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INTERNAL RESEARCH BUDGET PROPOSAL FEATURES DEVELOPMENT ON RESEARCH AND COMMUNITY OUTREACH SERVICES WEB-BASED INFORMATION SYSTEM AT PRIVATE CAMPUS

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Abstract
Service processes using conventional methods have many limitations and have the potential to result in data accumulation and repetitive work. Transforming a service model that initially used Linktree into an Information System has become necessary for the Research and Community Service Institute (LPPM) of Multimedia Nusantara University (UMN). One of the features developed is the budget Proposal of Internal Research service feature. The Agile Development Method, a renowned software development methodology, is used to optimize the feature development of the RCOS Information System. The development process is carried out by benchmarking, user interviews, and prototyping, following the stages contained in the Agile Development Method. The leverage of the Laravel framework and Tailwind CSS play a pivotal role in developing a website-based RCOS information system. This research resulted in developing a service model for the LPPM Department, which can be used through features in the RCOS Information System. Test results with the User Acceptance Test (UAT) carried out by users show that the Internal Research Budget Proposal feature in the RCOS information system can function well according to needs.

1. INTRODUCTION

Technology is developing quickly and has become embedded with humans to the point that it has become a primary need because it makes work easier [1][2]. This phenomenon of technological development occurs throughout the world and has been widely used in various sectors or industries [3][4][5]. Many software developers innovate to create technology to optimize human work or routines in their daily lives [6][7]. Some examples of the use of technology that can help optimize human work or routines in a company include website-based technology [8], internet [9], mobile applications [10], virtual reality [11], Point of Sales [12], Monitoring Information Systems [13], Helpdesk Ticketing Systems [14], and others.

The site or website itself is an example of a form of technological development that has the function of adapting to the initial purpose of the website created. A website is one or more collections of pages containing text, images or other elements that are connected to a domain and can be accessed using the internet [15]. In the past decade, writing reports or correspondence was generally done conventionally. Still, now there are website services such as Google Docs, which can be accessed anywhere and at any time to create a document and be accessed simultaneously. Many things were previously done conventionally and took a lot of time, but are now faster and easier with the various websites that have been developed [16].

Previous research has shown that information systems can enhance business processes, but there's a research gap when it comes to private campuses without a dedicated Research and Community Outreach Department (RCOS). This study addresses this gap by exploring the potential benefits and challenges of implementing information systems in a context where their role has yet to be studied extensively. Based on the phenomenon of technological development, it is felt that the use of technology at the Institute for Research and Community Service (LPPM) at one of the private campuses, namely Multimedia Nusantara University (UMN), is still not running well, so it needs to be improved. There are limitations to the service process for submitting Budget Proposals of Internal Research and Reports, which still use Linktree services, and the document form provided needs to be downloaded by the user and filled in, then sent back via Linktree. Apart from using Linktree, the Budget Proposal of Internal Research and Report service process also utilizes Google Forms and Google Sheets facilities for collecting data and submitting correspondence. One of the submissions available on Linktree is submitting a research budget and a letter of independent research results. LPPM UMN and lecturers who carry out internal research feel that this is still not optimal because submitting a budget proposal for internal research is repetitive and unstructured. It isn't easy to know the status of the submission. To optimize the use of currently developed technology, an information system has been developed for submitting budget proposals for internal research based on a website called the Research and Community Outreach Services (RCOS) website. The RCOS Information System is used to simplify the submission process and services related to budget proposals for internal research.

2.0 THEORETICAL

2.1. Theory is related to the object of research.

The Research and Community Outreach Department at a private campus encompasses a multifaceted approach to fostering academic and community engagement. This theory revolves around the core principle that educational institutions, including private campuses, should serve as dynamic centers of knowledge creation, dissemination, and community betterment. At its foundation, this theory recognizes the pivotal role of research in expanding the frontiers of knowledge. It emphasizes the importance of conducting high-quality research not only to advance academic understanding but also to address real-world challenges. The Research and Community Outreach Department is the hub for these research initiatives, promoting a culture of inquiry, innovation, and academic rigor. Furthermore, the theory underscores the crucial connection between research and community outreach. It posits that the knowledge generated within the academic realm should have a meaningful impact on society. The department actively facilitates the dissemination of research findings and promotes collaboration with local and global communities to address social, economic, and environmental issues [17].

