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DESIGNING A MICROSERVICES-BASED PROJECT MANAGEMENT SYSTEM AT XYZ INSTITUTE

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ABSTRACT

This study focuses on the analysis and design of a Project Management System (PMS) for the XYZ Institute's Research Department. The current system relies on manual methods, such as using Microsoft Excel and a project website, which often leads to inefficiencies and human errors. Through this research, the author aims to develop a system that streamlines project management processes by improving data management, communication, and overall efficiency. The design utilizes a Domain-Driven Design (DDD) approach with a microservices architecture to ensure scalability, modularity, and effective management of multiple research projects. The system also integrates the 10 Knowledge Areas of PMBOK to ensure that the specific requirements of the Research Department are addressed. The findings highlight that the proposed system could enhance project monitoring, reduce errors, and enable a more effective project management workflow. This design proposes a microservices-based architecture that supports independent services, providing greater system flexibility and scalability. The implementation of this system is expected to improve project performance and fulfill the operational needs of the XYZ Institute's Research Department.

KEYWORDS *Project Management; Microservices Architecture; Domain-Driven Design*

INTRODUCTION

All sectors in Indonesia have begun to apply technology and information to compete with the acceleration in information exchange. The core business of an organization has become highly dependent on computers and software to manage and run business operations, so increasing computer functionality or hardware is a natural step to enhance efficiency, ultimately leading to increased profits (Brewer & Dittman, 2022). In addressing various social challenges—including poverty, social inequality, education, and the environment—non-governmental organizations (*NGOs*) play an important role in society. *NGOs* strive to provide services effectively and efficiently. To streamline operations and make a positive impact, information and technology have evolved significantly in recent years. The

benefits of information technology provide quick access to information for *NGOs*, one of which is the internet, which is used as a tool for cost-efficient fundraising (Kamal, 2020). In addition, the use of the right software can help *NGOs* simplify financial management, cut costs, and offer more effective services (Naik, 2018; Redwood et al., 2017; Rimmington et al., 2015; Thapa et al., 2012). Therefore, it is necessary for organizations to maximize project management standards to achieve desired results (Institute, 2017; Institute, 2021).

Project management is a collection of activities that combine the processes of planning, organizing, and assigning responsibilities to accomplish organizational goals. In fulfilling project functions, a group of individuals is organized into specific roles collectively, so that the project can run effectively and efficiently. This coordination is crucial to improving project success (Institute, 2021). However, the execution of project management using project management tools (*PM Tools*) remains a common challenge. As many as 81% of respondents stated that they did not know about *PM Tools*, lacked experience in their application, or had insufficient training. Meanwhile, the remaining 19% reported difficulties in implementation (Agbejule & Lehtineva, 2022; Kaufmann & Kock, 2022; Lock, 2016; Musostova et al., 2022; Wang & Chen, 2023). This data was collected from 43 *NGOs* that had been surveyed. From the data above, the project head has an important role in the success of a project, as the project head is directly involved with the sponsor, project team, and all stakeholders to achieve the main goals of the project, as well as in mastering *PM Tools* (Abdul-Samad & Kulandaisamy, 2022; Chen et al., 2023; Chmielarz, 2015; Sahamir et al., 2021). In project management, it is highly recommended to use project management tools and techniques to organize projects, monitor performance, and provide detailed information related to ongoing projects.

A survey from a study related to *PM Tools* stated that the number of *PM Tools* is very large. Unfortunately, the majority of project managers surveyed only use Microsoft Project. It is also noted that Microsoft Excel is still widely used as a project management tool (Fox & Spence, 1998). Nowadays, technological developments are advancing rapidly, and the level of satisfaction with each *PM Tool* has changed. However, it is undeniable that, according to a survey conducted in 2023, Microsoft Project is still one of the *PM Tools* platforms in use.

XYZ Institute is an independent research institute established in 2001, aiming to conduct quality and impactful research covering a wide range of socio-economic issues, especially those with a focus on poverty and inequality. XYZ Institute has more than 20 years of experience conducting research on poverty and inequality, social protection, and human development in Indonesia. The institute has 69 staff members and has published more than 600 publications over the past 20 years. XYZ Institute also conducted nine national and regional studies in 2020 and seven studies in 2021 to examine the impact of the coronavirus disease 2019 (*COVID-19*) pandemic on the socio-economic conditions of Indonesian society, particularly related to poverty and human development. XYZ Institute also evaluates the effectiveness of various government policies and programs in the social protection, education, health, and employment sectors during the pandemic.

