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Optimizing scholarship distribution: a management information system approach

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Keywords: scholarship, distributions, management information system, rapid application development.
Abstract: Baitul Mal Unisba (BMU), a zakat-based philanthropic institution, offers scholarships to its students, aiming not only to support their tuition but also to foster exceptional character development. This research addresses a significant challenge at BMU: the inefficiency in its administrative processes due to the absence of a robust information system. The study proposes developing a management information system to optimize scholarship distribution, precision, and accuracy of managing scholarship data - from collection and recording to processing and reporting. This improvement is anticipated to support more informed decision-making in scholarship distribution. The system was built using the Rapid Application Development process, which consists of three stages: requirements planning, workshop design, and implementation. The emphasis is on the optimal use of scholarship funds, time, and manpower. This research made an important contribution by developing a prototype of a web-based scholarship information system aimed at improving the effectiveness of distribution. The newly created scholarship management information system improves these processes by removing duplicate tasks and streamlining the overall workflow. It provides comprehensive data for the decision-making panel, including academic performance, activity reports, and scholarship quotas. Initial testing of the prototype shows that it meets all functional requirements, suggesting its potential effectiveness in resolving the current challenges in BMU's scholarship selection and distribution process.

1 Introduction

The rapid evolution of information technology (IT) has significantly enhanced the efficiency and effectiveness of various sectors. This technological progress draws increasing interest from diverse organizations, including those in the philanthropic domain, to upgrade their IT performance [1]. In the field of philanthropy, IT plays a crucial role, especially for organizations involved in collecting and distributing donations [2]. The implementation of IT in zakat management systems notably impacts the quality of management reporting, both financially and non-financially [3]. Baitul Mal Unisba (BMU) as a zakat philanthropic institution should also look for the possibility of using information technology to improve its services. BMU, operating under the Universitas Islam Bandung, focuses on zakat, infaq, and alms funds management and distribution. Its primary program is a scholarship initiative for Unisba students. These scholarships, awarded based on merit, Quran memorization, and financial need, are pivotal for fostering competent and competitive resources [4]. Ensuring objectivity in their distribution is essential for aiding students in their academic pursuits [5].

BMU utilizes various communication channels to promote the scholarship program, including its website, Instagram, WhatsApp, and email. The rapid spread of information via these platforms necessitates careful content management to prevent misinformation [6]. The program provides financial assistance and focuses on character-building through various coaching activities. Participation in these activities, along with academic performance, is crucial for the annual scholarship renewal assessment. However, BMU faces challenges due to non-integrated computer systems for tracking scholarship recipients' activities, leading to inefficiencies and reduced organizational effectiveness. This situation delays decision-making and impacts the optimal distribution of scholarships.

Optimizing scholarship distribution aims to ensure the efficient and effective use of educational financial aid in meeting its designated objectives. To enhance scholarship distribution, various factors need consideration, including the criteria for awarding scholarships, the quantity of aid

provided, and the equity of the selection process. Numerous studies focus on augmenting scholarship allocations, incorporating technological advancements. The integration of information technology streamlines the submission, processing, and monitoring of scholarship applications. The utilization of machine learning for enrollment estimation has seen limited exploration in scholarship disbursement strategies [7]. Employing neural networks and genetic algorithms to fine-tune financial aid allocation [8] and leveraging student application data in higher education for scholarship optimization through machine learning and numerical methods are emerging approaches [9].

The research question is how the design of BMU's information system can minimize inefficiencies, eliminate redundant activities, simplify the overall workflow, and enhance organizational efficacy, thereby expediting decision-making processes to refine scholarship distribution. This study aims at designing a scholarship information system based on user needs. The users, in this case, are students who apply for the scholarships BMU Administration processes the applications. BMU scholarship information system can be used to manage academic information and student activities for scholarship recipients. Thus, academic progress and other coaching activities can be stored and retrieved to assess scholarship applications.

This study presents a distinctive approach to the development of information systems that are tailored to effectively facilitate the process of distributing scholarships. These systems are meant to cater to the distinct requirements and intricate nature of scholarship distribution. The present method incorporates multiple criteria for scholarship selection, including academic records, student involvement in extracurricular activities, and the availability of quotas. This integration aims to enhance the precision and reliability of the scholarship recipient selection process.

Rapid Application Development (RAD) is a prototyping-focused iterative application development approach that may be completed in a short period with a team of two to six people [10]. The RAD method is frequently employed in the domain of business software development. Its application in the realm of scholarship management can yield significant contributions. The outcome of this study yielded a prototype of a web-based system for disseminating scholarship material, to enhance accessibility and expand the user base. The utilization of the system can enhance the efficacy and accuracy of the decision-making process about scholarships, hence offering substantial advantages to the awarding organization.

2 Literature review

The literature review presents concepts and techniques in Rapid application development (RAD), Business process management notation (BPMN), Entity relationship diagram (ERD), and Use Case Diagram (UCD).

2.1 Rapid application development

The waterfall model and its variations are examples of traditional system development methodologies. RAD is a collection of methodologies intended to address the flaws of traditional methodologies [11]. Rapid Application Development can help in producing high-quality systems, while at the same time lowering the development cost and time [12]. This paradigm stresses a quick planning process and focuses on the software development process, testing, and feedback in its use [13].

