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Time Efficiency and Cost-Benefit Analysis of New Student Admissions Mobile Application: A Case Study in A Vocational School Palembang

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ABSTRACT

This study evaluates the effectiveness of an Android-based mobile application designed for new student admissions at a vocational school in Palembang. The application aims to replace manual registration processes, previously conducted via Google Forms and WhatsApp, by integrating features such as real-time push notifications and a MySQL database for data management. The research applies two key analytical methods: Time Efficiency, to measure time saved in the registration and notification processes compared to manual methods, and Cost-Benefit Analysis, to assess the financial viability of the application by comparing implementation costs against operational savings. The findings suggest that the new system enhances administrative efficiency, reduces operational costs, and improves user satisfaction. Although the system has significantly shortened the processing time and reduced manual workload, the effectiveness is limited by the fixed quota of student admissions, preventing further improvements in admission numbers. The study highlights the benefits of automating educational administrative tasks but calls for future efforts to address constraints related to system scalability and capacity.

1. INTRODUCTION

In the digital era, technological advancements have significantly impacted various sectors, including education. Schools are increasingly adopting information technology to streamline administrative processes and enhance operational efficiency [1]. One such implementation is the development of student admission systems that utilize mobile platforms. Most vocational schools face challenges in managing their annual student admissions due to a growing number of applicants [2]. The school's manual processes, which include handling physical forms and managing communications through platforms like WhatsApp, are time-consuming, prone to human error, and create inefficiencies in data management.

The development of an Android-based New Student Admission Information System with Push Notifications seeks to address these challenges by automating the admission process and integrating real-time communication features [3][4]. This system leverages Firebase Cloud Messaging (FCM) to notify both students and administrators of important updates such as registration status and deadlines, thus eliminating the need for manual follow-ups and reducing the administrative workload. Additionally, the use of SQL databases allows for seamless storage and retrieval of admission data, ensuring accurate and timely access to information [5][6].

This research evaluates the effectiveness of implementing the Android-based admission system at a vocational school in Palembang, focusing on two main metrics: time efficiency and cost-benefit analysis. Time efficiency measures the reduction in time spent on the admission process compared to the previous manual method [7], while cost-benefit analysis examines the financial viability of the system by comparing the implementation costs with the potential savings and operational improvements [8]. Through this study, we aim to demonstrate how the adoption of mobile technology and push notifications can modernize administrative processes in educational institutions, ultimately improving service delivery and user satisfaction.

2. LITERATURE REVIEW

The theoretical foundation of this study is based on several key areas relevant to the development of an Android-OS mobile application student admission system with push notifications [9]. These areas include the New Student Admission System, Spiral Model for system development Android Development and Push Notifications. These areas are critical in the design and implementation of an Android-based student admissions system with push notifications, which aims to improve efficiency in educational institutions. This research will conduct a quantitative analysis to evaluate the effectiveness and efficiency of the Android-based student admission system with push notifications [10]. This analysis will involve the collection of data. Key performance indicators (KPIs) such as user engagement rates, admission processing times, and notification response rates will be

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measured to assess the impact of the application on the admission process. This study will employ statistical techniques to analyze the collected data, determining correlations between the use of the mobile application and improvements in admission processing times and cost reductions.

2.1 New Student Admission System

Information system is a collection of interconnected components that work together to gather, process, store, and distribute information, ultimately supporting decision-making and management in organizations [11]. According to [12], an information system consists of people, data, processes, and technology that interact to produce useful outputs. These definitions highlight the importance of information systems in facilitating smooth data flow and operations within organizations. The efficiency of information systems directly impacts an organization's ability to function and make informed decisions.

Written in [12], researchers emphasize the role of information systems in organizations, explaining that it supports daily transaction processing, managerial operations, and long-term strategic planning. This research relies on information system principles to develop a student admission system that integrates smoothly with their existing data infrastructure. In this case, the system will help streamline operations by reducing the manual data entry currently performed by staff and improving communication between the school and prospective students. The New Student Admission System is a key administrative process in educational institutions. According to [13] it is an annual process that involves selecting and admitting students to schools. It is a crucial activity for the school, where the number of applicants is growing steadily each year.

