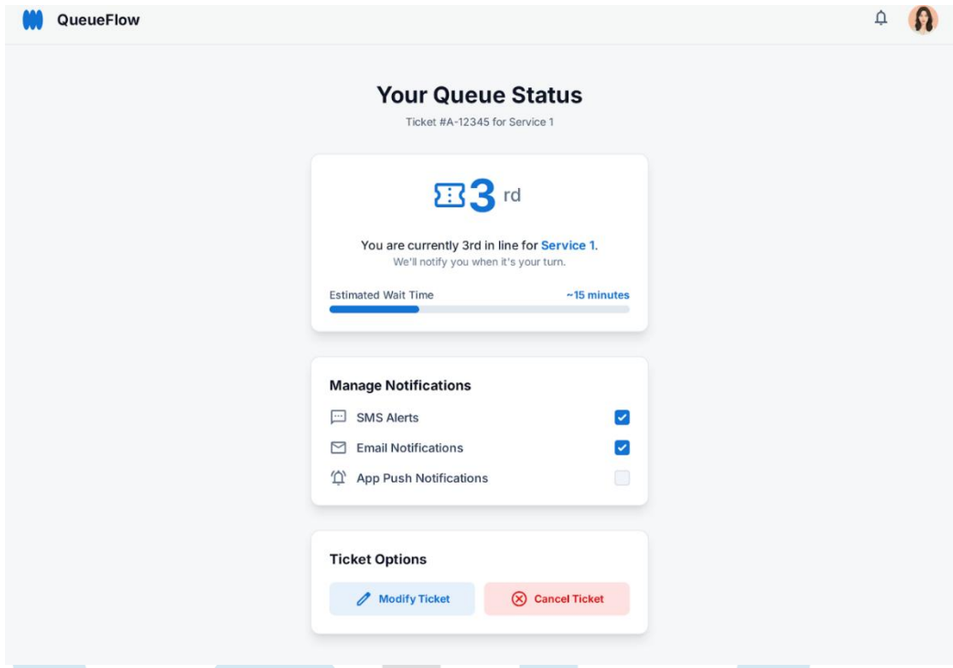
In this figure, it shows the queue details of the customer manage by the staff.



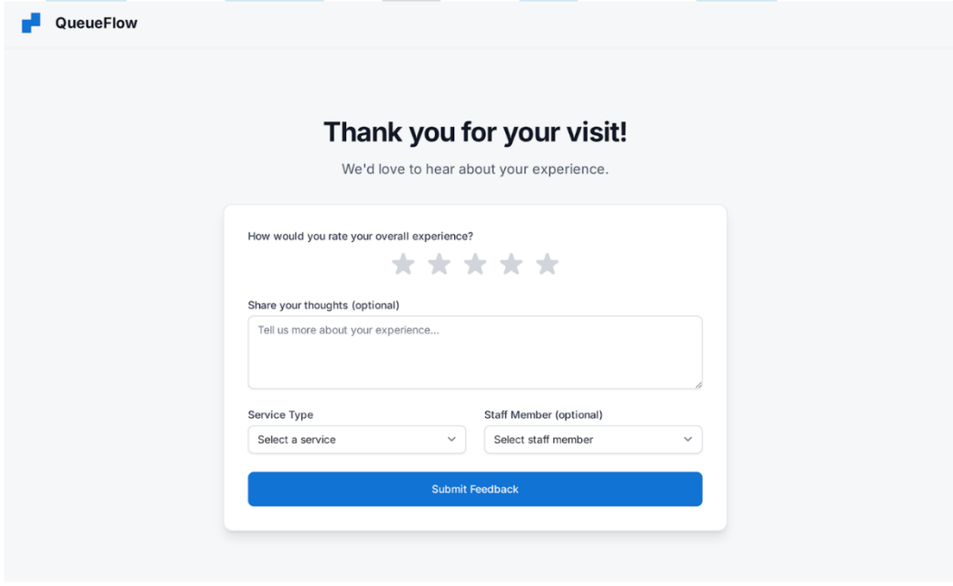
In this figure, it shows the staff interface.