There are three methods for implementing it: (i) iterative development, (ii) system prototyping, and (iii) single-use prototypes. A project is divided into series/versions that will be progressively produced through iterative development. The most crucial aspect of this strategy is creating the initial version of the system. A simplified waterfall approach was used to create this version quickly. Once implemented, users can provide feedback for the improvement of the next version of the system. Figure 1 depicts the phases of development.

2.2 Business process model notation

Business Process Model Notation (BPMN) is an essential modeling method. BPMN's core function is to visually represent business processes, aiming to enhance and refine aspects such as quality, time, and cost efficiencies. BPMN's major purpose is to offer a universally understandable notation that is accessible to a diverse range of stakeholders involved in business operations. This includes business analysts, who create initial process designs, technical specialists responsible for implementing the technology necessary to execute these processes, and managers overseeing their execution [14]. BPMN modeling aims to give notes that are simple to comprehend and comprehend by businesspeople. The purpose of BPMN is to serve as a link between the design and implementation processes. BPMN 2.0 offers a unified specification encompassing the notation, metamodel, and interchange format of the novel business process model. However, it does so with an altered vocabulary that maintains the BPMN label. Aligning BPMN, facilitating the interchange of business process models, and diagram layouts, and expanding BPMN to allow symphonic models and choreography are all features accessible in BPMN 2.0 [15].

2.3 Entity relationship diagram

The Entity-Relationship Diagram (ERD) is a model defined as a graphical representation of a data set's logic that includes a complete description of all entities, relationships, and restrictions [16]. ERD is also known as a technique for modeling data needs, and it is commonly used in system analysis and process requirements analysis of systems development projects. Based on the preceding

description, it can be stated that an ERD is a graphical representation of a data model that offers a complete image of all entities, and connections, and solves problems using analytical methods [17]. This ERD connects the contents to create conceptual data models, data structure and relationship modeling, and logical and physical DBMS implementations. This data modeling is viewed entity-relationship diagram by considering the required or not required provisions. Then, entity relationships can assist in answering the questions that need to be answered and how to apply the answers to the data.

2.4 Use case diagram

A use case diagram (UCD) visualizes a system's behavior and the actors who interact with it. When the system reacts to requests from actors, use cases define what happens in all circumstances. The principal actor initiates a system request based on the aim, and the system responds to the proposal [18]. In systems analysis, a use case is a method for identifying, clarifying, and managing system requirements. UML (Unified Modeling Language) serves as the preeminent modeling language for tangible systems and objects [19], use case diagrams are utilized Use case diagrams are a subclass of the Unified Modeling Language (UML) behavior diagrams [20].

3 Methodology

This research describes the system using the Rapid Application Development (RAD) development approach as a step method and focuses more on development [21]. The phases of this process resulted in the creation of a prototype that may be utilized as a foundation before being implemented on a real natural them. The three steps are the requirements planning stage, workshop design, and implementation. A system request and feasibility study are used to determine the planning stage. Before identifying, the study first collected information through direct interviews with several stakeholders, including directors, heads of programs and services, collection and marketing staff, and financial administration staff of BMU. Interviews were also conducted with representatives of students who will apply for scholarships and students who have received scholarships for 3 years. Other information was also obtained from documents and files of BMU.

Modeling business processes, identifying functional and non-functional system requirements, logical modeling using BPMN 2.0 for business process modeling [22], activity interaction modeling Use case Diagrams, and data modeling Entity-Relationship Diagram (ERD), which is one of the techniques used to model an organization needs, are all stages of the analysis. Analysts often use ERD to create systems, engineering diagrams, or visual aids. It is the foundation for constructing the relational database that underpins the information system [23].

The next step is to create a prototype design consisting of designs carried out in the system, such as physical business process modeling, physical data modeling, and prototype interface design using Figma. The system will be built utilizing an app server with a code igniter (CI) framework. As well as using Visual Studio Coding as a code editor. Figure 1 depicts the stages of the Rapid Application Development (RAD) stage technique. Rapid Application Development (RAD) steps are requirements planning, RAD design workshop, and implementation [24], as shown in Figure 1.

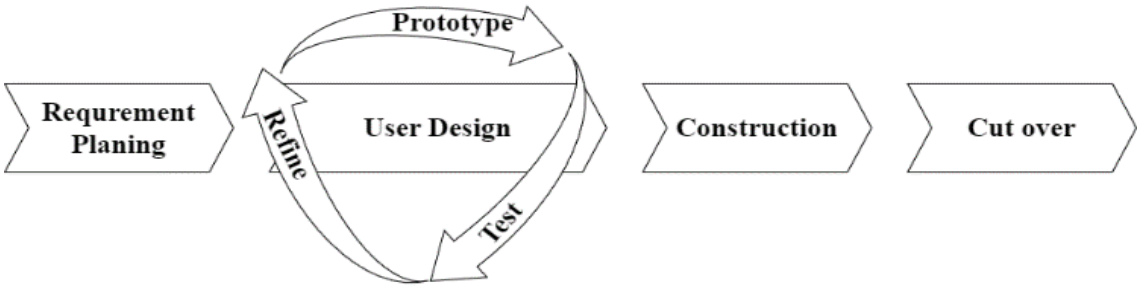

Figure 1 Method of Rapid Application Development (RAD) (Wixom, Roth, and Dennis, 2014)

3.1.1 Requirements planning

Users and analysts get together to start the first step of requirements planning by determining the application or system's goals. Then it's on to problem-solving.

