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# Exploration of Software as a Service (SaaS) as a Project Management Tools

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## Abstract

Companies increasingly adopt software as a Service (SaaS) as a project management tool. SaaS offers greater flexibility, availability, and accessibility than traditional information system software. In this study, SaaS is used as the basis for creating project management applications, including recording work plans, the progress of each user's performance, and meeting documentation. The stages of the literature study are carried out by looking at journals and books. The trial was carried out using black-box testing. Verification trials are carried out by involving a team of programmers to see the flow of the system algorithm. Validation trials are carried out by asking various users involved in project implementation to try the system and asking users to fill out questionnaires related to the ease of use of project management features. The two stages of the trial showed good results, as evidenced by 77.8% of users stating that the SaaS concept really helped them with the flexibility of system installation with a short waiting time. Meanwhile, 76.16% of users stated that the features provided and their configuration could help them in project management. The research results show that SaaS has great potential to help companies to manage projects effectively. In future research, various factors in different project management can be explored deeper, so that SaaS becomes more configurable and used by a wider variety of users.

**Keywords:** SaaS, Project Management, Information Technology, Multi-Tenancy, Project Management Tools.

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## I. INTRODUCTION

Organizations face a digital revolution that presents opportunities and threats [1]. One way to defend yourself in business competition is to digitize the system [2], [3]. These technical solutions can be developed in-house or purchased from companies specializing in the required area. Along with technological developments, another solution that can be done is to adopt software as a Service (SaaS) [4]. SaaS provides software stored on remote servers and accessed via the Internet for small and large enterprises [5], [6]. This offers greater flexibility, accessibility, and financing than traditional project management software [7].

Project management is essential in business development, especially for coordinating resources, time, and costs to achieve the desired project objectives [8]. Issues in project management have ongoing challenges [9]. Various tools have been developed to overcome project management problems, such as work delays, over-financing, documentation, and other monitoring processes [10]. Financing and mastery of technology in developing these tools is one of the problems faced by various companies [11], tiny companies with limited budgets [12].

Several other studies have also been developed related to project management in various aspects of the industry. In 2017, there were at least six studies related to project management. Jesse et. al. is one of the researchers from 2017 and found that project management must be equipped with proper control, both from the internal project team and externally [13]. The external party referred to in Jesse et.al's research. al., related to policies and regulations issued by the government. This internal and external control is to ensure the project can run well. Melanie et. al. in the same year also conducted research on the adoption of project management in the health sector [14]. This study intends to find out the responses, risks, and even rejection that may occur when project management is implemented in the health sector. The results obtained were unexpected, because it turned out that all parties in the health sector that were studied received well the project management that was implemented, because they felt it could really help work in the health sector. Furthermore, research conducted by Mauro et. al. perfecting what Jesse has done, with the addition that project management can be successful if it pays attention to four factors, namely innovation from business models, stakeholder management, economic competitive advantage, as well as government

policies and regulations [15]. Karen and Kathleen in the same year also conducted research on project management, which resulted in findings that project management must always be adaptive or adapt to needs [16]. Therefore, strategic planning is needed to increase the success and sustainability of a project management. Other research implements the Program Evaluation and Review Technique (PERT) combined with an intelligent system to be able to estimate the time and cost of a project more precisely [17]. This is necessary because often the realization of the project can be very different from what was planned due to activities that did not go well unexpectedly. Literature reviews have also been made related to research in the field of project management, and in 2017 a literature review showed that what influences the success of project management apart from internal and external factors, there are also technical factors such as the software used to assist project management activities [18]. In this literature review, it was found that there are still many who use only Microsoft Excel software.