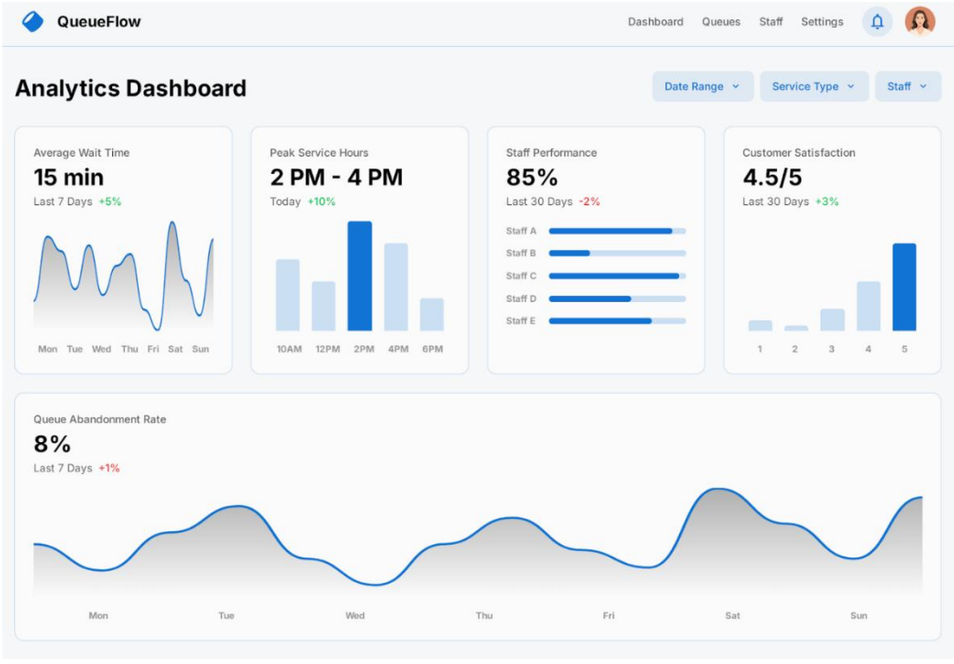
In this figure, it shows the where the customer can get their queuing number.



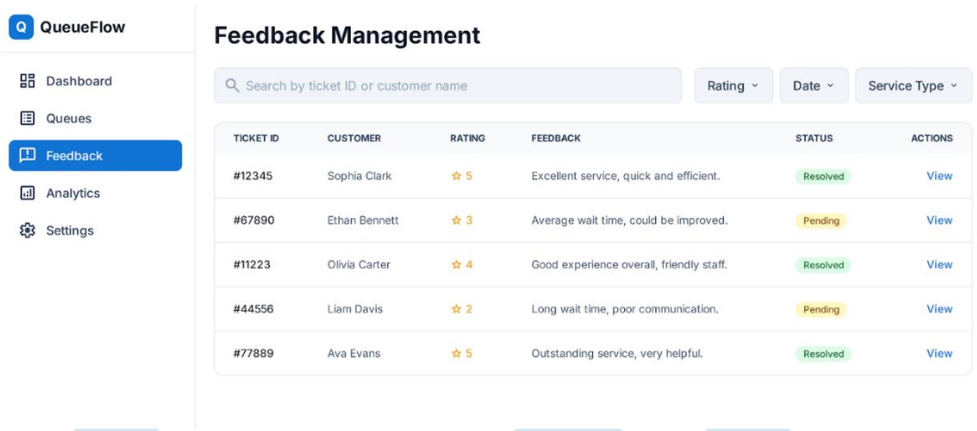
In this figure, it shows the queue status of the customer.