2.2 Spiral Model

The Spiral Model is a Software Development Life Cycle (SDLC) model that integrates elements of the Waterfall model and the Iterative model, it was first introduced by Barry Boehm and focuses on risk management through iterative cycles, making it suitable for large and complex projects with significant risks [14]. The Spiral Model is visually represented as a spiral twirl with loops, where each loop represents a phase of the software development process, including requirements gathering, risk analysis, design, implementation, and testing [13].

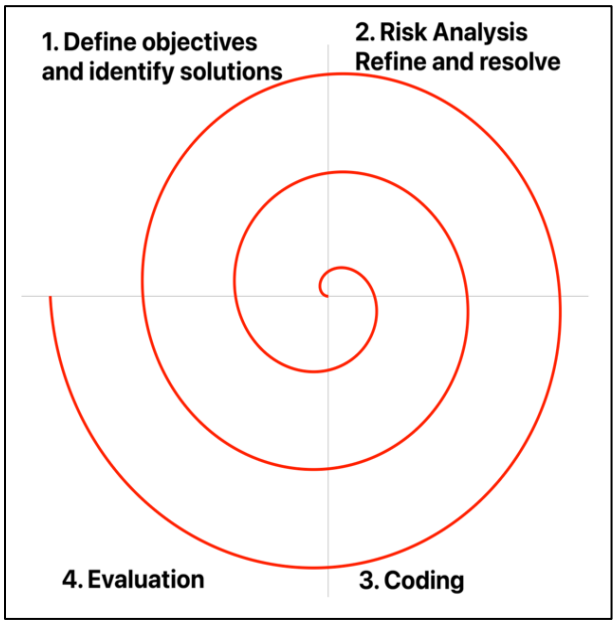

Figure 1. Spiral Model [13]

Each iteration of the spiral provides a more refined version of the product, and the number of iterations varies depending on project sizes and risk factors. The key focus of the model is handling risks at every stage of development. Phases of the Spiral Model include [15]:

1. Objectives Defined: Clarifying project goals, including functional and non-functional requirements.
2. Risk Analysis: Identifying and evaluating risks associated with the project.
3. Engineering: Developing and testing software based on requirements.
4. Evaluation: Evaluate the software to ensure it meets customer requirements.

After each evaluation, the process repeats and then begins with planning for the next iteration based on the feedback received. In this model, the risks are identified, evaluated, and resolved. If necessary, a prototype is built to address critical risks. Unlike other SDLC models, which may not handle new risks that arise during development, the Spiral Model provides flexibility by allowing for risk management at any stage. This continuous focus on risk handling makes it suitable for projects with uncertain requirements or high potential risks.

2.3 Android Mobile Application

Android is an open-source operating system based on the Linux kernel and is primarily used in mobile devices. A. Luca in [16] describes Android as a flexible environment that allows developers to build and distribute mobile applications widely. The platform's open-source nature has contributed to its popularity, enabling developers to access a wide range of resources and tools for building customized applications [17]. Given Android's widespread use and accessibility, it is a suitable platform for the development of the new student admissions system proposed in this study.

The choice of Android for this project is also driven by its vast user base. As [16] notes that android dominates the mobile operating system market, making it a practical choice for reaching a broad audience of users. By building the admissions system on Android, the institution can ensure that prospective students and their families can access the system easily through their smartphones, thus enhancing accessibility and engagement in the admissions process.

Push notifications are a critical feature in modern mobile applications, allowing real-time communication between the system and users. According to [3], push notifications enable event-based messaging, where information is pushed to a mobile device without requiring user intervention. This technology improves user experience by providing timely updates, alerts, and other essential information, even when the application is not actively in use. In this study, Firebase Cloud Messaging (FCM) is used to implement push notifications due to its simplicity and cost-effectiveness.

The use of FCM in the proposed system will allow the institution to send real-time updates to students, informing them of changes in the admissions process, such as deadlines or registration status. Additionally, FCM offers a cheaper alternative to traditional SMS gateways, providing the school with a more efficient and cost-effective method of communication [3]. This ensures that the system not only improves efficiency but also reduces operational costs, enhancing the overall effectiveness of the student admissions process.