2.2. Theories system used.

The Laravel framework, a robust and widely acclaimed PHP web application framework, has significantly impacted modern web development. Known for its elegant syntax, efficient tools, and comprehensive features, Laravel simplifies the development process and enhances developers' productivity. It offers an array of built-in functions and libraries, making tasks such as authentication, routing, and caching straightforward. Laravel also excels in database management through its Object-Relational Mapping (ORM) system, Eloquent, which enables developers to interact with databases using PHP syntax. Moreover, Laravel's Blade templating engine facilitates the creation of dynamic and engaging user interfaces. The framework's focus on maintainability and scalability makes it an ideal choice for projects of all sizes, from

small applications to large-scale enterprise solutions. Laravel's active and supportive community continually contributes to its evolution, ensuring it remains a cutting-edge tool in the ever-evolving web development landscape [18].

Tailwind CSS is a popular utility-first CSS framework that has revolutionized how web developers approach front-end design. It offers a unique and highly efficient approach to styling web applications by providing a vast array of pre-defined utility classes that can be easily applied to HTML elements. This utility-first approach promotes rapid development and design consistency. Tailwind CSS is highly configurable, allowing developers to tailor the framework to their project's needs. It enables a "write less, do more" philosophy, where developers can quickly create responsive and visually appealing user interfaces by composing classes in their HTML markup.

One of the most significant advantages of Tailwind CSS is its developer-friendly nature, making it accessible to both seasoned professionals and newcomers to web development. It eliminates the need for writing custom CSS styles, and its intuitive class naming conventions make it easy to understand and maintain. Additionally, Tailwind CSS's modularity enables developers to keep their styles organized and scalable. Tailwind CSS has gained widespread popularity in the web development community due to its flexibility, speed, and ease of use. It empowers developers to create visually stunning and highly functional websites and applications with less effort and a shorter development cycle [19].

3.0 METHODOLOGY

The methodology section of this research delves into implementing the Agile development methodology in the context of the RCOS Information System. Agile is a dynamic and adaptive approach to software development that prioritizes flexibility, collaboration, and customer-centricity [20][21]. In this research, Agile principles were employed to guide the entire development process, ensuring that the system's evolution remained aligned with the evolving needs of its end-users. The Agile methodology's iterative and incremental nature was instrumental in achieving this objective [22]. It allowed for continuous collaboration between the development team and stakeholders, promoting open communication, transparency, and the opportunity for users to provide feedback and insights throughout the project's lifecycle [23]. The section also outlines the specific Agile practices, such as Scrum or Kanban, adopted to effectively manage tasks, ensure regular project assessment, and maintain a high degree of adaptability [24]. Furthermore, the methodology section discusses how Agile principles guided vital development stages, including project planning, design, coding, testing, and deployment. The methodology encouraged short development cycles, or sprints, during which small, functional portions of the system were developed, tested, and refined. This iterative process allowed for the rapid incorporation of user feedback, ultimately leading to an information system that closely met user requirements [25].

Figure 1. Key Agile Software development lifecycle phases

Agile software development is characterized by its iterative and flexible approach, focusing on delivering functional software in shorter cycles [26][27]. The Agile software development lifecycle consists of several key phases:

a) *Requirement Gathering and Analysis:*
In Agile, the requirement gathering, and analysis phase involves close collaboration between the product owner, stakeholders, and the development team. The emphasis is on creating a dynamic and evolving list of requirements, often called the product backlog. User stories are a common way to capture these requirements, focusing on the needs and priorities of end-users.

b) *Design:*
In Agile, Design, often aided by Unified Modeling Language (UML), occurs iteratively and concurrently with Development. Instead of creating extensive upfront design documentation, Agile teams focus on creating just enough Design, including UML diagrams, to support the current user stories [28]. This approach ensures that design decisions align with the most recent requirements and that changes can be accommodated easily. Design activities may include defining the system architecture, user interfaces, and data models.