Furthermore, in 2018 there were also several studies related to project management, including the implementation of project management in the security sector. In this field, the data collected will be very large, so you cannot use a simple system, but instead you must use an integrated system so that the data can be recorded properly [19]. Kavishe and Chileshe also conducted research related to an integrated project management system between the public and private sectors for residential development projects [20]. In this study emphasizes that integration is needed to expedite the project, as well as to further accelerate project work. In 2018 there was also research in the form of a literature review, in which the review found that research related to project management had experienced a shift from previously only a lot conceptually to be more applicable [21]. In addition, the factors studied related to their influence on project management are also increasingly widespread, including human factors and the organization that runs the project. The results of this review indicate that there are still many research results in the field of project management that have not been seen in real terms.

In 2019 an article in the *Journal of Business and Marketing* researched that the factors that increase success in the advertising industry are not only creativity in making these ads, but also the need for good project management [22]. This statement is supported by research results which show that creativity without project management will make the realization of each project chaotic and not well controlled, which in turn can reduce customer satisfaction. Literature review was also found in articles in 2019, in which research was carried out which was almost the same as in previous years, namely identifying factors that affect the sustainability of project management. The difference is that this review of the literature found that there are other factors that can affect project management, namely social factors [23]. So, it is not only necessary to pay attention to those directly related to business, but also to pay attention to the social factors that are around.

Project management is also examined not only for general project work, but can also be used to implement risk

management in a project. Using project management in the risk management process, makes data and information clearer, making it easier to make decisions [24]. In 2020 there will be research that will again implement project management in the health sector. However, in this study, it was tested in more detail, specifically on Activity Based Costing (ABC) Systems. The results of this study found that project management, which directly regulates finances, is easier for users to accept [25]. Besides that, it was also found that actually users prefer if the implemented system is simple, and fast in implementation.

In 2021 there will be a literature review that is more specific about Agile Project Management (APM), where it turns out that the results of this study found that the actual factors that influence the implementation of APM are very similar to the factors that affect the implementation of project management in general. One thing that is different is in the implementation of APM, cultural factors are very important, because when a project management is implemented quickly, it requires a fast work culture from the personnel who will be involved in the project management [26].

Many studies related to project management have begun to discuss the factors that are important for the successful implementation of project management, to the implementation of agile project management. Apart from that, there have also been many studies looking at the implementation of project management in various fields that may not be common in project management so far, such as the advertising industry. However, there is still little to discuss from a technical point of view, especially the software used in the project management. Even though software is also important in the successful implementation of project management in various industries [18]. The existing project management software cannot be used flexibly and not all features can be used freely. Users must follow the business processes provided by existing software.

The lifestyle shift occurred after the Covid-19 storm. People are starting to depend on digital applications to support their lives, one of which is recording activity agendas using e-calendars [27], [28]. Based on searches made on Google, both in general and on Google Scholar, Google Calendar is the most widely used e-calendar application. This happens because the number of Android users is high, and this application already exists in every Android mobile phone.

Another convenience offered in digital life is the speech to text technology. Speech to text technology has been used in various studies, such as helping disabled people to play games [29], recognize hate speech [30], and record meeting minutes [31]. Some of the obstacles encountered in recording meeting minutes is the speed of recording from the note taker which can cause information to be missed.

This study uses the SaaS concept to build small and medium scale project management, which is complemented by integration of activity reminders into google calendar and automatic recording of meeting minutes. The system is built with SaaS technology, so that the features can be configured according to the needs of the organization [32]. This paper is divided into several sections, covering literature studies to

capture the factors used as a reference in project management and SaaS, analysis to determine the features needed by small and medium-scale organizations, and system implementation according to system requirements. The development of a Software as a Service-based project management system is expected to facilitate progress management in project work, including work plans, monitoring the implementation of user performance, as well as project documentation, such as meeting preparations, managing the course of meetings, and tracking assignments from meeting results.

## II. LITERATURE REVIEW

The literature review describes the critical aspects of using SaaS in project management. Several studies address the factors influencing SaaS adoption in project management, including project characteristics, software features and capabilities, and the influence of organizational factors on SaaS usage. Other studies discuss the advantages and challenges of using SaaS in project management, business performance, and customer satisfaction. Therefore, a survey of the literature on this topic can provide a better understanding of how best to adopt SaaS in project management and its impact on organizations and businesses.