From the results of data collection by the author, the project management process at XYZ Institute still does not implement the concept of project management optimally. Based on interviews, all processes—such as proposal engagement, schedule planning, implementation, and reporting—are carried out conventionally, without a system to help project managers monitor all ongoing projects. As a result, some aspects are overlooked, causing delays in project timelines. Project control at XYZ Institute, as previously mentioned, still uses schedules and time plans starting from proposal design, data collection, data analysis, to project closure. All of these plans are recorded in an Excel file, and the analysis data is stored on a project website. On this website, the team leader also records the monthly progress of each project, but the frequency of updates is still irregular. This project website is a dedicated webpage created in the *CMS* office intranet *Drupal*. If there is a problem with the office intranet website, the project website also becomes inaccessible.

Because the position of project manager is held by the Head of the Research Department, this person must monitor all ongoing projects, use Excel, and constantly update and follow up with each team leader regarding project development.

In terms of the financial sector, the recording of reports and budgeting for each project is still managed using the *Zahir* application. However, the *Zahir* application cannot yet classify the financial records of each project. According to interview results, the Finance Sector has also experienced confusion in the process of reimbursing or applying for funds from multiple projects. All of these processes are conducted manually via *Telegram*; researchers send proof of reimbursement along with a form to apply for fund disbursement. It was also mentioned during interviews that the presence of a system that could facilitate recording, sorting, and timely processing would be highly beneficial.

Therefore, a system is needed that can help the Head of the Research Department, team leaders, and all stakeholders involved in the project to organize, monitor, and enhance the effectiveness of project processes, as well as provide all information, from essential to detailed, related to the project. Organizations that use project-based project management software systems (*PMSS*) face certain challenges, such as *PMSS* access issues and their effectiveness in conveying project material and data.

Microservices are the chosen approach in designing this project management system. The *microservices* approach offers significant advantages, as it consists of various components that can be updated and installed independently, making code management easier and providing better scalability than monolithic systems. With its modular nature, errors in one component will not affect the entire system, making it easier to understand and manage because it is broken down into simpler parts.

Based on the conditions at XYZ Institute, the formulation of this research problem includes two main questions: how to design a project management system that helps the Research Department organize projects by reducing manual processes and providing detailed information, and how to design the system to reduce the time required to complete and finalize projects. The purpose of this research is to produce

a comprehensive conceptual design of the project management system, develop integrated modules that improve performance and simplify project management, and ensure that each module is stand-alone with optimal flexibility and scalability. The benefits of this research are divided into two aspects: the organizational aspect, where the design results can serve as the basis for the development or implementation of a new project management system that meets the needs of XYZ Institute, and the academic aspect, which contributes as a reference for future research and development of project management systems.

RESEARCH METHOD

This study employs an analytical method with a quantitative approach to examine the design of a microservices-based project management system at XYZ Institute. The research stages include: observation and data collection through direct observation and in-depth interviews with relevant departments to describe project management issues and identify system requirements; analysis of the existing project management system in the Research Division by defining procedures, mechanisms, and software utilized; literature review to identify project management concepts such as *PMBOK*, *PRINCE2*, and *ISO 21500*, and to compare these with the conditions at XYZ Institute; system modeling using the *Domain-Driven Design* approach as the foundation for designing a modular and scalable microservices architecture; designing the project management system, which encompasses feature mapping, entity creation, aggregates, *saga*, and wireframe user interface; as well as design evaluation through interviews and user acceptance testing to ensure that the system aligns with operational needs. All data were collected using instruments that had been tested for validity and reliability, and data analysis was conducted quantitatively using *Smart-PLS* software, with image captions included as part of the image titles.

RESULT AND DISCUSSION

Sistem Project Management Existing

in project management in the research department of XYZ Institute currently uses Microsoft Excel as a storage medium – data related to ongoing projects. This data is managed directly by the Head of the Research Department as the Head of the project. Only the Head of the Research Department can make changes to the Microsoft Excel file.