c) *Development and Coding:*
The development phase in Agile is where the actual coding takes place. Agile teams work in short iterations or sprints, typically lasting two to four weeks. During each sprint, the team selects a subset of user stories from the product backlog and works to implement them. Continuous integration and frequent code reviews ensure that code quality remains high, and any issues are addressed promptly.

d) *Testing:*
This context, continuous testing is fundamental to the entire project. Each user story is subject to rigorous examination during its implementation, often employing automated testing techniques to uphold the standards of code quality. The primary objective of this meticulous testing is the early detection and resolution of issues, thereby ensuring the alignment of the software with the acceptance criteria defined in the user stories. In the scope of this research, the testing process specifically entailed the utilization of User Acceptance Tests (UAT) to evaluate the functionality of the RCOS Information System [29].

e) *Development:*
There may be some duplication in the phases mentioned. The "Development and Coding" phase typically covers the coding activities in Agile, which is carried out iteratively in alignment with the sprint cycles. However, if there's an additional "Development" phase mentioned separately, it would be beneficial to clarify its specific purpose or context.

4.0 RESULANTS

In the initial phase of this research, needs were collected and analyzed in collaboration with resource persons, namely several lecturers and staff of LPPM UMN. User stories are conducted by interviewing sources and processed into user needs. User needs are outlined in Table 1, requirements gathering analysis:

Table 1. Requirement Gathering and Analysis

No	Features	Function
1	Store data	Input submission data into the RCOS Information System.
2	Delete data	Deleting submission data from the database.
3	Table	Displays application data that has been successfully entered.
4	Update status	Displays the status of approval and disapproval of the application, as well as additional information to provide revisions or reasons for the letter being rejected.

The results of the Requirement Gathering Analysis contained in Table 1 it was then reduced to designing a low-fidelity prototype using Figma in order to provide an overview of the user interface appearance to the user. After the Table Requirement Analysis and low-fidelity prototype have been successfully designed, an Entity Relationship Diagram (ERD) is also created based on the ongoing business processes.