### A. Project Management

Project Management is managing a project to achieve objectives, namely achieving the desired results within a predetermined time and budget and meeting the expected quality standards [33]. The ultimate goal of project management is to achieve project success, measured based on factors such as stakeholder satisfaction, such as consumers and project owners, and elements of the iron triangle (cost, time, and quality) [34].

Project management involves various elements such as planning, executing, and controlling [35]. In the planning process, the project is analyzed, objectives and scope are determined, resources are projected, schedules are created, risks are identified, and a quality control plan is developed. Project execution involves team organizing, task execution, performance monitoring, and risk management. While under supervision, projects are monitored to ensure that schedule, cost, and quality are kept under control and according to plan.

To achieve project success, a project manager must have skills and knowledge in leadership, time management, cost management, risk management, quality management, and human resource management [34]. Project managers must communicate clearly, build strong client relationships, lead teams effectively, and make informed decisions in complex situations.

Project management can also be applied in various sectors and fields, such as Information Technology (IT), construction, manufacturing, research and development, and government. The importance of project management is recognized in various industries and organizations, and training and certifications in this field are available worldwide.

Project management is a complex and critical process in achieving project objectives. Strong project management skills and a deep understanding of processes and methodologies can help ensure project success.

### B. SaaS

SaaS or Software as a Service is a business model in the use of software or applications via the internet using infrastructure managed by service providers [36], like Google docs or Microsoft Office 365. In this model, software or applications are stored in the cloud and can be accessed via the internet by users who have registered and paid a subscription fee according to their organizational needs [33], besides that by using SaaS, service providers can update the system more easily [4]. SaaS architecture model can be seen in Figure 1 [37].

This SaaS business model provides various advantages, such as easy access, scalability, and lower costs [38] and can generally be used by small and medium scale organizations [39]. Users can access applications or software from various devices, including computers, laptops, tablets and smartphones, which makes it easier for them to work from anywhere and anytime. The infrastructure and servers used in the provision of SaaS services are managed by the service provider, so users don't have to worry about infrastructure costs and management.

While SaaS offers many benefits, there are some drawbacks to consider. One of them is concern about data security and privacy, because user data is stored in the cloud and accessed via the internet. Users also do not have complete control over the application or software because they do not physically own it, and they are dependent on the service provider to manage and update the software. In addition, systems developed with the SaaS concept generally have a complicated structure, because they must provide various features needed in certain business fields [4].

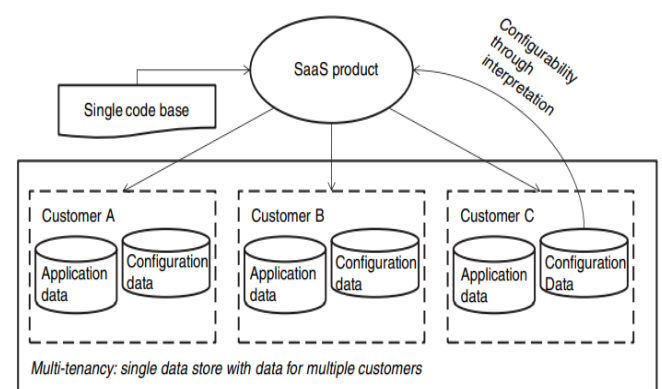


Figure 1. SaaS Architecture Model [37]

There are two approaches in SaaS, namely single schema and multi schema. In this study, a multi-schema approach was used. Multi-schema implements separate database schemas that will be managed by each user so that each schema can implement specific customizations for each user [37]. Figure 2 shows an illustration of implementing SaaS using multi-

schema. In the figure, each customer has a different database based on a custom field in the meta-data table. The metadata table stores custom fields, but does not store values because values exist in each table. This makes the design more straightforward and more accessible to modify than implementing a single schema.