3.1.2 Design Workshop

This step entails creating and perfecting a previously designed development. System decision support to encourage users to agree with an existing user. The role of programmers and analysts is to create and offer a visual representation of methods and procedures. The user will next give feedback on the actual working prototype. The analyst then refines the designed module in response to user feedback.

3.1.3 Implementation

The last stage is implementing the newly developed or partially built system, testing it, and introducing it to the company. There's no need to operate the old system parallel after making a new one.

4 Result and discussion

4.1 Requirements planning

The flow of scholarship activities at BMU is now specified using use case diagrams and BPMN 2.0 business processes to identify the parties involved and the phases of actions that must be completed. After discovering the flow of scholarship activities at BMU, system modeling using ERD was used to determine the data flow that happened in each step. The information system planning step is based on the use case, business processes, and ERD.

Table 1 System request baitul mal scholarship application Unisba

System Request - Baitul Maal Unisba Scholarship Application
Project Sponsor: Baitul Mal Unisba (Scholarship)
Business requirements: Potential scholarship applicants can register and upload registration files directly through the system, with the required data being recorded in a database.
Business Criteria: The system must meet the following needs: - It must be able to preserve data. - It must be able to show essential announcement information. - It must be able to upload file requirements. - The system may display user-created logins and registrations.
Business Value: BMU can improve services, such as scholarships, by allowing users to register and upload material directly to a database. Prospective scholarship winners can also view the availability of scholarship quotas and the notification of acceptance. The business value that may be produced is that the administration will be able to handle existing data easily and will be able to reduce the time it takes to verify registration requirements and inform the timetable for the implementation of acceptance operations.
Special Issues and Limitations: Shortly, a system is required.

At this stage, identification is carried out on the old system, and changes are discovered via a system request, as shown in Table 1. The following step is development, by assessing the information system on the scholarship process at BMU to determine the present system's requirements.

During the system analysis, two needs were identified: functional and non-functional requirements and logical design modeling study analytic practical conditions consisting of admin and user requirements, whereas non-functional requirements analysis consists of a system behavior or system operational requirements.

4.2 Design workshop

The following step is to create a logical system. A Use-case Diagram is used to model logical system interactions. Business Process Modeling and Notation 2.0 by logis menggambarkan pemodelan desain proses bisnis. The scholarship business process model follows a logical path from registration to comprehensive personal data. When applying for a scholarship, the prospective beneficiary enters the submission data and uploads the required documents right away. BMU administrator will next review the scholarship application data and deliver information about the activities of the admissions schedule to potential scholarship winners. Following that, potential scholarship applicants will be given information on the admissions timetable and will be required to participate in a series of activities according to the schedule, evaluate the written test surah memory test, and conduct interviews with potential scholarship applicants. BMU administration will disseminate information on the scholarship acceptance results via the website.

Figures 2 and Figure 3 illustrate user actions before and after, whereas Figures 4 and Figure 5 show the exchange of business processes before and after.