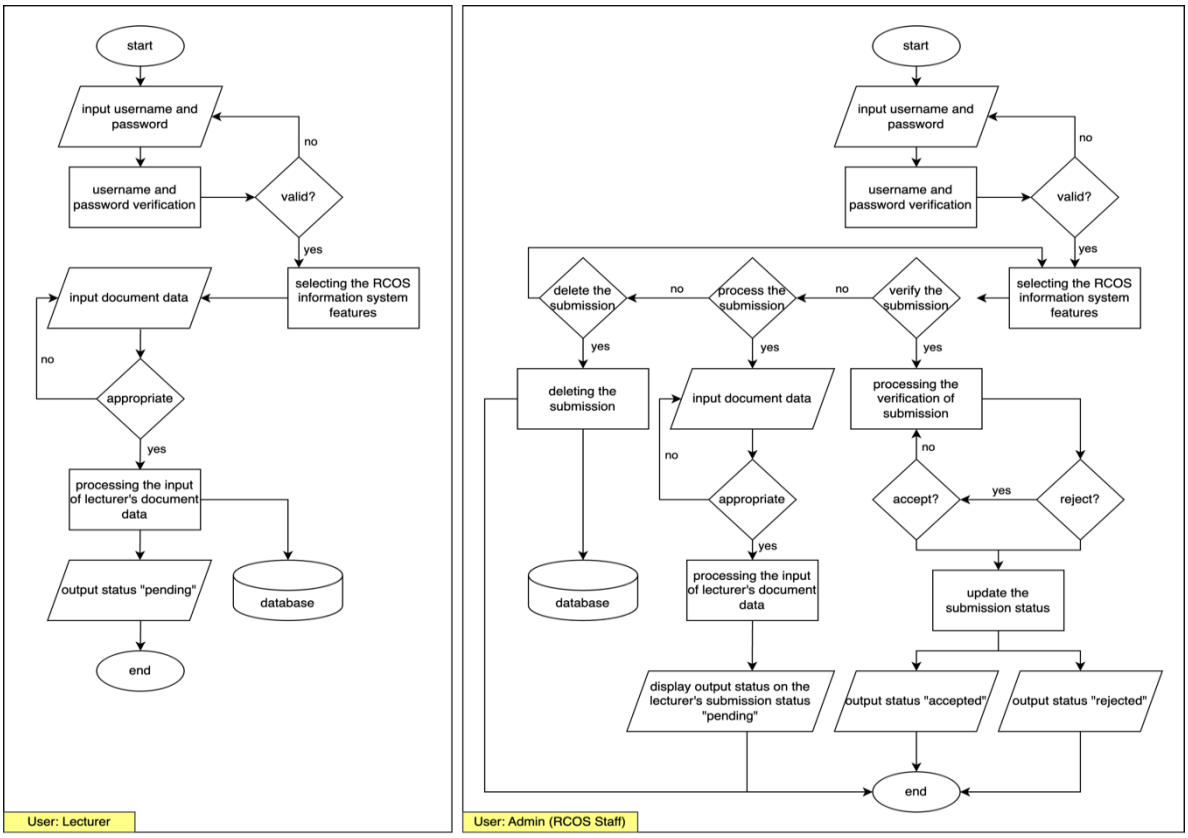

Figure 2. Lecturer flowchart (left) and RCOS Admin flowchart (right)

In the research budget submission process on the RCOS website, there are two types of users, namely, Staff of LPPM UMN (Admin) and Lecturers. In the first scenario, after the lecturer accesses the localhost RCOS Information System and successfully logs in, the lecturer can then select the budget proposal for the internal research submission feature. After the application form is filled in and successfully created, the form will be entered into the management systems database and produce a "pending" status output. After that, the lecturer can wait for the admin to process the application and the results.

Figure 2 displays the lecturer flowchart (on the left) and the Admin flowchart (on the right). On the admin side, three things can be done. First, after logging in and entering the budget submission feature, the admin can provide the lecturer with the submission status, namely whether the application has been accepted or not. Then, it will be displayed on the lecturer's page. Second, the admin can enter lecturer submission data, and this phase can be done so that when lecturers experience problems in submitting forms, the admin can help them. After the admin successfully fills in the application form, the data will be entered into the relevant database. Third, the admin can delete data from the database so that when successful, the data will no longer appear on the lecturer or admin pages.