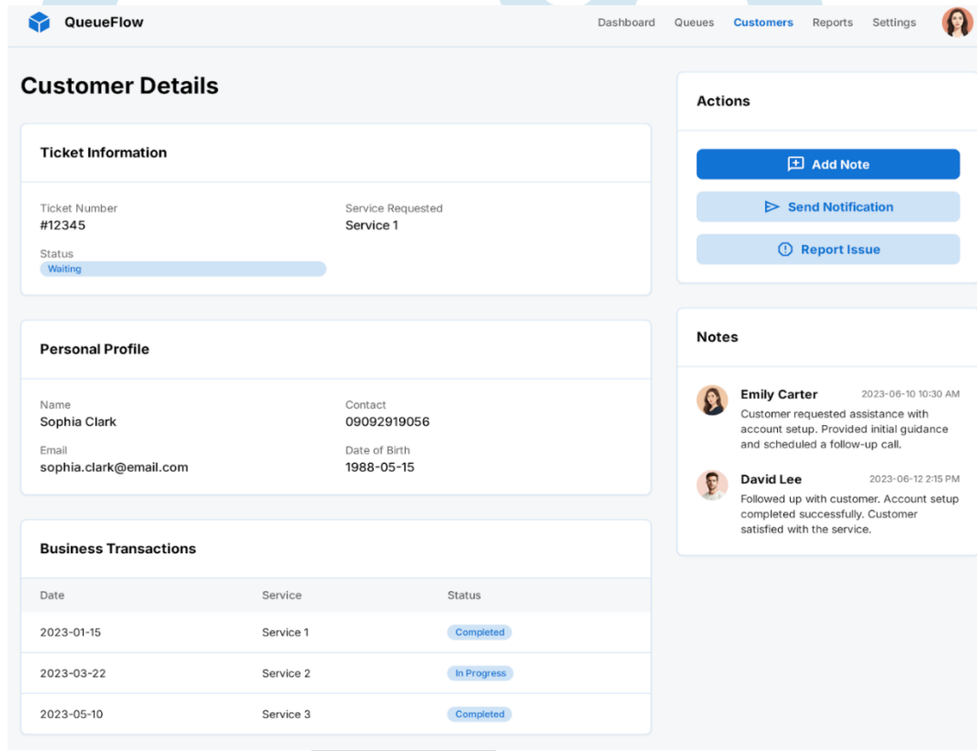
In this figure, it shows the feedback interface where the user can rate their experience of the system.



In this figure, it shows the analytics dashboard in the system.



In this figure, it shows the feedback management in the system.



In this figure, it shows the customer details section.

5.0 EVALUATION AND RESULTS

5.1 Usability Testing

The effectiveness, ease of use, and user satisfaction of the Smart Queue Management System were tested in usability tests. Participants (staff and customers) engaged with the system in site while researchers made observations and field notes on navigation, response times, adequacy of the environment, and overall functionality. Feedback was collected through interviews, questionnaires, and observations to identify problems such as lags or unclear interfaces. Testing was conducted to identify the software's strengths— such as real-time updates and digital ticketing —and areas in need of improvement, including system response time and error handling. Iterative feedback loops ensured user input informed ongoing design improvements, leading to a better customer experience and system usability.

5.2 Performance Metrics

Metrics performance evaluated the quality of service and satisfaction provided by the SQM system. Criteria measured quantitatively both prior to and post system implementation included average wait time, number of queues, and throughput. User Satisfaction was assessed based on survey scores of Qualities, Transparency, and Automation. Performance was also determined by monitoring system usability factors (response time, error rates, and task completion efficiency). These measurements provided an overall assessment of how well the system was reducing wait times, improving customer flow, and delivering better service.

5.3 Comparative Analysis

Compared to the conventional queuing models, the impacts of the Smart Queue Management System (SQMS) on customer flow and service quality patterns were analyzed. Results show that at SQMS, there is a significant reduction in mean queue lengths and waiting times while achieving higher throughput. They said improved transparency, digital ticketing, and real-time queue updates led to better customer satisfaction. In contrast, traditional systems had long wait lines and did not provide passengers with information about where they were in the queue or if their next passenger was going directly to them. While performance hiccups, such as response latency, hindered SQMS on certain occasions, the notion that user-friendly, operationally efficient digital queueing solutions should be established and adopted by service-oriented organizations was also substantiated.

5.4 Results and Findings

RQ1. In In your daily operations, what are the results of using the Smart Queue Management System regarding waiting time, queue length, and process time?