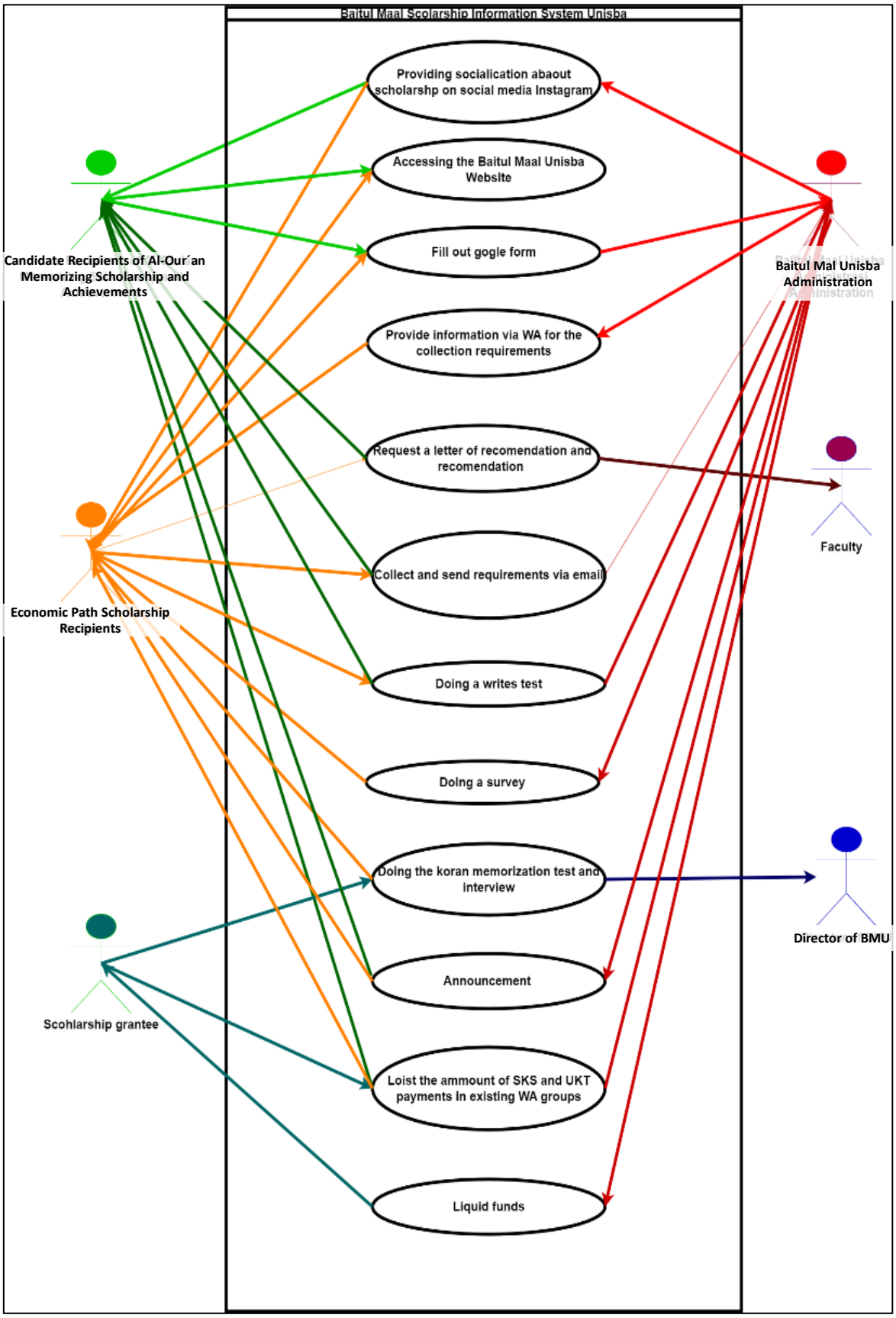

Figure 2 Use-Case Diagram with current use r activity

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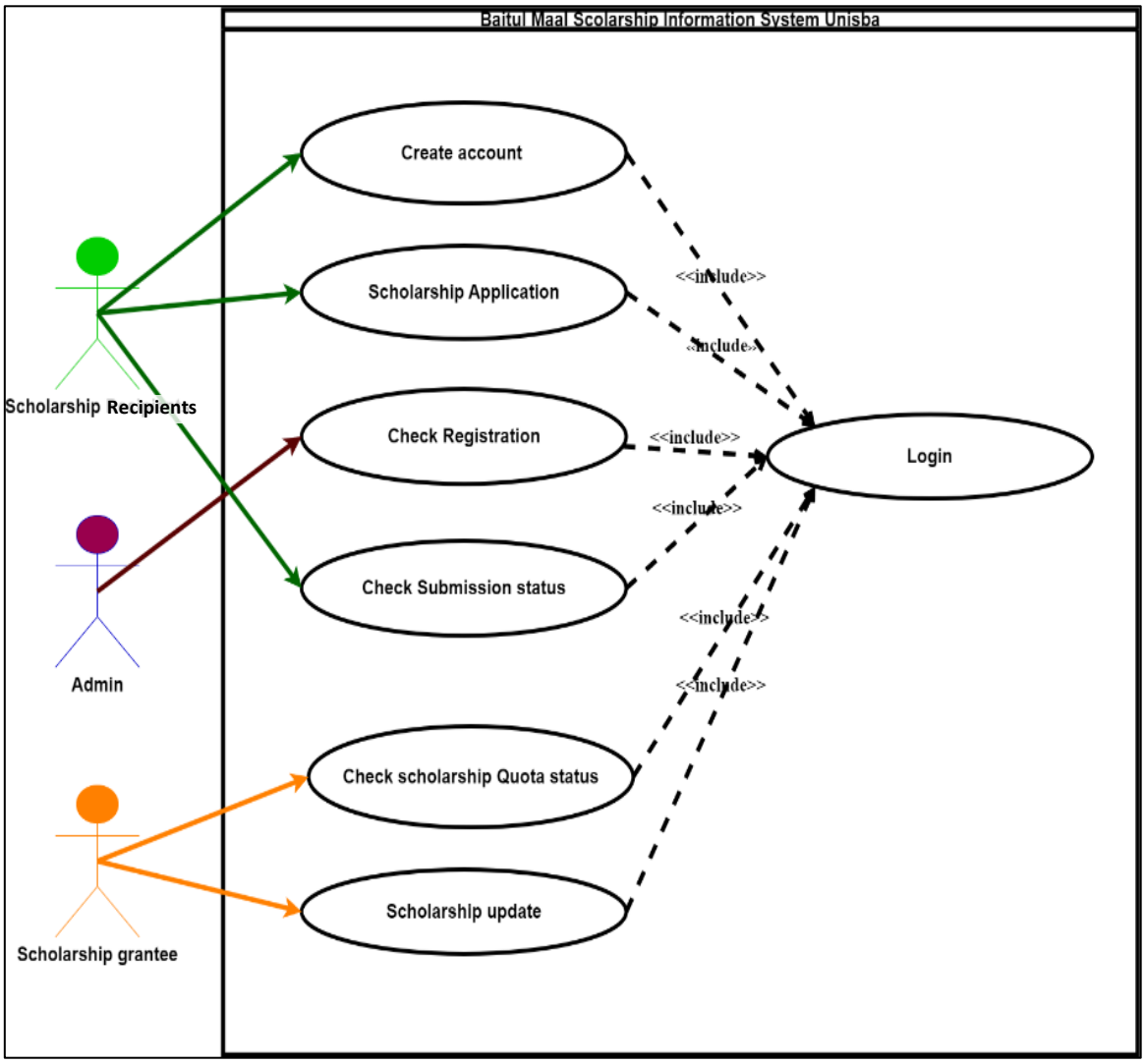