3. RESEARCH METHODS

In this research, data collection [17] will focus on two primary methods: interviews and archival data collection from the previous year. Semi-structured interviews were conducted with key stakeholders as a data collection method; including school administrators, teachers, and staff involved in the admissions process. These interviews will aim to gather qualitative insights regarding their experiences with the mobile application, perceived improvements in efficiency, and any challenges faced during implementation. The semi-structured format will allow for flexibility in exploring relevant topics while ensuring that essential questions are addressed.

Figure 2. Research Methodology

To assess time efficiency and conduct a cost-benefit analysis, historical data from the previous year's student admissions process will be obtained. This data may include metrics such as the time taken to process applications, the number of students admitted, and associated costs. Analysing this archival data will provide a baseline for comparing the performance of the new mobile application against traditional methods.

The data collected through interviews and archival sources will undergo a rigorous cleaning process to ensure validity and reliability, this involves reviewing the data for inconsistencies, missing values, and errors [18]. Interview documents had been carefully reviewed and coded for themes, while archival data will be checked against original records to ensure accuracy. Any discrepancies will be resolved through follow-up with relevant stakeholders. Through this focused approach to data collection, this research aims to ensure high-quality data that will support valid conclusions regarding the effectiveness of the new student admissions mobile application

2.4 Time Efficiency

Refer to [19] Time efficiency refers to the ability to complete tasks or processes in a shorter amount of time without sacrificing quality. In the context of software implementation, particularly in systems like a student admissions mobile application, automation plays a crucial role in enhancing time efficiency. Automation through software implementation involves using technology to perform repetitive and time-consuming tasks that would otherwise require significant manual effort. In this case of the admissions process, an automated system can streamline various steps such as application submission, document verification, and data entry. By reducing or eliminating manual interventions, automation minimizes the likelihood of human error, ensuring that tasks are completed quickly and accurately.

One of the primary benefits of automation is its ability to process large volumes of data rapidly [20]. With automated systems, the admissions staff can manage numerous applications simultaneously, significantly reducing processing times compared to traditional methods. Automated notifications and reminders can also be sent to applicants, keeping them informed of their application status and important deadlines without the need for manual communication. Moreover, automation allows for real-time

data analysis and reporting [21]. Admissions officers can quickly access insights into application trends, processing times, and other key performance indicators, enabling them to make informed decisions swiftly. This immediate access to information enhances responsiveness and helps institutions adapt to changing needs more effectively.

In [22] Time efficiency is often quantified using formulas that relate time spent on tasks with the ideal time as:

$$Time\ Efficiency = \frac{Processing\ Time}{Actual\ Time} \times 100\% \quad (1)$$

Note:
Processing Time : This is the expected time to complete a task or process under optimal conditions.
Actual Time : This is the time taken to complete the task on real scenarios. This can vary due to various factors, such as delays, errors, or inefficiencies.

2.5 Cost-Benefit Analysis

Cost-benefit analysis (CBA) is a systematic approach used to evaluate the financial implications of a project or investment by comparing its costs to the benefits it generates [23]. CBA serves as a crucial tool for determining whether the investment in the application is justified and how it impacts the admissions process. The analysis begins with identifying the costs associated with the project, which includes initial development costs, such as expenses related to software development, design, and implementation, as well as ongoing operational costs like maintenance, updates, and support services. Additionally, opportunity costs, which represent potential benefits that could have been realized if the resources allocated to the mobile application were used elsewhere, should also be considered [24].

On the benefits side, several key factors must be quantified. Time savings from the reduction in the duration of the admissions process can significantly increase staff productivity, allowing them to focus on other critical tasks [25]. Improved accuracy, resulting from reduced manual processes and errors, minimizes costs associated with mistakes. Enhanced user experience is another important benefit, as faster response times and better communication through automated notifications lead to greater satisfaction among students and parents [26]. Furthermore, the long-term savings from increased efficiency and reduced administrative overhead contribute to the overall financial viability of the project.