Use Case Diagram

The following is a chart related to the interaction of actors with the project management system in the XYZ Institute's Research Department. The interaction between the Head of Research Department and the Project Team Leader with the Microsoft Excel system and the office web portal, which is Illustrated in the following Use Case Diagram.

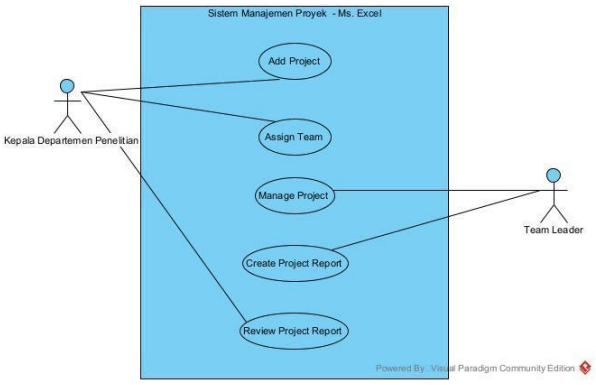

Figure 1. Use Case Diagram Exisiting System
(Source: Author Analysis Results, 2024)

Existing Project Management System – Data Definition

Project Management System research at XYZ Institute currently still relies on Microsoft Excel as a documentation and project management application. There is a lot of data stored and managed by the Head of the Research Department as the admin of all research projects, such as project data, project requirements, primary data; secondary data, project team data and more.

Existing Process Workflow – XYZ Institute Research Project Management

The management of research projects at XYZ Institute is carried out using the Project Life Cycle method in an agile manner. The agile method itself is a method in software development where the work needs to be carried out repeatedly, starting from the initiation, planning, implementation, control, and closing stages. These stages are then adjusted to the needs of XYZ Institute. With some specific processes, where iterations are carried out if the entire process has been carried out. The process will be described in more detail in this section. From attachments 5,6,7,8, and 9 are described in an overview of the research project process from the beginning to the end of the project, which can be seen in the figure below.

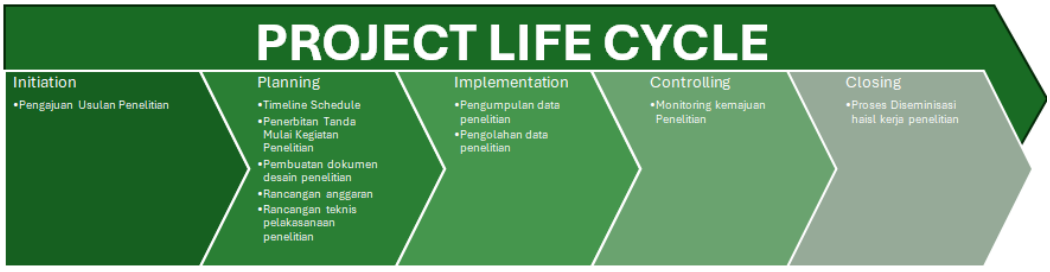

Figure 2. Workflow and Project Life Cycle of existing research projects
(Source: Author Analysis Results, 2024)

In the Project Life Cycle above, not all phases are managed by the Head of the Research Department and Team Leader. The following are the stages of the

Project Life Cycle whose research projects are managed directly by the Head of the Research Department and Team Leader, which basically matters related to the research project are recorded, followed up and monitored by the Head of the Research Department. The Team Leader and his research team focus on the data collection and processing process, as well as reporting to the Head of the Research Department. The stages are as follows:

Fase Planning

In this phase, planning related to the research project is carried out, by building a research timeline, budget plan, research administrative documents, and technical design for research implementation. Where all the above plans are the result of a joint meeting between the Head of the Research Department, Team Leader, and the researchers concerned with the research. The Team Leader will prepare a timeline schedule according to the results of the agreement at the inaugural meeting and conduct a review with the Head of the Research Department. From the results of the review, the actual framework was socialized to be continued in the next phase.

Fase Implementation

From the results of the Planning phase, the implementation phase will focus on working on the research project, starting from data collection and data processing. The collection is carried out based on the reference of the framework resulting from the planning process. In this phase, the Team Leader will start carrying out every activity that has been planned according to the timeline and the Head of the Research Department as the Project Manager monitors the progress of the research process. Reporting will be carried out when all data has been processed and a joint review will be carried out with the Team Leader and the research team concerned.

