A Development of Queuing Management System with Automatic SMS Notification and Descriptive Analytics for the Improvement of Enrollment Process in Higher Education

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**Abstract.** Schools in different higher education institutions in the Philippines manually use a traditional way of managing enrollment procedures. This results in some common difficulties in handling large enrollees and inefficient process flow. The queuing management systems significantly enhance resource utilization and reduce customer wait times by balancing customer satisfaction, operational efficiency, and resource utilization. This research aims to enhance the enrollment procedure of different higher education and universities and improve customer satisfaction by implementing a proactive Short Message Service (SMS) for the user to notify them regarding the queuing number system and real-time descriptive analytics to monitor the enrollment bottleneck from an average waiting and processing time per transaction. This research was conducted at the National University Mall of Asia campus during the first term of the enrollment period, which is known as peak season and accommodates thousands of students. The researchers conducted their study during the first term enrollment period of National University Mall of Asia campus as it was known as the enrollment peak season that accommodates thousands of students and enrollees. The researchers uses different tools for studying and analysis such as surveys, interviews, and an actual observations while implementation of the system happens. The system testing focusses on the waiting times that was based on the service priority that also gives active notification for the expected waiting time. The system generates statistical reports for the efficiency of the service including the total number of students served within a specific time intervals. With the use of this study with the implementation of the queuing management system empowered with an automatic short message service and descriptive analytics helps the university improve its enrollment procedure.

# INTRODUCTION

The importance of having computer system software was stated in a book [1] as one of the essential aspects in an organization when it comes to a significant process that interacts with the client and customer. It is also essential to have comprehensive and manageable system software that will act as an integral part of a specific procedure that incorporates systematic and well-organized transactions with the clients and customers. This research aims to provide and implement a comprehensive queuing management system that would help manage the university’s enrollment procedure, which could improve overall customer experience and satisfaction by reducing waiting times, enhancing staff productivity, and providing transparency in service delivery. Specifically, this research aims to:

* Monitor the total number of transactions of students/applicants that have been processed within the day, week, or month to generate different reports and data statistics.
* Provide a system that can generate descriptive reports for the whole queuing process on different users, such as the admin and different tellers from each department.
* Provide a user-friendly interface of the system for the university staff who will work in processing the queue and the students/parents who will get a queue ticket number at the start of the process from different categories such as a PWD, New Student, Transferee, and Old Student.
* Develop a system that can display the summary of the whole queuing process as the visual guide for the student/applicant in the waiting area with an AI-voice-generated function and SMS generation and notification once they are next in line.
* Provide a system that can generate a unique queue number per transaction and print queuing tickets for the students/parents who will join in the queuing process for enrollment.

The University’s enrollment procedure comes to a sequential flow. From registration of accounts and submission of requirements in the Admission Office, assessing the course subjects in the Registrar, processing the payment and other transactions in the Accounting/Treasury office, up to claiming an official I.D. of the student in the I.T. Department that will serve as the last procedure in enrollment that makes the student officially enrolled in the university. The developers and researchers of this study provide a computer program that helps the institution manage its daily enrollment process and resolves a common problem with some other universities dealing with a long queue of clients and difficulties in managing their transactions. This may also be a challenging part for the end-users unfamiliar with using technology that would help make every transaction easier. With the help of advanced technologies, computer programs, and descriptive analytics, the researchers will help the university, and the clients make the enrollment procedure more accessible and manageable using this queuing management system.

# LITERATURE REVIEW

Recognizing the transformative impact of digital technologies on organizational operations, the author of this study analyzed some of the existing and related systems locally and internationally to develop a pertinent proposal for the university. This analysis aims to:

* Investigate the functionalities of the leading queuing management system app.
* Gain a comprehensive understanding of automation processes in queuing management systems.
* Evaluate some system capabilities that can be applied to the features and functionalities of the study.

There are many diverse types of queuing management systems, both local and international, from different industries, such as universities, hospitals, clinics, restaurants, government, and service offices. The developer of this study conducted thorough research of some related studies, literature, and existing systems that would help with the success of this study.

*Application of the Queuing Theory in the Encoding and Paying Processes of the Enrollment System in TIP-QC.* This study [2] evaluated the Queuing Theory, which offers a systematic framework that optimizes TIP0QC’s enrollment system processes by analyzing the traffic flow, resource allocation, and service efficiency. This approach enables mathematical modeling of arrival rates, wait times, and service durations. Additionally, this study addresses customer dissatisfaction linked to delays, which are often perceived as poor service quality.