Figure 3 Use-Case Diagram with logical user activity

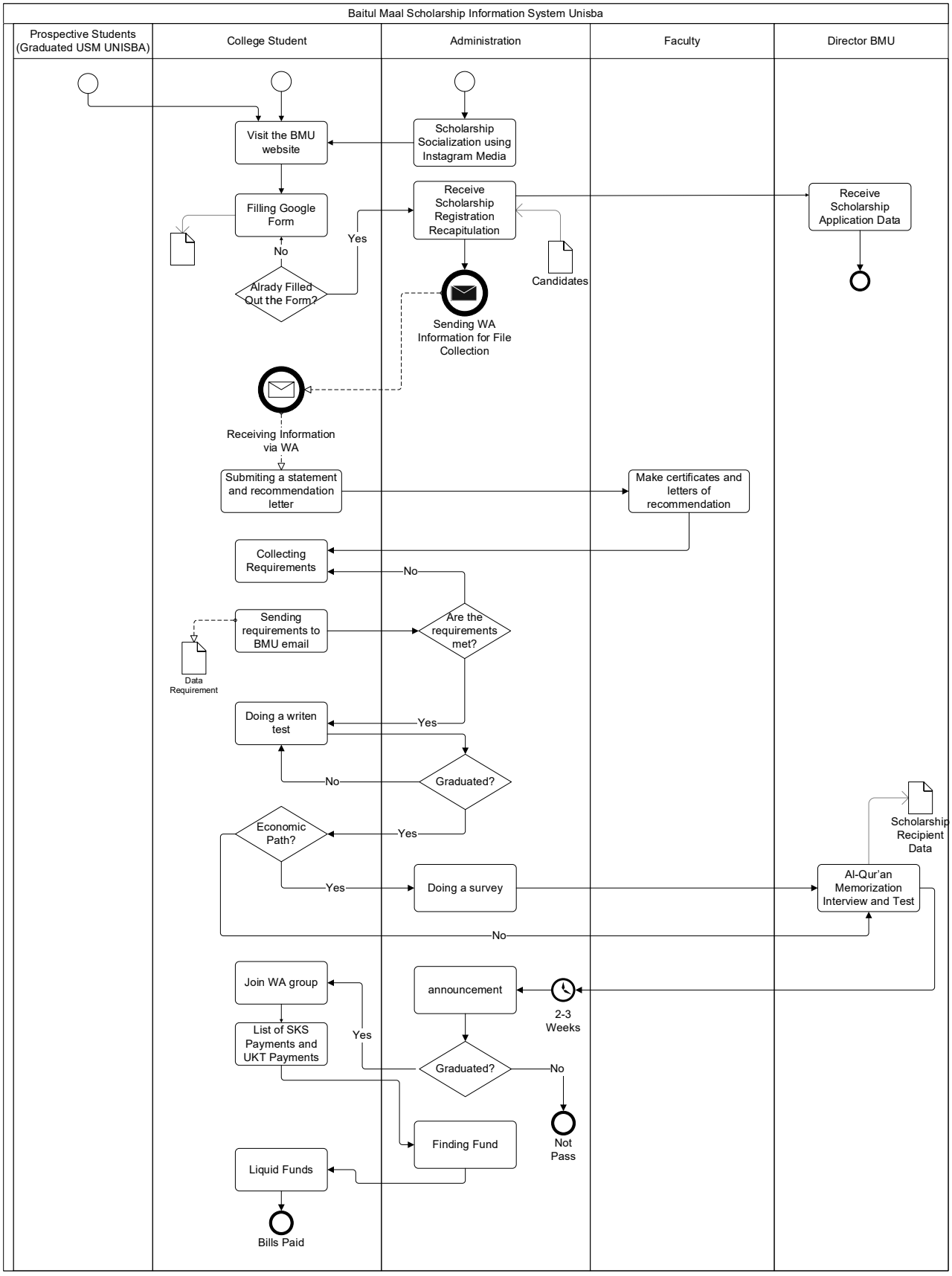

Figure 4 Business process in use

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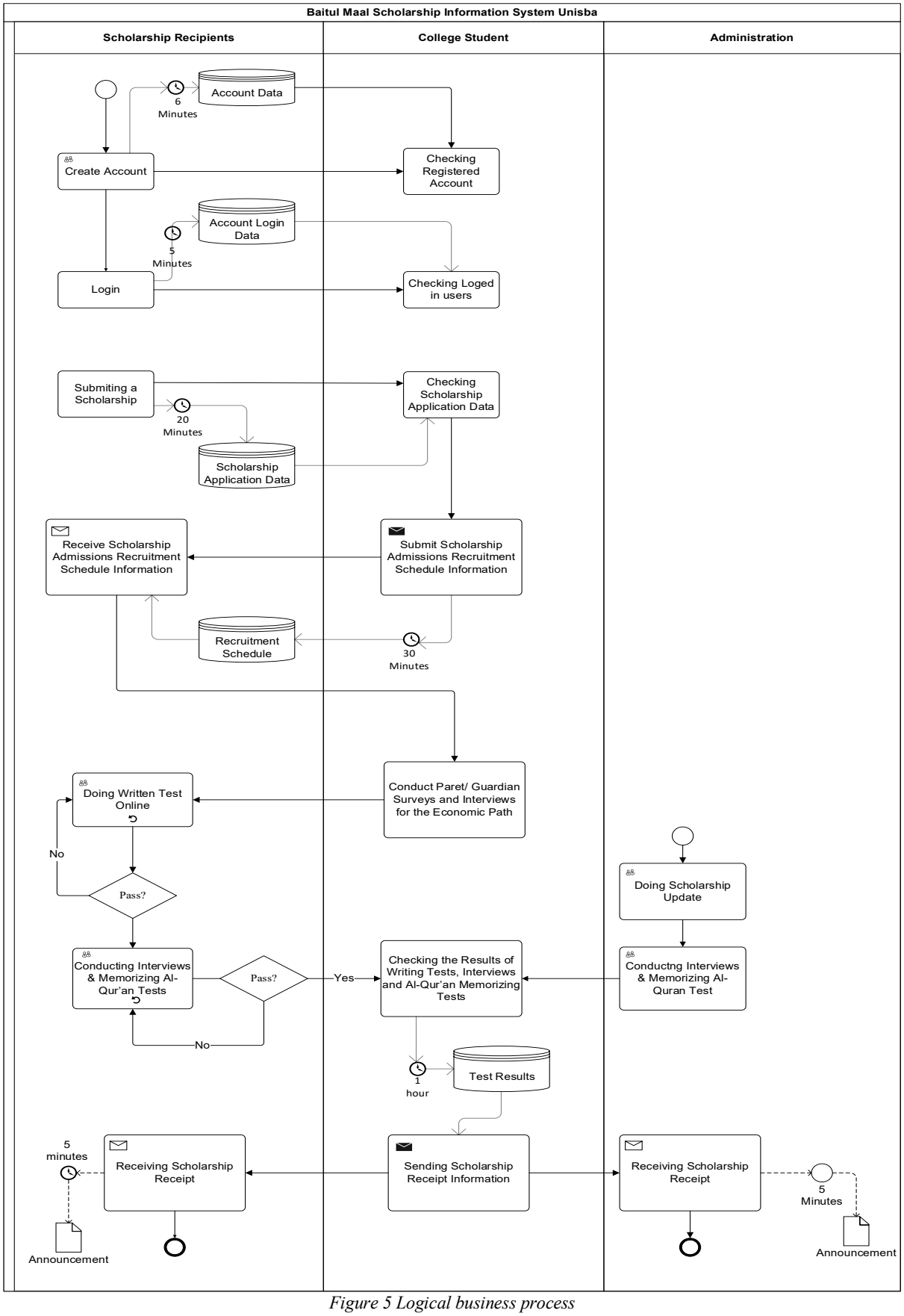

Figure 5 Logical business process

4.3 Implementation

4.3.1 Database design

Business processes and logical relationships between actors are used to create database designs. The database was created to make it easier to search for data and speed up the information delivery process—the existence of a database architecture that allows data to be appropriately structured and saved in one location. Normalization is one of the things that must be addressed while designing a database. Normalization aims to create a database structure that minimizes data duplication. This study of Baitul Mal Unisba's scholarship program employs normalization to the third stage, yielding 13 tables.

Proceed to the following step: create a data dictionary with data types, sizes, table components, and sample data based on the 13 tables. Then go on to make connections between tables that are connected. The visual representation of the relationship between tables in a database utilized in the application is called a relationship. The Entity-Relationship Diagram (ERD), as seen in Figure 6, depicts connections or relationships between tables.