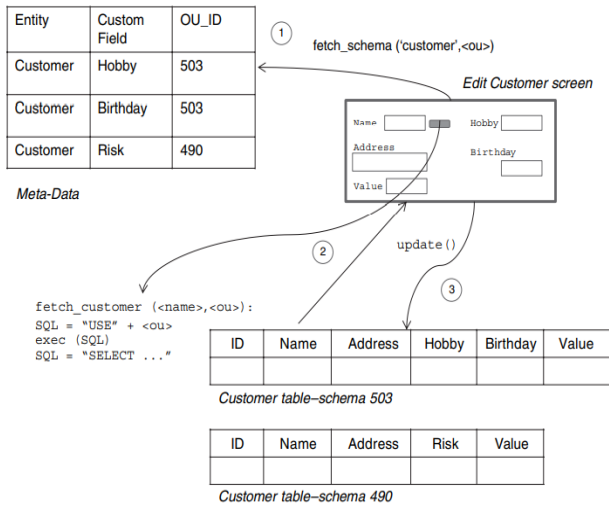


Figure 2. Illustration of Implementing SaaS Using Multi-Schema [37]

III. RESEARCH METHODOLOGY

This research was developed using Design Science Research Method [40] as shown in Figure 3. The research begins by analyzing current conditions related to needs in small-medium scale project management environment, while seeking supporting knowledge. The current condition was analyzed by surveying 45 respondents who had been involved in the project, and most of the respondents were involved in the information system development project.

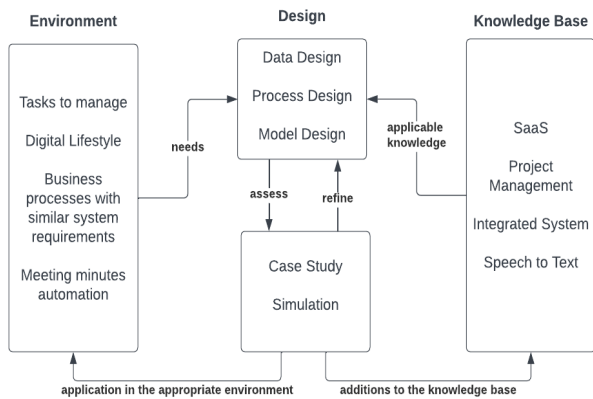


Figure 3. Design Science Research Methodology Process Model

System design is carried out in three stages: data design [41], process design [42], and user interface design. The data design in this system is divided into two database designs, namely the central database and the tenant database to accommodate the needs of a SaaS-based database structure, with illustrations as shown in Figure 4. This database implementation is done using the database migration concept.

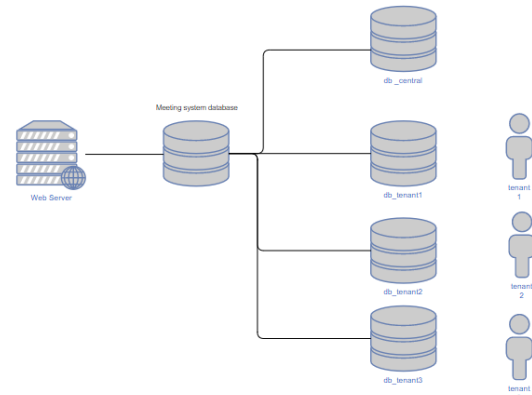


Figure 4. Illustration of Multi-Tenant With Multi-Schema Model

While system implementation is carried out using the Laravel 8.0 framework. System validation was carried out using a black box testing system [43], after the research team confirmed that the system was error free. A project management scenario is prepared, accompanied by a meeting agenda. Users are asked to run the application according to the project management scenario that has been prepared, including holding a meeting containing several people, to test the success rate of recording minutes and making a summary of minutes. The duration of the testing is a week. After that, users are asked to fill out a questionnaire to measure the level of user acceptance of the feature groups in the system created, which are divided into perceived ease of use and perceived usability.