Fase Controlling

In this phase, the Head of the Research Department monitors the progress of every research project that is still active. The Team Leader will report to the Head of the Research Department periodically so that the Head of the Research Department can update the timeline and give warnings if there is a research project that starts to go off track.

User Needs Analysis

In this section, the author makes several attempts to obtain information related to project management, the Head of the Research Department and the research staff who are active in working on the research project, where the data will be useful as material for the analysis of the proposed system. These efforts include conducting direct observations and conducting interviews with several parties in the Research

Department. Here are the details and results of the user needs interviews that have been conducted.

Based on the interview conducted with the Head of the Research Department, the author identified several things as follows, where the transcript of the interview conducted is in the attached file. Findings of the interview on user needs and problems:

Project data is managed manually using the Microsoft excel application. Both for research project initialization, monitoring the progress of research projects, and also reporting. With the current system, it sometimes causes communication problems, misdelivery of information, or information that is not conveyed. In the process of monitoring and tracking research projects, this process is done manually which often takes quite a lot of time. Some manual processes such as collection, sending documents, requesting approval, and several other manual processes can cause several problems such as incomplete documents, left out, full emails, and so on. Checking project data is also manual by each research team leader, so there is a possibility of human error in checking and is quite time-consuming.

There were 15 interviewees who were staff of the research department, 15 participants already knew about project management systems, with 55.3 percent of participants knowing project management systems such as Microsoft Project and Trello.

Then the author wants to know the opinions of the participants regarding how important the project management system is in the management of research projects in the XYZ Institute Research Department or from other workplace experiences. From the results of the interview, 93.3 percent answered that the existence of a Project Management System is very important for project management.

Of some participants who have used the project management system or are currently using it, the author conducted interviews with 5 participants where the following things are felt to be factors that provide satisfaction in using the system, including User Interface and User Experience that are easy to understand, easy to use, and not complicated. and Completeness of project management system features, one of which is project monitoring and project tracking features.

Then the participants argued that the most important management concepts that must be applied to the project management system are Time/Schedule Management and Resource Management with the answer level from the participants as much as 53.3 percent which can be seen in figure 4.11 and the level of need for the Resource Management concept is also the highest with a percentage of 66.7 percent and followed by the second place with Time/Schedule Management with 53.3 percent.

From the results of the observation of the SOP framework of the research, from the kick-off of the project start to the reporting of deliverables (attachments

4,5,6,7 and 8), that all processes have been described clearly and in detail, but in reality quoted from the results of the interview that there are several human errors that occur such as the negligence of the researcher in filling in the monthly progress routine. In terms of the Financial Sector, the problem that needs to be addressed is the type of reporting of reimburses and the submission of advances following systematically and structured into a system. Quoted from the results of an interview with the head of finance.

PMBOK Knowledge Area Analysis

Based on the existing conditions and activities carried out by the Research Department inside and outside the scope of Microsoft Excel in managing research projects and based on the observations and experiences of the author working in the ICT division of XYZ Institute, the author tries to design a special Project Management system for the Research Department, which is designed based on one of the most popular project management concepts by PMBOK, 10 Knowledge Areas. After the research study was carried out above, PMBOK is more suitable for several knewledge areas applied to the project management of the XYZ Institute Research Department. The following are some reviews, findings and analyses conducted by researchers based on the conditions and project management needs of the XYZ Institute Research Department.

Project Integration Management

A Project Charter is a document that shows the existence of a project, which contains many things about the project, ranging from the project name, description, stakeholders, scope and requirements, timeline, cost/budget, resources, risks, to project approval. project implementation (PMBOK Guide, 2017). The project charter presented in this integration management project has been implemented in XYZ Institute, not only in the Research Department but also in other departments besides the Research Department, so this project charter itself must be implemented in the Research Project Management system as it is the standard of procedures and regulations at XYZ Institute.