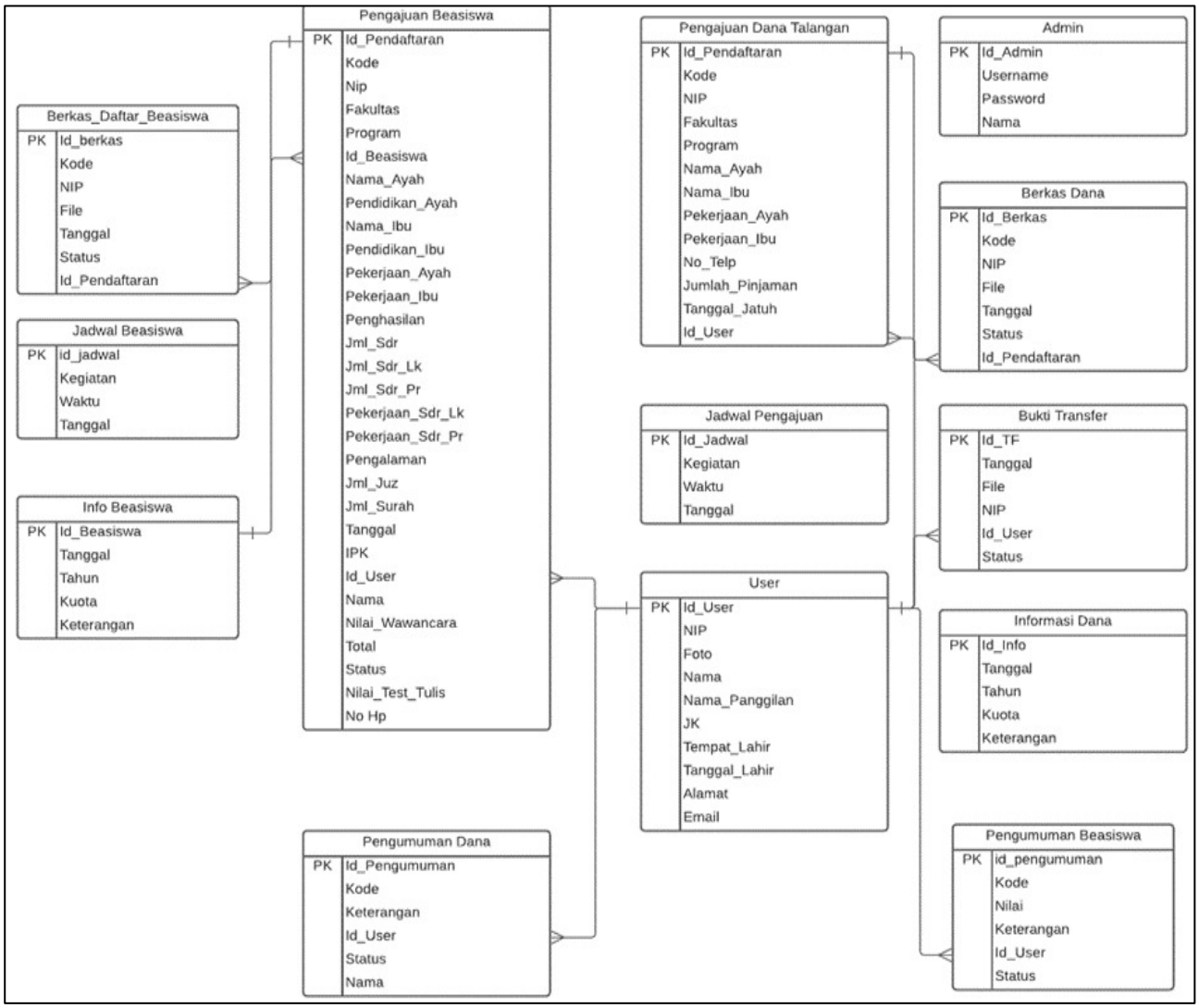

Figure 6 Table-to-Table Relationship

4.3.2 User interface design

The next step is to create a user interface that would make accessing the database easier for users. The Figma platform was used to create the user interface. In this study, the interface needs to amount to 43 forms with two access levels, admin and student, as follows:

- All users: form welcome;
- All users: form login;
- College student: shape create account;
- College student: form choose service;
- College student: form input scholarship application;
- College student: form scholarship information;
- College student: form scholarship announcement;
- Admin: Dashboard;
- Admin: Database scholarship information.

4.3.3 Application design

The next stage is to create the program after completing the user interface. The software code is made in line with the database and user interface utilizing the Visual Studio code application at this stage. The xampp server, MySQL database, and code igniter (CI) framework are used to create the application. Figure 7 and Figure 8, depict the application development design.

Table	Action	Rows	Type	Collation	Size	Overhead
admin	Browse Structure Search Insert Empty Drop	1	InnoDB	utf8mb4_general_ci	16.0 KiB	-
berkas_beasiswa	Browse Structure Search Insert Empty Drop	3	InnoDB	utf8mb4_general_ci	32.0 KiB	-
berkas_dana	Browse Structure Search Insert Empty Drop	1	InnoDB	utf8mb4_general_ci	32.0 KiB	-
bukti_tf	Browse Structure Search Insert Empty Drop	2	InnoDB	utf8mb4_general_ci	16.0 KiB	-
foto	Browse Structure Search Insert Empty Drop	0	InnoDB	utf8mb4_general_ci	16.0 KiB	-
foto_user	Browse Structure Search Insert Empty Drop	0	InnoDB	utf8mb4_general_ci	16.0 KiB	-
info_beasiswa	Browse Structure Search Insert Empty Drop	1	InnoDB	utf8mb4_general_ci	16.0 KiB	-
info_dana	Browse Structure Search Insert Empty Drop	1	InnoDB	utf8mb4_general_ci	16.0 KiB	-
jadwal	Browse Structure Search Insert Empty Drop	1	InnoDB	utf8mb4_general_ci	16.0 KiB	-
jadwal_dana	Browse Structure Search Insert Empty Drop	1	InnoDB	utf8mb4_general_ci	16.0 KiB	-
pengajuan	Browse Structure Search Insert Empty Drop	3	InnoDB	utf8mb4_general_ci	16.0 KiB	-
pengajuan_dana	Browse Structure Search Insert Empty Drop	1	InnoDB	utf8mb4_general_ci	32.0 KiB	-
pengumuman_beasiswa	Browse Structure Search Insert Empty Drop	3	InnoDB	utf8mb4_general_ci	32.0 KiB	-
pengumuman_dana	Browse Structure Search Insert Empty Drop	1	InnoDB	utf8mb4_general_ci	32.0 KiB	-
pengumuman_nilai	Browse Structure Search Insert Empty Drop	0	InnoDB	latin1_swedish_ci	16.0 KiB	-
user	Browse Structure Search Insert Empty Drop	3	InnoDB	utf8mb4_general_ci	16.0 KiB	-
16 tables	Sum	22	InnoDB	utf8mb4_general_ci	336.0 KiB	0 B