The implementation is carried out by building two database structures, namely the central database and the tenant database. Database Central is applied to the main system which aims to store user data, tenant data, super admin data, and registered domains, as shown in Figure 5. Tenants can register the desired subdomain name after being verified by the super admin. First, the tenant needs to input the desired subdomain name on the tenant settings page. When a tenant sends a subdomain name, several flows are executed, namely, checking whether the subdomain already exists, creating a tenancy database based on the dummy name and id format from the tenants table using Laravel migration, seeding data, and domain registration to Cloudflare. Creating a domain for the application is done using the createDomain function. The function can be seen in Algorithm 1.

The createDomain function receives the subdomain data desired by the user, along with the central domain. For example, a user wants to have a subdomain name "tenant1", so the delivery result is "tenant1.jastiohanna.my.id" because the application's central domain is "informatikaubaya.my.id".

Each domain in the application must be unique, so it is validated at the beginning of the code to ensure that the domain is unique. After passing validation, a domain is created in the application with the "domain()->create()" function. After the domain is successfully stored in the main database, the system will automatically call the jobs contained in multitenancy-for-laravel.

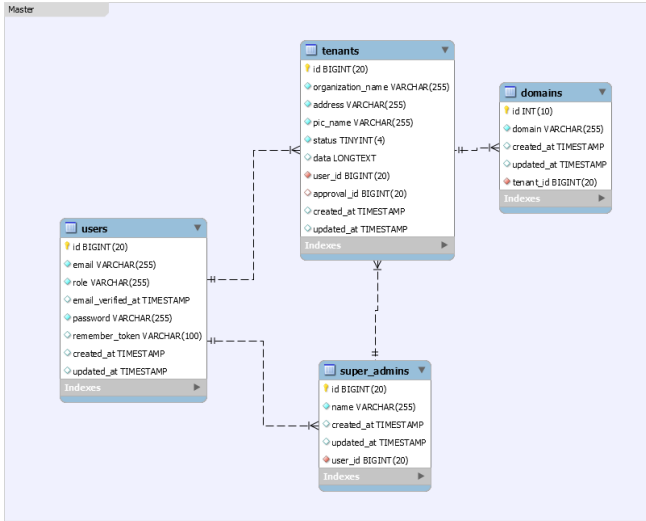


Figure 5. Central Database

**Algorithm 1. Create Domain**

```
public function createDomain(Tenant $tenant,
Request $request){
    $request-> validate
        (["domain"=>['required','unique:domains',
        'regex: /^[0-9A-Za-z.]+$/']);
    list($subdomain) = explode(".",
    $request["domain"]);
    if (empty($tenant->domains[0]))
        $domain=$tenant->domains()->create(['domain'
        => $request["domain"],]);
}
```

Figure 6 explains the workflow of SaaS implementation in this research. In the previous section, it was also explained that the process will begin with registration of tenants who will join this SaaS system, then the admin will validate the tenant data. Once valid, the system will generate the database schema for the tenant, which is based on the existing master database. After the schema is created, the migration process will be carried out, and ends with filling in user tenant data sourced from the central database. The final process is subdomain registration for the tenant. In this flow, everything is done through Laravel. There are 3 jobs that will be performed by Laravel. First, Laravel will migrate database creation, database migration, and finally database seeding. The seeding database will add user data that registers on the central system to become an admin on the tenant database. The process continues with subdomain registration on Cloudflare. Registration with Cloudflare is done by making a Cloudflare API call on Create Domain Name System (DNS)

Record. Subdomain registration on Cloudflare is done in the createDomain function after the create data domain. The system will send a POST request to a special endpoint on Cloudflare using the authentication obtained on the Cloudflare account. The type to be sent is CNAME, where the name is the subdomain, and the content is the main domain. After the system finishes registering subdomains on Cloudflare, the tenant registration process is successfully completed. Tenants can access their domains in approximately 5 minutes, to wait for a new DNS record update.