Figure 3. Low Fidelity Prototype user Lecturer

Figure 4. Low Fidelity Prototype user Admin RCOS

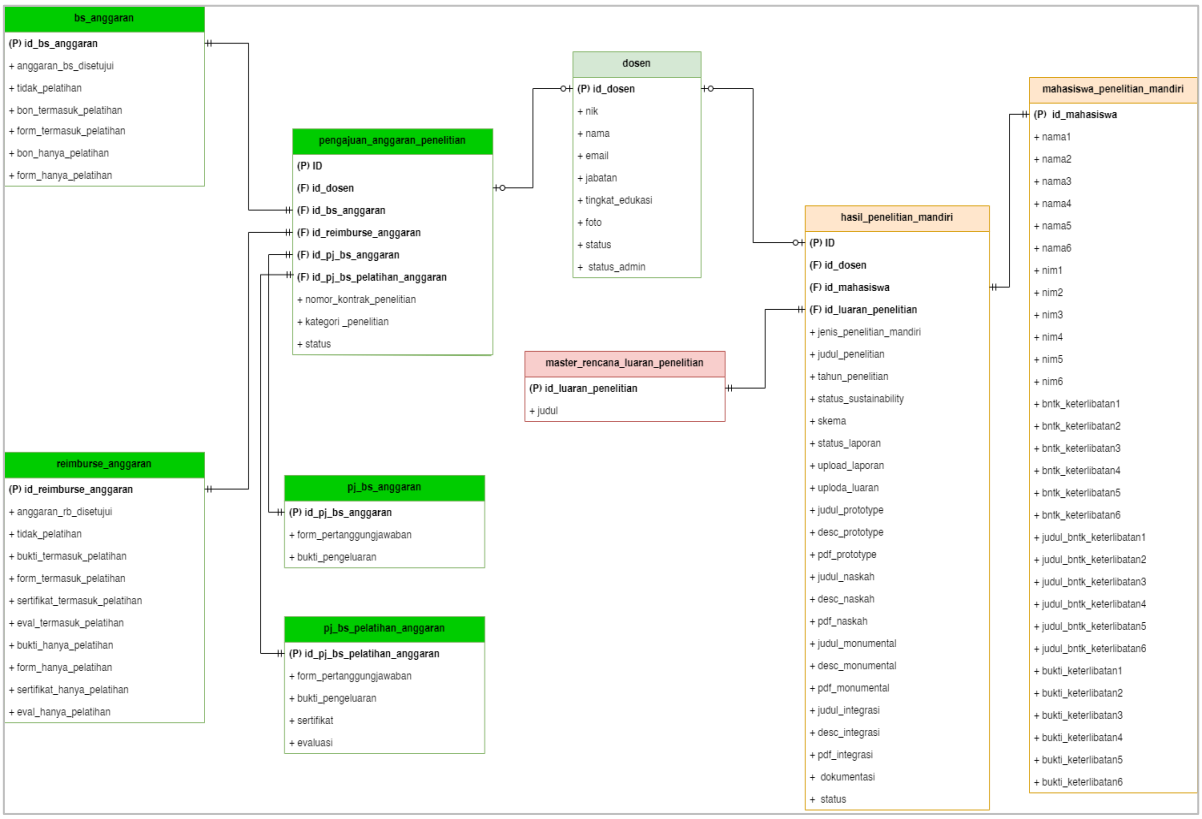

Figure 5. ERD RCOS Information System

In display design, a Low-Fidelity Prototype (LFP) was created using the Figma tools. Figures 3 and 4 show the low-fidelity prototype display, which is the initial design and guideline for displaying the features on the RCOS LPPM UMN website. A low-fidelity prototype is a system design that has limited interactions or functions. This prototype describes the concept layout and still needs to model user interactions in more detail. In both LFP views, this page is displayed when the lecturer selects one of the features on the left side of the navbar. On this page, you can see that there is a page description on the left, an "add" button on the right, which will display the submission form, as well as a table display accompanied by a search feature to look for data in related tables and other features.

After creating the LFP, the next step is designing a database as an Entity Relationship Diagram (ERD) to serve as a guide for creating the backend CRUD data section for each

feature. The ERD design created is then used to develop the RCOS Information System backend, especially the Content Management System: create, read, update, and delete (CRUD) sections on each page and feature created. In the budget submission database, there are several branches which are types of budget submissions. The kinds of budget proposed are Temporary Bonus (BS), Reimbursement, BS Accountability, and Training. These types have their database to make it easier for admins to view and record budget applications based on type. Database connection is done using foreign keys. A foreign key is a column that contains a unique table ID (primary key) taken from the related table.

Designing an independent research results database is more or less like submitting a budget, the difference being that there are foreign keys from the research output master data. This master data connection is carried out to retrieve research output data, which will later be displayed as an option on the independent research results form. Figure 5 is the ERD of RCOS Information System. In creating the database, models, and migrations were created using the Laravel framework.

```php
public function up(): void
{
    Schema::create('pengajuan_anggaran_penelitians', function (Blueprint $table) {
        $table->id();
        $table->unsignedBigInteger('id_dosen');
        $table->unsignedBigInteger('id_bs_anggaran');
        $table->unsignedBigInteger('id_reimburse_anggaran');
        $table->unsignedBigInteger('id_pj_bs_anggaran');
        $table->unsignedBigInteger('id_pj_bs_pel_anggaran');

        $table->foreign('id_dosen')->references('id')->on('dosens')->onDelete('cascade');
        $table->foreign('id_bs_anggaran')->references('id')->on('bs_anggarans')->onDelete('cascade');
        $table->foreign('id_reimburse_anggaran')->references('id')->on('reimburse_anggarans')->onDelete('cascade');
        $table->foreign('id_pj_bs_anggaran')->references('id')->on('pj_bs_anggarans')->onDelete('cascade');
        $table->foreign('id_pj_bs_pel_anggaran')->references('id')->on('pj_bs_pelatihan_anggarans')->onDelete('cascade');

        $table->string('nomor_kontrak_penelitian');
        $table->string('kategori_penelitian');
        $table->string('status');
        $table->string('keterangan')->nullable()->default("");
        $table->timestamps();
    });
}
```