Project Schedule Management

Gantt charts, Pert charts with CPM and Project Schedule Network charts are charts that graphically and logically represent the project schedule, activities and elapsed time for each activity. Gantt charts are usually created sequentially and there is no dependency between each activity, while Project Schedule Network also describes the relationship of one task/activity to another and also the dependence of each activity in a project. The project manager or project member can see the leads or lags in detail about the project activities, which can illustrate whether the

activities are experiencing problems, delays, or even faster than the specified completion time target. For any activity that is unusual or does not follow existing standards/procedures, a complete description should be created to help the project manager or project team understand the activity. Typically, this schedule network diagram is created or created manually by the project manager/user, or some software can help create it (PMBOK Guide, 2017). This project schedule network diagram is suitable for research project management systems designed to help make it easier for project managers and team members to know the description of the Project Life Cycle and the detailed status of each project task/activity.

Project Cost Management

Project Cost Management is the process of identifying, determining, estimating, designing, managing, and monitoring project costs. Several methods or methods of cost management analysis can help project managers determine or estimate project costs. One of the calculations is carried out using Earned Value Analysis (EVA). Several existing project management information systems usually monitor the three dimensions of EVA such as Planned Value (PV), Earned Value (EV), and Actual Cost (AC) to graphically illustrate patterns and to estimate the cost range for a project or other than in the form of graphs, usually the results of calculations using EVA are generally made in the form of reports (PMBOK Guide, 2017). Currently, the calculation of the cost / budget of each project is carried out manually, assisted and supervised by the Head of Finance. The cost/budget value is usually the result of discussions and agreements with relevant stakeholders and directors. Thus, to assist project managers and related stakeholders in calculating, determining, or projecting the cost of a project, this EVA calculation will be applied to the research project management system, which is designed in conjunction with the EVA guidelines themselves.

Project Quality Management

Project Quality Management is the process of identifying standards, maintaining project quality, and assessing the quality of the project being carried out, which is done to help maintain the quality of the project or project outcomes following predetermined requirements. In controlling the quality of a project, several techniques or tools can be used, including check sheets. Check Sheets are tally sheets that are usually used to group or organize factual data about the condition, status, or information of a project, to find out potential problems and the value or ranking of each of these problems that will affect the quality of a project. (PMBOK Guide, 2017).

Project Resource Management

Project Resource Management is the process of identifying or determining needs, estimating, how to manage and optimize existing resources, both human resources and other resources. Resource management planning is very important before the implementation of the project. It can help project managers know and then analyze the organization's resources to support the project's needs. This planning can be done using a Resource Breakdown Structure, which is a hierarchical representation of resources divided into categories and types, such as personnel, materials, and equipment. Furthermore, specifically focusing on personnel in the project, project managers can use RACI charts to determine personnel activities and roles. A simple but very useful resource planning and monitoring tool (PMBOK Guide, 2017). It also includes the process of tying up abilities, competencies, interactions, and work environments to improve the quality or performance of the project. To improve the quality and performance of the project, it is usually carried out with counseling, training, community events, etc. (PMBOK Guide, 2017). In resource management, team performance appraisals are necessary to monitor the team's Key Performance Indicators (KPIs) and help review project managers to maintain or even improve project performance. XYZ Institute also recognizes the importance of this and has built a web-based application specifically for staff performance assessment, using self-assessment models and layered assessments. So, everyone in the structure of the subdivisions can make an assessment.

Project Communication Management

Project Communications Management consists of several processes necessary to ensure that any information related to the project is conveyed correctly, clearly, and effectively to every team and stakeholder involved. Which is broken down into two main processes: first, developing an effective communication strategy, and carrying out certain activities based on the strategy created. Some things need to be defined and done in the strategy stage, for example what kind of data needs to be informed, who needs to be informed, what media can be used, how to communicate things about the project effectively. Inform all teams and stakeholders about the project through discussions/meetings, presentations, training, and communication media. The media used depends on the organization or the circumstances of the project itself, which can also be supported by the Project Management Information System (PMIS) (PMBOK Guide, 2017).

Modeling Domain – Driven Design

Analysis Domain Model & Bounded Context

At this stage, analysis and modeling are carried out for the system that will be designed based on 10 Knowledge Areas. Domain Driven Modeling, in this case,

modeling the decomposition of the domain to become an independent service is carried out based on 10 knowledge areas with the core of the Project Management domain. From this system modeling analysis, sub-domains to services will be obtained based on the management concept and areas that have been discussed previously. It then specifies the bounded context of the model being created. Bounded context itself is a conceptual semantic boundary concept, Bounded context is commonly used because usually development teams don't know when to stop collecting and stacking more concepts into their domain model.