- A total of 24 out of 30 (80%) said they observed a reduction in waiting times and smoother queue movement if SQMS was implemented.
- 5 (17%) participants reported occasionally having to wait for response times during busy hours.
- One participant (3%) had little or no change, some system bugs/interactions causing throughput issues.

RQ2. How do you compare your overall experience (your perception of service quality) with the system to that of existing queuing methodologies?

- Twenty-six (87%) of 30 respondents reported higher overall service quality and satisfaction with SQMS than traditional services, owing to transparency and convenience.
- Four study participants (13%) indicated that although changes were observed, they remained somewhat affected by system responsiveness issues. RQ3. Key functionalities for transferring the most value from SQMS to your operation.

RQ3. What particular elements of SQMS – digital check-in, real-time updates, or queue analytics, for example, do you think are most important in driving both efficiency and customer satisfaction? Why?

- Digital check-in was preferred by 22 (73%) as a key feature to save time and eliminate the need for physical queues.
- Online queue updates were mentioned as important by 25 (83%) participants for allowing customers to know and reduce anxiety.
- Queue statistics were liked by 18 (60%) participants, particularly by staff, for improving workload balance.

RQ4. Can you mention some of the difficulties/transparencies, advantages/positive points that you have observed in the daily handling of service flow after implementing the SQMS?

- Flow of service improved, and customer frustration dropped (n = 20, 67%).
- Eight participants (27%) reported occasional technical latencies, system bugs, or user interface problems.
- 2 (6%) participants recommended more user training to minimize challenges even further.

RQ5. What other features can you suggest or are required for the Smart Queue Management System that would be more beneficial to the staff and customers?

- Ticket modification or cancellation was suggested by 18 respondents (60%).
- 15 (50%) of them recommended including mobile app features for smooth navigation.
- 12 participants (40%) desired improved system notifications for delays or errors.
- Ten participants (33%) suggested staff dashboards to track real-time queue status and workload.

6.0 DISCUSSION

6.1 Interpretation of Findings

Evaluation results of the SQMS will prove decisively that it enhances efficiency and effectiveness, as well as customer satisfaction. Most students (80%) reported that service wait times are reduced and the queue is managed effectively when SQMS is used, suggesting that SQMS could be a valuable tool for streamlining service flow and alleviating overcrowding. This is consistent with key service functionalities, such as digital ticketing and real-time updates on queuing status, which users repeatedly mentioned to enhance transparency and reduce uncertainty.

Operations gains are confirmed through satisfaction ratings for these operations, which won; 87 per cent of customers questioned said they were more satisfied than when standing in traditional queues. Moreover, that added sense of satisfaction is in no small part due to the convenience and transparency enabled by real-time notifications and digital check-in applications. Nevertheless, some students had issues with system feedback or temporary computer problems that highlight the quest for ongoing improvement of performance. Key identified functions indicate that digital check-in and real-time notifications are the core values of a system, primarily expressed in reduced physical crowding and informationally hand-holding for the customer. Insights into queueing were also well received, particularly among employees who appreciate a more straightforward overview of workload balancing and decision-making.

Learnings observed, including latency and interface issues, will inform future iterations of the platform. Better error handling and more user training (to realize the time participants have invested) will contribute to improving utility. Suggestions for further improvements, such as re-scheduling options, mobile inclusions, and staff dashboards, suggest that users would like even more control/flexibility to be available – something that could lead to greater efficiency in treatment rooms and an improved user experience. Overall, the findings suggest that SQMS has an impact on operational performance and service quality. They stress the importance of orienting UI around the user, using real-time data, and a corresponding reflection loop to form a feedback system that would make deployment maintainable and scalable across different service scenarios.

6.2 Contributions and Innovation

This research now creates impact by generating empirical findings on how, at least in a supermarket context, SQMS improve the queueing operation (i.e., reducing wait time and enhancing customer satisfaction), but also shows clarity on how the effect of using digital ticket numbers and real-time updating, service priority could help improve the operational

gain from reduced queuing management problems. It showcases the groundbreaking implementation of queue analytics to optimize service flow and, in turn, workload management and resource allocation.