Figure 6. Code of migration from the budget submission database

The model is one part of MVC that communicates with the database. Once the model is connected to the database, it will be used and called in the controller. Migration is one of the Laravel framework features with a version control function for databases. Database management in the RCOS Information System is managed using phpMyAdmin. In Figure 6, there is a code of migration from the budget submission database. The data in the lecturer table is the result of input submissions that have been successfully made. Submission data is created in tabular form to make it easier for admin users to check or for lecturer users to monitor the status of the submission process. The lecturer table has the same submission flow described in the previous lecturer flowchart. The different parts are the logic in the controller section and the data you want to submit. The controller itself functions as a link between user requests and the model, which will later be returned to the view in the form of a response.

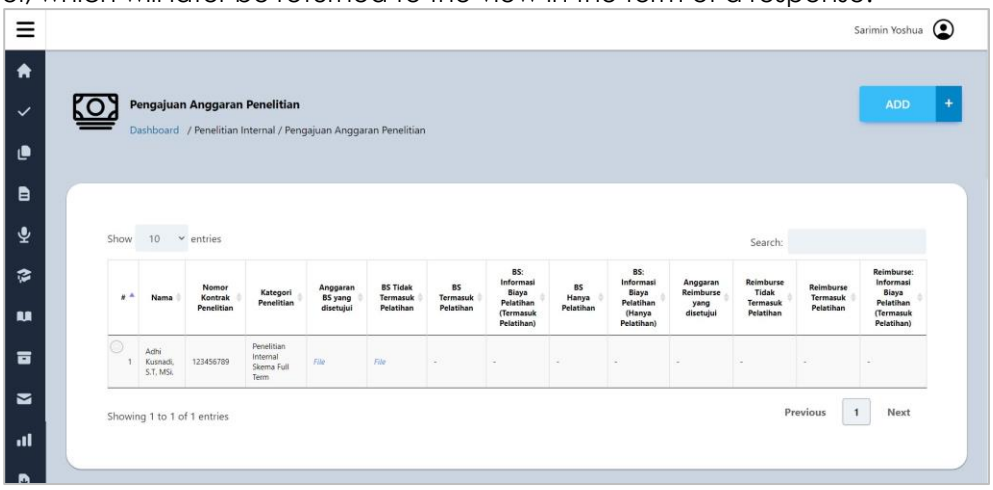

Figure 7. Lecturer user information of a research budget proposal

The lecturer user budget submission table displays the results of form submission data submitted by lecturer users where some data must appear or is required in the controller section, such as name, research contract number, and research category. The rest depends on the type of budget submission chosen and what files are uploaded by the lecturer user. If the lecturer user does not enter files in other budget types, the display will be "-" which means blank. Meanwhile, if the lecturer user enters a file, a blue "file" will be displayed, which, when pressed, will show the document that the lecturer user has entered. The display was created so that lecturer users could see and check whether the documents entered were appropriate.

Figure 7 is an example of a lecturer user information of a research budget proposal. In the table, the columns displayed are the types of budget, namely "BS," which means temporary bonus, reimbursement budget, temporary bonus accountability, and training. At the left end of the number, there is a circle which, when pressed by the lecturer user, will reveal other parts of the table that still need to be displayed. After the submission is processed, further information will appear, as in Figure 8.