There are 6 sub-domains modeled based on 10 knowledge areas, with project management as the core domain. From each sub-domain there are entities or attributes that can also exist in other sub-domains, but have or for different contexts. For example, the context of "project" can vary in each sub-domain, in this case for example "project" in a charter project or project portfolio that has a context that talks about the project scope, schedule, members, etc. But "project" in the cost sub-domain has a different context, namely, focusing on how much the cost or budget of the project is. Then it also includes project management, such as registration, development, and finalization, then the resources used in project management such as infrastructure and costs needed/used. The context can be seen as in the following image. Another example in the context of "user" in the resource management sub-domain has a meaning that focuses on the human/member of the project or user of the project management system that is designed, then about the skill development of project members, and so on. Meanwhile, the context of "user" in the sub-domain of integration management or scope management has a meaning that focuses more on the user of the system as a result of a project, or the owner of the business/product being developed.

Entity Analysis

In modeling using the Domain-Driven Design approach, there is a stage called Entity Analysis. This stage is an activity to organize and identify information related to the domain. Entity analysis and modeling with a Domain-Driven design (DDD) approach recommends the rule that data entities change only through a specific constructor/method, this favors a more focused and clean coverage of aggregates from domains that are not related to that entity.

Aggregates

An aggregate is a collection or cluster of domain objects within a boundary that can be treated as a unit. An aggregate consists of a root entity and one or more entities and value objects. In general, business objects are modeled as aggregates. For example, in the previous discussion and analysis of domains, and entity analysis, according to user needs, an overview of aggregates has been obtained. In

DDD, the main key in designing a domain model is to identify aggregates, constraints, and roots. The advantages of aggregates, go beyond the modularization of the domain model. That's because the aggregation group has to abide by certain rules. DDD requires aggregates to adhere to a set of rules. This rule ensures that an aggregate is an independent unit that can stand alone. Here are some of these rules:

Reference only for Aggregate root This rule specifies that every transaction within the boundaries service such as create, update, delete will only be performed or invoked through the aggregate root. This is useful to avoid inconsistent data problems, because if what is updated is an invariant or an object in the aggregates only, then other objects do not get the data update. The Inter-Aggregate reference must use the primary key In this rule, it is explained that between aggregates is associated with the primary key. So if there is a transaction that occurs in the boundary of an aggregate, and requires create, update, delete in the database service on other aggregates, then it must use the primary key, which later the transaction process will be continued and managed by other aggregates. A transaction creates or updates only one aggregate In this rule, it specifies that one transaction can only create or update only one aggregate, if there is a need to update other aggregates, then it must use the saga pattern.

Module Identification

From the Domain-Driven Design modeling that was done earlier, the author then describes a list of modules based on the service domain that has been identified. Various modules of an important nature are obtained for further analysis in order to get a broad system overview of how several services interact with each other.

Saga Pattern

Saga Pattern is a mechanism used to maintain data consistency in a microservices architecture by specifying a saga for each system command that needs to update data in a service. A saga is a series of transactions that exist in a sequence. Each transaction updates the data in the services using specific transaction frameworks and libraries. The system starts the transaction at the first stage of the saga triggered by the user, then if the transaction is completed, it will trigger the execution of the transaction at the next stage, and so on, until it is completed. There are a few different ways to structure the coordination logic of a saga, which are:

Choreography

Choreography is a way to coordinate a saga in which participants exchange events without a centralized control point. With choreography, each local

transaction publishes a domain event that triggers a local transaction in another service.

Orchestration

In the design of this project management system, the saga coordination technique is carried out using Orchestration. Orchestration is simpler and not difficult for users who are not familiar with IT systems or architecture designs. In the design of the saga that was made, it can be seen that each existing service only commits in the form of the Create, Update, Delete data function only on one specific database, thus increasing the level of loss coupled between existing services, so that each service becomes more independent and no longer depends on each other.