Once costs and benefits are identified, they must be quantified in monetary terms to facilitate comparison. This involves assigning values to time savings, estimating reductions in labor costs, and calculating the financial impact of improved accuracy and user satisfaction. Refer to [27], the net benefit of the mobile application can then be calculated using the formula:

$$Net\ Benefit = Total\ Benefit - Total\ Cost \quad (2)$$

A positive net benefit indicates that the advantages of implementing the mobile application outweigh its costs, thereby justifying the investment to the system [27]. By conducting a thorough cost-benefit analysis, this research will provide valuable insights into the financial implications of implementing the new student admissions mobile application, aiding in understanding the cost feasibility of the project and informing resource allocation decisions. CBA will contribute to a comprehensive understanding of how the mobile application enhances both time efficiency and overall effectiveness in the admissions process [28].

4. RESULTS AND DISCUSSIONS

The implementation of the new system in 2023 has improved efficiency and accelerated the process, but the overall effectiveness in accepting students has decreased due to the limited quota of admissions compared to the increasing number of applicants each year. However, the new system with automated document checking and push notifications has helped improve the user experience and reduce the administrative burden, although the quota remains a major constraint.

Table 1. New Student Admissions Data

Year	Students	
	Prospectives	**Accepted**
2020	500	428
2021	580	433
2022	640	447
2023	700	450
2024	815	450

The comparison between the old and new systems reveals significant changes in the student admissions process. During the period from 2020 to 2022, the school operated under the old system, which was entirely manual and lacked automation. Students were required to submit physical documents, and data compilation was done using Excel spreadsheets. This system faced several challenges, including delays in document submission, which led to slow verification processes. Additionally, human errors were prevalent, as administrative staff often made mistakes while checking document completeness. Communication was also inefficient,

with no automated notifications to inform students about their registration status. Consequently, despite a steady increase in the number of applicants from 2020 to 2022, the acceptance rate was relatively low due to many students failing to complete their registrations on time.

In contrast, starting in 2023, this vocational school implemented a new mobile application-based system that introduced various automated features. One notable improvement is the automation of document checks, allowing the system to automatically verify the completeness of documents uploaded by students, thereby reducing the risk of human error. Furthermore, push notifications were integrated, enabling students to receive automatic updates about their registration status, including whether their documents were complete, the remaining acceptance quota, the selection schedule, and the announcement of selection results. This enhancement significantly improved the responsiveness between students and the administration. Additionally, the new system allowed for more efficient quota management by providing real-time updates on the remaining acceptance slots, giving students a clearer understanding of their chances for admission.

Table 2. Comparison table of Cost-Benefit Analysis, Time Efficiency, and Effectiveness of the new student admission system

Year	Normal Admission Cost (IDR)	Duration for Verification + Test	Time Efficiency	Effectiveness (%)	Benefit
2020	< 50 million	1 month	0	65%	None
2021	< 50 million	1 month	0	61%	None
2022	< 50 million	1 month	0	58%	None
2023	> 100 million (system + training cost)	2 weeks	50%	90%	15 million (staff efficiency)
2024	~40 million	2 weeks	50%	95%	15 million (staff efficiency)

To calculate Time Efficiency based on provided data, we need to compare the time spent on the student admission process between the old system (2020-2022) and the new system (2023-2024). From 2020 to 2022, under the old system, the process of verifying documents and checking the entrance exam sheets took one month, which is equivalent to four weeks. However, starting from 2023, with the implementation of the new automated system, the same process only took two weeks.

Time efficiency formula:

$$Time\ Efficiency = \frac{Processing\ Time}{Actual\ Time} \times 100\% = \frac{Processing\ Time_{Old} - Processing\ Time_{New}}{Actual\ Time} \times 100\%$$