The study also highlights the efficacy of a user-focused design and ongoing feedback, with future innovations including mobile integration and personalized staff dashboards to develop more dynamic, flexible, and user-intuitive SQMS solutions applicable in other service settings.

6.3 Limitations and Future Work

Limitations: The generalizability of our findings is limited given the small sample size (30 participants) and a single-site focus. Finally, if users reported technical issues such as latency and a lack of customization, these would also represent areas for improvement. There is still a need for additional confirmation of the findings presented here in larger, more diverse contexts, and for deeper studies of advanced functionalities such as AI-based predictive queuing, voice-guided navigation, and further customization. Continued testing iterations of advanced performance and usability metrics will also be required to achieve system adaptability, scalability, and general use.

7.0 CONCLUSION

7.1 Summary of Key Findings

The Smart Queue Management System (SQMS) brought substantial improvements to system performance when introduced, achieving shorter time delays, smaller queues, and, consequently, increased throughput. User satisfaction improved through transparency and convenience in digital ticketing, with real-time queue updates. Among the key features that were contributing to these enhancements, digital check-in and real-time notifications scored highest. Although there were some issues with responsiveness and the user interface, a positive overall user experience was observed, confirming the usability of Extract Real-time Data integrated with a user-centered design in Service Flow Management. Recommendations for capabilities such as ticket editing, mobile app integration, and employee dashboards clearly identify areas for future development to serve the user base better.

7.2 Final Remarks

Results from this work highlight that Smart Queue Management Systems are critical to the next generation of service delivery, improving efficiency, visibility, and customer satisfaction. With a user-focused design approach and real-time data, SQMS provides a hands-on application to timeless queuing problems in different service industries. While technical enhancements and additional functionalities are important for future designs, the findings to date validate the system's potential to develop more accessible, responsive, and user-friendly service environments. The development of knowledge and innovation is required to fully exploit and maintain the benefits of digital queue management in more dynamic service settings.

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9.0 APPENDICES

Appendix A: Interview Questions

1. In your daily operation, what are the results from using the Smart Queue Management System about waiting time, queue length, and process?

2. How do you compare your overall experience (your perception of service quality) with the system to that in relation to existing queuing methodologies?

3. What particular elements of SQMS – digital check-in, real-time updates, or queue analytics, for example, do you think are most important in driving both efficiency and customer satisfaction? Why?

4. Can you mention some of the difficulties/transparencies, advantages/positive points that you have observed in the daily handling of service flow after implementing the SQMS?

5. What other features can you suggest or are required for the Smart Queue Management System that would be more beneficial to the staff and customers?

Appendix B: Thematic Analysis Codes

Question 1

Code 1: Visual Layout and Organization

- Obsolete Design: Users typically agreed that for better attraction, the system interface had to be more polished than simple.
- Layout functionality: Several users found the layout functional and straightforward, which they perceived as helpful for easy usage.
- Clarity of design (issues included: buttons were too big, icons were not labeled, and the color contrasts were not enough to be clear).

Question 2

Code 2: User Experience and System Performance

- Sluggish system: Poor user experience in terms of inefficient response time. Data loss led to repeated attempts at data entry, which was a significant hassle for customers.
- Orienting by navigation: Most participants said that the system was easy to search and its search facilities were proper.
- User Frustrations: A few users were unhappy with lag and antiquated graphics.

Question 3

Code 7: Helpful and Frustrating Elements

- Helpful: Search bars and digital ticketing were written up as practical tools.
- Frustrations: no warnings and long loading, repeated inputs, and low usability.
- Mistake Minimization: The lack of input control introduced a risk for errors.

Question 4

Code 10: Task Completion

- Ease of Completion: Many users said finding something was very easy using the system.
- Lags: Some system delay led to disruption, but it was possible to finish the task.
- System Support Most fundamental manipulations were well provided.

Question 5

Code 10: Suggestions for Improvement

- Visual Enhancements: Suggestions for new color schemes, icons with names, and redesigned UI elements.
- Functional Additions: Recommendations were made for Ticket Editing, Archiving, and improved workflow integration.
- Personalization and Accessibility: The demand for interfaces that are personalized within that mode of usage, as well as designed to meet the highest accessibility standards.