*Proposed Queueing Systems to Minimize the Waiting Time during Enrolment in Southern Luzon State University, Lucban, Quezon.* This study [3] addressed long enrollment wait times at SLSU by analyzing student flow and staff efficiency across key offices. Observations revealed uneven service speeds. Some sections, such as on different cashier windows, operated quickly, while on other cashier windows lagged. Using queuing models, researchers proposed adding six more staff and five more registrars and streamlining processes to cut service times to 3.5 minutes per student. This research aims to reduce chaos in the enrollment process, eliminate bottlenecks, and create a calmer and faster enrollment experience.

*Automated Enrollment Queueing System in a University Towards Student Experience and Operational Efficiency.* This study [4] introduced a new system for the university in which automates the enrollment queuing system that addresses inefficiencies on the process such as long waiting times, overcrowded lobby, and a disruptive noises produced during manual announcements with a loud speaker. After analyzing the existing system shortcomings, the research aims to develop an effective software-based solution that minimizes physical queues, and at the same time reduces stress for the students and their guardians, and finally, enhances the operational efficiency of the university.

*Queuing and Service Management System with SMS Notification in Southern Leyte State University – College of Agriculture, Food and Environmental Sciences.* This study [5] stated the dilemma caused by the long waiting line at the SLSU-CAFES by proposing an automated queuing and service management system. The system aims to fix the issues with the long wait time and long line of queues to streamline, digitize, and automate the services by promoting best practices in service management with text notifications.

*Queuing Management System in Manuel S. Enverga University Foundation Candelaria Inc.* This study [6] promotes the effectiveness of having a queuing management system in the university that provides enhancements to the student experience and productive administrative tasks. This study focuses on the implementation of a queuing management system at the Manuel S. Enverga University Foundation that aims to improve user satisfaction, reduce long waiting times, and boost productivity. In digitizing the queuing process, students can even join the lines virtually, which saves them time and increases their satisfaction with the good quality of service. The system implemented also allows the faculty and staff to focus on assisting the students rather than managing physical waiting lines while improving data accuracy, integrity, security, and providing insights to the queue patterns for better decision-making processes.

The presented systems were sourced from local systems of different universities in the Philippines, serving as the foundation for creating the queuing system. These systems highlight features that are accessible within the system and those that are not available. Various characteristics emerged throughout the discussion of related systems, contributing to efficient customer management. The focus of system innovation is especially on reducing average waiting times. However, more security measures for record-keeping and statistical reporting must be needed. Among the related systems, the researchers of this project thoroughly analyzed its modules and functions, drawing insights that can enhance the system’s development, efficiency, and effectiveness. By incorporating features from these related studies, the system aims to benefit students and staff across various offices, including the Registrar’s, Admissions, Treasury, and ITRO offices. The systems stated in this study share common goals of improving customer service, reducing waiting times, and providing valuable insights into customer flow and service efficiency. They use technology to offer remote queuing, real-time updates, and detailed analytics, making them essential tools for businesses aiming to enhance their customer experience.

# MATERIALS AND METHODS

Figure 1 shows the conceptual framework which begins with the existing manual queuing system. It faces challenges such as long waiting times, lack of transparency, resource mismanagement, and customer dissatisfaction due to its reliance on physical queues and paper-based processes. To address these issues, a qualitative research process combines questionnaires to capture customer pain points, interviews to understand staff and managerial challenges, observations to identify bottlenecks, and document analysis to review service logs. Data gathered from these methods is processed and analyzed to prioritize features for an improved system, such as automated notifications and analytics. The output is an enhanced Queuing Management System with SMS Notifications and Descriptive Analytics, which digitizes ticketing, sends real-time SMS updates to customers in queue status and wait times, and provides a dashboard for managers to track metrics like peak-hour demand, staff performance, and service efficiency.

Existing Manual Queuing Management System

Problems Encountered

1. Qualitative Method using a questionnaire, interviews, observations and document analysis
2. Gathering of Data
3. Processing of Data
4. Analysis and Interpretation of Data

Queuing Management System with Automatic SMS Notification and Data Analytics

**INPUT**

**PROCESS**

**OUTPUT**

**FEEDBACK**

**Figure 1.** Input, process, and output (IPO) research model

## Project Hardware and Software Specifications

The developed system requires a minimum set of hardware specifications, such as a computer system unit (laptop/ desktop), auto-cutter thermal receipt printer, 50-inch smart TV, or a much bigger screen size monitor, and a broadband stick (see Figure 2) for SMS sending purposes with a loaded SIM card.

A close-up of a usb flash drive

AI-generated content may be incorrect.

**Figure 2.** Mobile broadband stick for SMS sending

Figure 3 shows the effectiveness of using the broadband stick as an alternative for sending SMS notifications to the clients inside the university while using the developed Queuing Management System. It will notify the client about the ticket number, the total number of clients waiting, and when the client’s number will be next on the line. The only requirement for using this method is to keep the SIM Card subscribed to unlimited SMS and always loaded in all types of networks to be able to send the notification to all clients.