Figure 7 MySQL's database view

Figure 8 Database administrator view

4.3.4 Result analysis

This study develops a scholarship information system design in the form of a prototype that may be used to solve difficulties at BMU linked to scholarships. Some process tasks become fewer, and data is kept in a single database due to the availability of an application prototype. Furthermore, because diverse access privileges exist, the stored data has adequate storage security. The system's functional needs state is "Fulfilled," which means that the system can fulfill all applicable criteria and is available on the created system. The processes that happened earlier in each area have been recognized, and the new system may encounter different methods, process reductions, and process transfers during the information system development process. The following are the process modifications that occur:

College student:

1. The sort of scholarship that will be applied for may be viewed and used by prospective scholarship winners.
2. Applicants for scholarships can upload a file containing the conditions that must be satisfied as part of the scholarship application process.

3. The timetable of award acceptance events can be viewed in real-time by prospective scholarship winners.
4. The amount of available scholarship quotas is visible to scholarship awardees.
5. Scholarship winners get full access to comprehensive admission results.
6. Scholarship recipients can make changes to their profiles.

Administrator:
1. The administrator can process the database of scholarship receipts.
2. The administrator can update the timetable of scholarship acceptance activities.
3. The administrator can update scholarship quota information.
4. The administrator can enter the scholarship admission written test results.
5. The administrator can enter the scholarship acceptance announcement.

At the system planning stage, the system request presents the results of identifying the existing system and the system that the user expects. Table 2 shows the state of the system request following the construction of the information system. It can be observed from the table that all of the system request's expected indicators have been satisfied. The RAD (Rapid Application Development) approach is used to develop systems in phases, and the prototype created in this research will not be used (discarded). The new system will be constructed by revamping the database (physical data design), developing biological processes, and creating a more user-friendly interface than the previous one (prototype). In addition, the design of the system architecture began to be specified. Furthermore, the architectural system design began to be explained in greater depth. The database and system interfaces will be rebuilt and implemented on the live system.

Compared to previous studies, apart from differences in the methods used, in this study, the design of the information system is equipped with an academic information system and scholarship recipients' activities. The information system is made from the registration phase, assessment, announcement of results, academic progress, activities, and involvement in the coaching program that is followed, which will be used as an assessment of scholarship applications in the following semester.

Table 2 System request after system development

Main Reason	***Current System***	***System Request***	***Status***
Better Performances	Prospective scholarship applicants' data is still handled manually, and duplicate information is standard when the data is processed.	Data about prospective scholarship participants, such as scholarship registration data, data collection requirements files, and scholarship recipient data, is easy to find.	Data about prospective scholarship participants, such as scholarship registration data, file collecting data requirements, and the number of scholarship beneficiaries, is easily searchable.
More Information	Scholarship registration information is still kept in an Excel file, registration criteria are gathered by email, and scholarship participant acceptance information is sent via WhatsApp group.	Registration information and scholarship requirements files are maintained on a single server and may be accessed and displayed at any time and from any location. The receipt data can then be shown in detail.	Registration data and scholarship requirements files are all stored on one server and may be accessed and shown at any time and from any location. The receipt data can then be displayed in detail.
Stronger Control	Anyone has access to data.	Only authorized parties have access to data (administrator and scholarship recipients)	Data can only be accessible by authorized people when it has been fulfilled (admin and scholarship recipients)
Improved Services	Finding out the number of scholarship awardees and the scholarship quota available requires a significant amount of effort.	Admins and other interested parties can have immediate access to information on the number of admissions and the availability of scholarship quotas.	When this requirement is met, information on the number of admissions and scholarship quotas can be immediately available to administrators and other interested parties.

5 Conclusions

This research highlights significant differences between current and ideal business processes at Baitul Mal Unisba (BMU), particularly in the context of scholarship management. There are differences in current business processes compared to logical and physical business processes constructed when constructing the scholarship information system at BMU. Some activities may be removed by creating an information system, making the scholarship business process more straightforward. According to a status analysis of system requirements, the demands of each user are addressed by the information system that has been constructed. The newly developed scholarship management information system streamlines these processes by eliminating redundant activities, thereby simplifying the overall workflow. This scholarship information system will fulfill user demands and make it simpler for candidates, scholarship recipients, administrators, and other stakeholders who want information about BMU scholarships. Existing data may be adequately recorded and presented faster, more accurately, and more precisely, allowing it to be used to make the best decisions possible.

Looking ahead, the study opens avenues for future research aimed at enhancing the efficiency and impact of scholarship distribution. The integration of advanced technologies like Artificial Intelligence (AI) and Data Analytics presents an exciting frontier. These technologies could be employed to refine recipient selection, optimize decision-making, and forecast scholarship distribution trends. Such advancements promise to improve resource allocation efficiency within educational institutions. Furthermore, the development of sophisticated, secure data management methods will be pivotal in adapting to technological progress. The findings from this study lay a foundation for frameworks that can be adopted by various educational institutions, potentially revolutionizing scholarship allocation strategies for broader societal benefit.

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