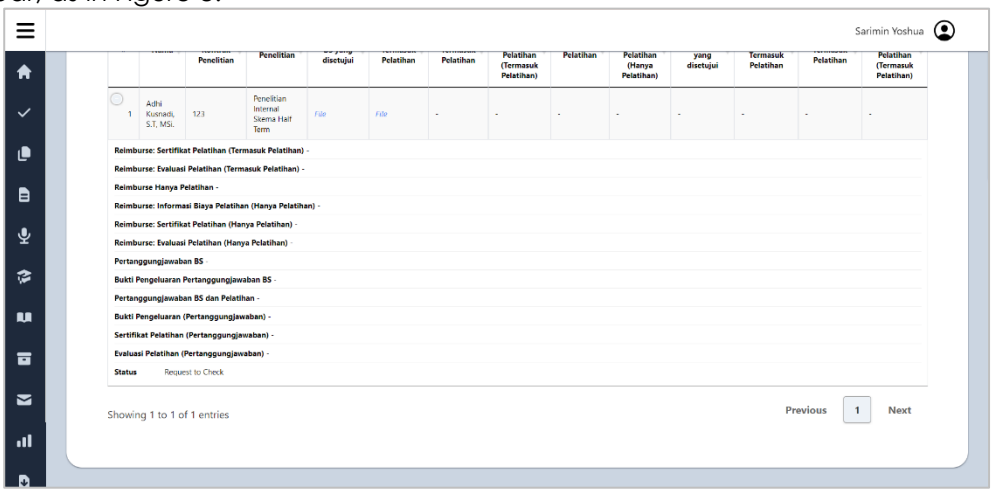

Figure 8. Lecturer user submission status

The code in the controller used to declare the budget submission database into variables can be seen in the figure below. The independent research results table is more or less the same as the budget submission table, and the difference is in the data displayed. Required data is name, research title, type of research, sustainability status, scheme, and report status. The rest, such as student statements, monumental works, documentation, manuscripts, and others, are input that adapts and depends on the lecturer's needs. Figure 9 shows a table of lecturers resulting from independent research.

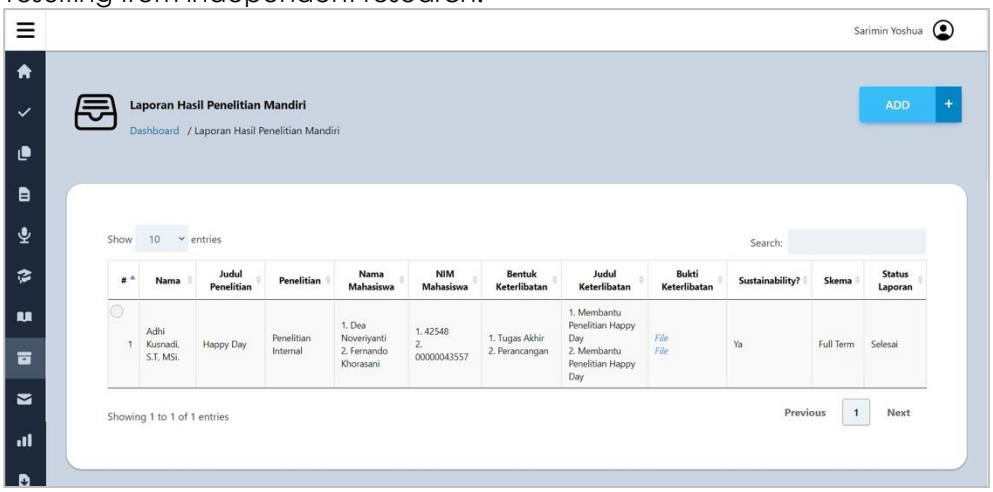

Figure 9. Submission of Internal Research report.