For 2023:

$$Time\ Efficiency = \frac{4\ weeks - 2\ weeks}{4\ weeks} \times 100\% = 50\%$$

For 2024:

$$Time\ Efficiency = \frac{4\ weeks - 2\ weeks}{4\ weeks} \times 100\% = 50\%$$

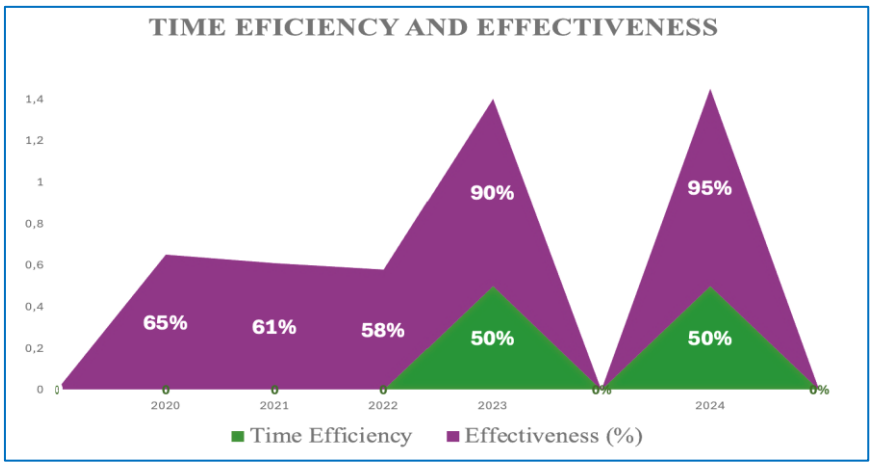

Figure 3. Time Efficiency, and Effectiveness of Application Implementation

The old student admission system, used from 2020 to 2022, incurred a total annual cost of IDR 45 million, which included expenses such as PPDB team salaries, promotions, printing costs, office supplies, transportation like fuel, and miscellaneous costs. In 2023, the school implemented a new mobile app system to automate the process. This new system involved an initial setup and training cost of IDR 100 million and ongoing operational costs of IDR 15 million, as it reduced manual work, leading to significant staff efficiency savings. The benefits of the new system primarily came from a 50% reduction in processing time, cutting the admissions process from 1 month to 2 weeks. The automation also led to cost savings, estimated at IDR 15 million per year, due to reduced workload for the staff. By 2024, the operational maintenance cost of the system decreased to IDR 50 million, while maintaining the same level of savings from staff efficiency, making the system more financially sustainable in the long term.

Net Benefit Calculation (2023): Net Benefit = Total Benefits − Total Costs
= Rp 15.000.000,00 − Rp 100.000.000.,00
= - Rp 85.000.000,00

Net Benefit Calculation (2024): Net Benefit = Total Benefits − Total Costs
= Rp 15.000.000,00 − Rp 40.000.000.,00
= - Rp 25.000.000,00

From the calculation above, it shows that in 2023, the initial costs of system implementation exceed the benefits due to the high investment cost. The net benefit in 2024 results in a loss of Rp 25.000.000,00, as the total costs of Rp 40 million still exceed the benefits generated from staff efficiency savings.

5. CONCLUSIONS

The analysis of the mobile application for new student admission at this vocational school reveals several key insights regarding the system's impact on operational efficiency, time management, and overall user satisfaction. The application significantly streamlines the admission process, reducing manual data input and improving communication between prospective students and the school. The incorporation of push notifications enhances the real-time exchange of information, ensuring timely updates and responses, which contribute to a more organized and responsive admissions system.

The implementation of new student admissions mobile application has shown significant improvements in both time efficiency and cost-benefit analysis compared to traditional methods. The system's integration of push notifications and automated document verification has reduced manual processes, leading to faster processing times and fewer errors. These enhancements have improved the user experience for both administrators and prospective students, fostering a more responsive and organized admissions process. While the new system has reduced the time required for processing from four weeks to two, its long-term financial viability has also been demonstrated. In 2024, despite initial high setup costs in 2023, the cost savings from reduced staff workload and operational efficiency have resulted in a positive net benefit. This new system enhanced operational efficiency and user satisfaction, but it has yet to resolve issues related to limited admissions capacity. The time efficiency improvements are clear, with the admissions processing time halved, but the system's effectiveness in terms of accepting students is constrained by the fixed admissions quota. This creates a bottleneck in the system, even though administrative processes have been streamlined significantly. Nonetheless, the cost-benefit analysis confirms that the system is financially sustainable, with notable cost savings in staff efficiency and reduced operational costs from 2023 to 2024.

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