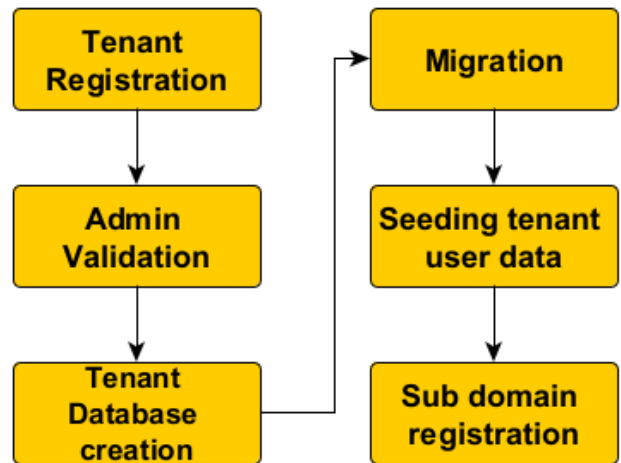


Figure 6. SaaS Implementation Workflow

Tenant database is a database design that is used and owned by each tenant registered in the central system. In this data tenant design, there are five main parts, namely user, project, event, assignment, and attachment. The user section is the user data registered on the system. The project section is a collection of data about projects carried out by tenants. The event section is a data collection of activity schedules held by tenants. The attachment section is a collection of data files. The assignment section is a collection of data about tasks within the scope of projects and events. The relationships that occur between entities can be seen in Figure 7. Explanation of entity projects can be seen in Table 1.

In the central system, the super admin can verify the registered tenant data. For tenants who have been verified, they can use the tenant system by configuring features. For project admins/owners on the tenant system it has a main menu for project creation. An example of a project structure can be seen in Figure 8, including the main project data input, sub-projects: detailed information, person in charge, and schedule, and assignment: detailed information, person in charge, and schedule (Figure 9). Each person in charge can input field implementers for each sub-project/assignment. For each assignment, the project owner can monitor which assignments have been completed and which are in the process of completion. This is also used as a basis for measuring the progress of project completion based on the specified time limit and completion time.



The person in charge can create an event such as a coordination meeting, by inputting event information, time information and a list of invitees, as shown in Figure 10. In preparing for a coordination meeting, the person in charge can input the documents to be used. And in the implementation of coordination meetings, discussions during the meeting can be documented using the text-to-speech feature, and assignments from the results of the meeting can be given to certain personnel. The system will provide notification to designated personnel, and these personnel are required to report their work results.

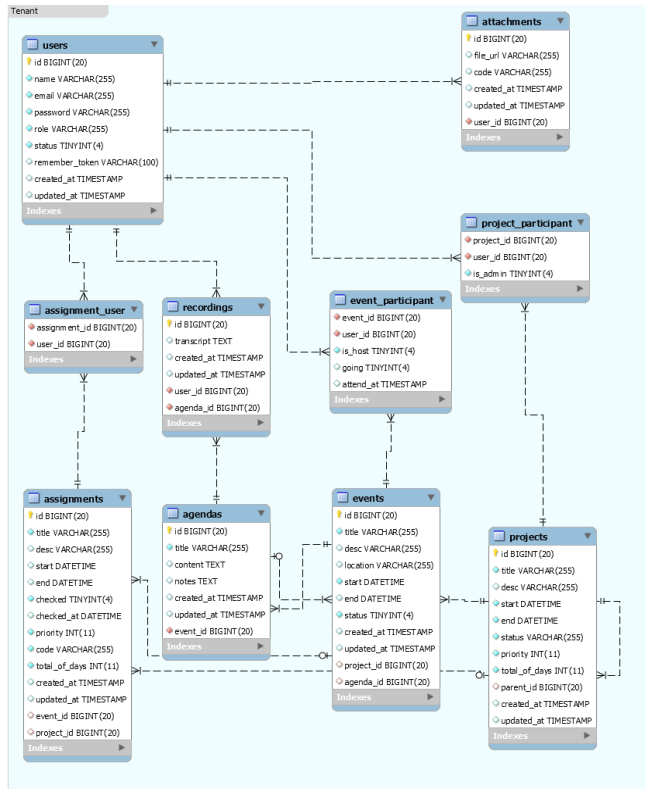


Figure 7. Tenant Database

Table 1. Explanation of Entity 'Projects'