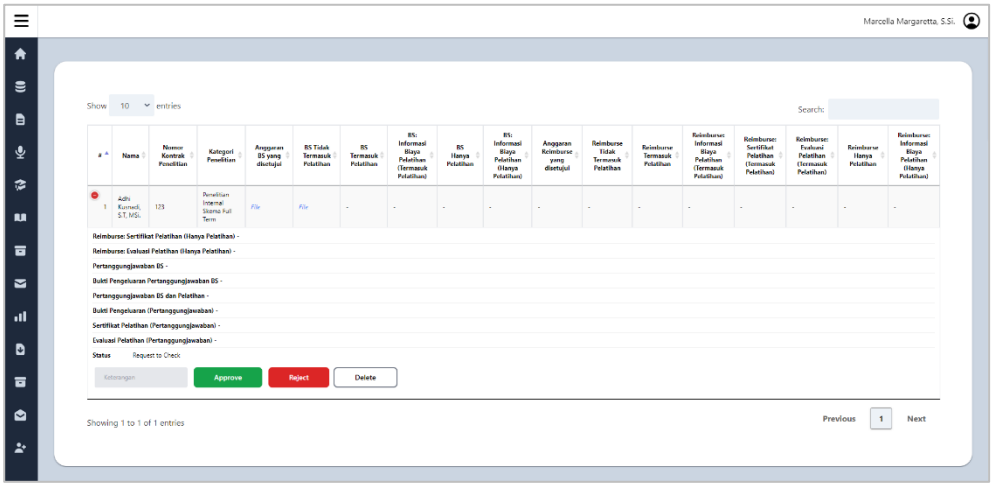

Figure 10. Admin user research budget submission

Figure 10 shows the user admin user view of the research budget submission.The overall appearance of the admin user is the same as the lecturer user, but the difference is in the additional columns "approve," "reject," description, and "delete." When pressed, the "approve" or "reject" button will change the status in the table to "approve" or "reject," which also depends on the button pressed by the admin user. Before updating the status, the admin user can input information. This information functions when the admin user has notes or revisions related to letters or data from lecturer user submissions. Finally, the "delete" button deletes data from the submission table, whether submissions from lecturers or the admin user itself.

The final stage in implementing the Agile Software Development method in this research is to test the system functionality using the User Acceptance Test (UAT) method. Seven users of the RCOS Information System, consisting of 3 lecturer users and four admin users, were involved in testing this functionality to measure the system's suitability that had been successfully created with the requirements formulated at the initial stage (Requirement Gathering Analysis). The following is a summary of the UAT test results from 7 users, which are shown in Table 2:

Table 2. UAT results

No	Features	Test results						
		User 1	User 2	User 3	User 4	User 5	User 6	User 7
1	Store data	ok	ok	ok	ok	ok	ok	ok
2	Delete data	ok	ok	ok	ok	ok	ok	ok
3	Table	ok	ok	ok	ok	ok	ok	ok
4	Update status	ok	ok	ok	ok	ok	ok	ok

The research on "Internal Research Budget Proposal Features Development on Research and Community Outreach Services Web-Based Information System at Private Campus" offers a fresh perspective on web-based information system development. One notable aspect of novelty is the successful use of agile software development methodology, proving its effectiveness even when faced with constraints like limited time, resources, and budget. This demonstrates the adaptability of modern development practices, particularly in educational settings.

Additionally, the study breaks new ground by addressing the specific needs of a private campus lacking a dedicated Research and Community Outreach Department (RCOS). While prior research has focused on information systems in typical business settings, this research explores uncharted territory. The positive User Acceptance Test (UAT) results confirm that the RCOS Information system is both functional and well-received, further underscoring the uniqueness of this study. By emphasizing the potential of information systems to enhance research and community outreach services in an educational context, this research opens up new possibilities for similar environments.

5.0 CONCLUSION

In conclusion, the agile software development methodology is successful in the development and implementation of a web-based information system. This choice of

methodology was driven by constraints such as limited time, personnel resources, and budget. The research results demonstrate that the agile approach was suitable and highly effective in delivering a functional and user-ready system. The User Acceptance Test (UAT) confirmed that the system's features were ready for use, validating its suitability for research and community outreach services at the private campus. This research underscores the importance of agile development methodologies in addressing resource limitations and highlights the successful fusion of technology and community-focused services in the academic setting.

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