A group of people sitting on benches

AI-generated content may be incorrect.

**Figure 3.** Use of broadband stick for SMS notification on queuing management system

## Research Environment, Respondents, and Procedure

This study will be conducted at the National University – Mall of Asia Campus (NU MOA) in Pasay City, Philippines, during peak enrollment season for the first term of the academic year. During the conduct of this research, the data will be gathered from the officially enrolled students with a total population of approximately 8000 in 1 building of NU MOA from different departments: School of Allied Health, College of Dentistry, School of Accountancy and Management, School of Architecture, School of Information Technology, School of Arts and Sciences, School of Optometry, and Senior High School. On the other hand, 20 administrative and academic staff will be gathered from different departments and offices such as the Admission Office, Registrar Office, Accounting Office, and Information Technology Resource Office. The researchers chose to use stratified proportionate sampling [7] for this study. According to F. Blog and ThoughtCo, this approach involves breaking the population down into specific groups, or strata, and then randomly selecting a sample from each group based on its size. By doing this, the researchers ensure that every group is represented in the final sample according to its size within the overall population. This helps create a more accurate picture of the whole. Based on Table 1, the researchers gathered responses from 431 students across various departments and courses and 10 staff members.

|  |  |  |
| --- | --- | --- |
| **TABLE 1.** Research respondents | | |
| **Respondents** | **Total** | **Sample Size** |
| Students | 7, 950 | 431 |
| Staff | 20 | 10 |
| **Total** | 7, 970 | 441 |

Equation (1) shows Slovin’s formula that the researchers used to calculate the minimum sample size that is needed to make the survey efficient and valid:

(1)

Variables:

* N is the total population size
* e is the margin of error (as a decimal)
* n is the sample size

In calculating the sample size using Slovin’s formula, the researchers conduct a computation by dividing the population size by the sum of 1 and adding the population size multiplied by the square of the margin of error. The minimum sample size is 381 with a 5% margin of error, having a total of 7,970 total population of 7,970.

## Research Procedure

This study used a list of questionnaires that had been made by the researchers as the main method for collecting data. The instrument was carefully used, aligning with the objectives of the study, ensuring all questions were created to address all objectives. The researchers of this study prioritized adaptability when designing each question, enabling an accurate customization to the context and goals of the study. All data for this research were collected through a survey that was designed for the evaluation of the current system. Using the stratified proportionate sampling method [8], each representative and participant is ensured to be selected across different groups. The researchers practiced confidentiality, security, and integrity for the participant's identity and the sensitive nature of the data.

All the data that has been collected was shown in Equation (2). Such as the Number of Cases, the total sum of the observations, and the scores needed to find the Arithmetic Mean. All data in this study were thoroughly managed and studied by using the correct statistical techniques. Each result was combined to generate data insights and identify major issues during the investigation. The following formula was applied to compute the Average Weighted Mean based on Table 2.

X – Arithmetic Mean

∑ f1X1 – Sum of all the observations or scores

N – Number of cases

(2)

|  |  |  |
| --- | --- | --- |
| **TABLE 2.** Range for weighted mean | | |
| **Scale** | **Range-Value** | **Verbal Interpretation** |
| 5 | 5.00 | Very High |
| 4 | 4.0 – 4.99 | High |
| 3 | 3.0 – 3.99 | Moderately High |
| 2 | 2.0 – 2.99 | Low |
| 1 | 1.00-1.99 | Very Low |

## RESULTS AND DISCUSSION

During the implementation of the developed Queuing Management System, the researchers surveyed the system's end-users, such as the students, enrollees, and the staff of the enrollment procedure, and the study results showed positive feedback from the end-users. Not only will the development of the system be the only focus, but it will also test the system's efficiency and effectiveness for the enrollment process. The output of this study is a developed comprehensive queuing management system with SMS integration and data analytics, which was designed to modernize and digitalize the enrollment process of the National University - Mall of Asia campus.

On Figure 4 shows demographically, the respondents are 51% female and 49% male, and their ages range from 18 to 44 years old. Most respondents are technically and digitally proficient in using new computers and technology.

**Figure 4.** Total number of respondents

# CONCLUSION

The successful implementation of the Queuing Management System with Automatic SMS Notification and Descriptive Analytics at the National University – Mall of Asia represents a significant milestone in enhancing operational efficiency and user satisfaction. The project results demonstrate the advantages of transitioning from a manual queuing system to an automated, data-driven approach. By reducing waiting hours, improving resource allocation, and providing real-time updates, the new system has significantly improved the overall experience for students and staff alike. The insights gained from descriptive analytics will continue to inform and optimize future operations, ensuring that the system remains responsive to the evolving needs of the university community. This research addresses current challenges and sets a foundation for continuous improvement and innovation in queue management.

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