Attribute Name	Data Type	Description
id	int	id is the primary key column of the projects entity that has auto-increment.
title	varchar (255)	title is the title of the project. This data is mandatory.
desc	text	desc is a description of the project.
start	datetime	start is the start date of the project implementation. This data is mandatory.
end	datetime	end is the date the project ends. This data is mandatory.
status	varchar (10)	status is the status of the project. This data is mandatory.
priority	tinyINT	priority shows the priority of the project compared to other projects. 1: Low priority 2: Medium priority 3: High priority
total_of_days	int	total_of_days is the calculation of the total number of days the project was implemented.

parent_id	big int	parent_id is the foreign key column of the projects table. This data can be made NULL. If parent_id has a non-NULL value, then this project is a sub project of projects that have id parent_id.
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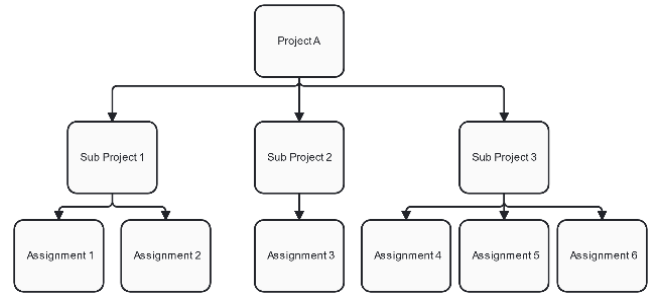


Figure 8. Example of Project Structure

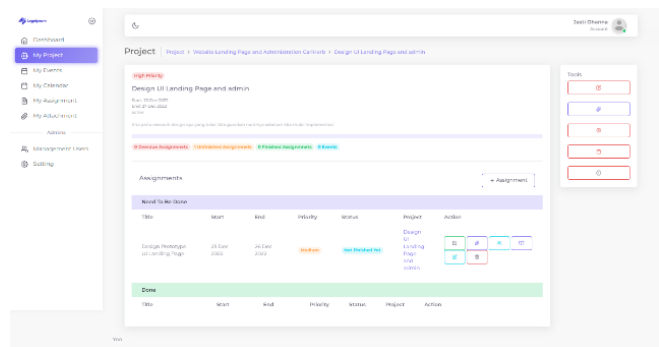


Figure 9. Assignment Page in a Project

Testing is carried out using the concept of black-box testing, where the person doing the validation is the prospective user of this project management software. Each test carried out is focused on seeing the suitability of the functionality of the system being developed, especially in the input and output sections. The input in question starts from the initial configuration of the tenant database, to the use of the project management software that will be formed for the tenant. While the intended output is the result of the tenant application system that is formed until the output of each project activity is input into the system.

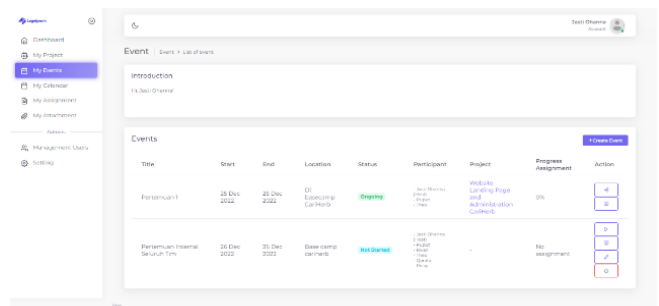


Figure 10. Event Menu From Person in Charge Point of View

#### IV. RESULT AND DISCUSSION

The analysis was carried out through a survey of 45 respondents. Respondents involved in this trial had at least been involved in a software development project. The difficulties most frequently mentioned by respondents were difficulties in monitoring project progress and the number of meetings being held, which made monitoring project progress even more complicated. The survey also found that meeting management that supports the implementation of a project has critical obstacles, such as reminders of meeting implementation that are spread across various platforms, assignment of agreements in meetings that have not been monitored, and meeting minutes which depend on the understanding of the minutes and have the risk of not being well documented. In addition, in the identification of the project management process flow described by the respondents, a significant level of business process similarity was found. Therefore, in this study, a system was developed that can be used to manage meetings, both related to certain projects and independent meetings, which are equipped with integration with e-calendar and speech to text features for compiling meeting minutes. The level of similarity of business processes in the several project managements studied is the basis for selecting the SaaS concept, so that the system can address various types of system requirements.

At this stage validation is carried out to ensure that the system created meets the objectives of making the system. This validation process was carried out by involving 2 groups of respondents. Group A consists of 3 people and group B consists of 6 people. Group A organizes a course application project. Group B is an IT startup organization called CariHerb. The discussion conducted by the two groups is oriented in the field of information technology.

The validation stage is carried out by asking the user to create a project scenario and the required coordination meeting. The trial duration was one week. After the trial period is over, the users involved are asked to fill out a questionnaire related to their experience in using the system using likert scale [44]. System validation results show that 77.8% of users stated that the SaaS concept really helped them in the flexibility of system installation with a short waiting time. Meanwhile, 76.16% of users stated that the features provided and their configuration could help them in project management, especially in terms of saving time and cost of making the system. Some users state that the weakness of the system is that the features provided are not complex enough to address the specific needs of the project management they are doing. Referring to the validation results of these potential users, it can be seen that users felt that before trying to use the SaaS application, there were problems related to flexibility, speed and also the costs that had to be incurred when implementing a new system. However, after having a SaaS-based application, implementing the new system becomes faster, easier and more cost efficient.

The Software as a Service (SaaS) based project management system that has been created can be implemented and used flexibly according to company needs. In addition,

the project management features offered have also assisted companies in managing existing projects within the company. However, it should also be noted that the level of flexibility provided is different from custom software, where in this software model, development from the start is specifically tailored to the user's needs. In the SaaS model, flexibility is more about providing the main features that many project management system users commonly need. Of course, the SaaS system still cannot be the solution if there are exceptional and unique needs.

Conceptually, a system built using a SaaS basis should also be a configurable system or a system that can be adapted to user needs. Of course, there are still limitations to how this configuration can be carried out. In this study, validation is limited to several companies because validating the project management system requires a long time. Besides improving the validation accuracy, this system should be tested on an actual project from scratch. Meanwhile, finding a real company that has just started a project is not easy. In addition, this research also cannot be benchmarked with other studies that have the same direction as this research, because in other studies there has not been anything that leads to optimization of the project management system software used. As explained in the introduction section, that other studies focus more on the factors that influence the implementation of the project management system.

In future research, it is necessary to allocate a longer time to conducting the test, and it is essential to try it on an actual project. The scheme being tested is to carry out two processes simultaneously, one process using the project management system that exists in the current company, while the following process is also managing the same project at the same company but using a Software as a Service-based project management system. It is also necessary to prove whether the user's level of trust in SaaS can still be maintained when the server is not internal. Conversely, when using an internal server, it is also necessary to consider whether the SaaS concept's cost efficiency can still be obtained optimally.

#### V. CONCLUSION

Project success is determined by various factors, such as user participation, stakeholder relationships, project manager's skills and top management support [34]. However, the monitoring process in the implementation of a project also plays a significant role [12]. This research discusses the development of tools for project management with the SaaS platform. In various studies, SaaS has been found to be able to help various small and medium scale organizations to digitize their business processes, without the need to spend large resources [5]. In this study, the developed application can assist users in configuring system requirements according to company needs, monitoring project work, and documenting each stage of project work. In addition, the system has been able to measure project success based on time. The limitation of this research is that there is no involvement of cost and

quality measurements. In addition, the respondents used in the trial were limited to implementing IT projects.

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