External API

The system's external APIs are designed to be accessible to more people as well as web or desktop developers outside of the system it was designed for. For organizations or businesses, external APIs are an opportunity to benefit from innovative developments. External APIs can also be used for systems that are developed and used internally. Overall, platforms that offer the same approach to launching internal and external APIs will be best positioned to help businesses looking to create an ecosystem in their API stack. The good news is that most platforms have design features that allow for publishing, sharing, and API use. It's important to know the difference between internal and external APIs. It's true, understanding the differences contributes to effective API management. Most companies without APIs would be better off starting with internal APIs before deploying them for external use. These external APIs can interact with the provisioned API Gateway and will be passed as REST APIs. The following are some proposals for the use of external APIs in the Project management system:

Human Reseouce and workload Management

Currently, XYZ Institute is implementing a workload system to serve and manage researcher activities, namely a special human resource management system to monitor and assign researchers for the next research. In this system, especially the Head of the Research Department, can see the expectations of the researcher's work activities, when the researcher can be assigned again for the next project. So if this system can interact with the project management system that is created, the data of the two systems can be synchronized, such as project schedule data that is running with future projects, so that this project management system can maximize the capacity of researchers in a structured manner.

Project Management System Microservices Architecture Proposal

From the results of the analysis that has been held and presented in detail in the previous discussion, the following author re-describes the essence of the stage process and the results of the project management analysis that has been carried

out. The following are the stages and the results obtained from the previous discussion.

Analysis of Existing Research Project Management System

At this stage, the author uses various methods to collect data or information related to the circumstances, situations, conditions, procedures, Project Life Cycle that exist in the project management system of the research department that is currently operating. This data was collected using interview and observation methods, as well as the author's experience as an ICT staff at XYZ Institute for 2 years. After collecting data, the author analyzed the data or information and found that currently the Research department at XYZ Institute does not have a project management system. With a large number of projects and varying levels of project complexity, the Head of the research department as the project manager uses the Project Life Cycle waterfall in the development of research projects where the Project Life cycle is part of the overall project management activities.

User Needs Analysis

At this stage, the author collects user needs data by interviewing each Head of Research Department and some Researchers and Team leaders, with user knowledge backgrounds from various different roles/positions in the Research Department. After conducting interviews, the authors found that the participants were the target users of the designed project management system, with the highest percentage of opinions stating that resource management, and time and schedule management, are the most important aspects of project management in the current Research department, therefore, participants are of the opinion that they need the most important features or functions to exist in the system being designed and most importantly time management-related features or functions, which can provide time information, track and monitor the IT status of the project. and Resource Management to monitor the capacity of each researcher involved in the projects. As well as several other features or functions that are quite important have been explained in detail in the previous discussion.

Document Analysis

At this stage, the author collects data on existing research project documents such as Project Charter/Project Portfolio documents, proposal documents, timeline documents, project reports, and several other documents related to research. These projects include projects that are still ongoing, that are no longer being worked on/cancelled, or projects that have been completed/closed. After collecting all these documents, the author then analyzes each document to find out what data and

information is needed that must be covered by the design of the project management system.

Project Management Concept Analysis

At this stage, the author collects data and conducts research on previous research in books or scientific articles about the current project management concept. The author then analyzes and compares several popular project management concepts such as PMBOK, PRINCE2, and ISO 21500 which are compared to the current conditions, circumstances, procedures and project life cycle situations in the XYZ Institute research department. From the results of the analysis, it can be concluded that PMBOK 10 Knowledge Area is the most appropriate project management concept and suitable to be applied in the research department of XYZ Institute, and applied to the designed project management system.

Analysis of 10 PMBOK Knowledge Areas

At this stage, the author conducts a more detailed analysis and deepening of the project management concept of the 10 Knowledge Areas of PMBOK, in order to know what features, techniques, or functionalities have been applied in the research department of XYZ Institute, which can and will be applied to the project management system designed, based on the areas that include the research department.

Modeling using Domain – Driven Design

At this stage, the author began to model the project management system of the XYZ Institute research department using the Domain – Driven Design approach. Modeling is carried out by analyzing the core domain of the project management system, where the core domain is project management, taken from the project management concept that has been selected in the previous discussion based on the suitability or suitability to the situation, conditions, needs, procedures and Project Life Cycle of the research department. The project management concept is 10 knowledge areas from PMBOK, where each domain and candidate services resulting from the analysis are obtained based on areas that are specifically sorted as domains, along with the techniques that exist in each of these areas, so that 6 domains are obtained for the designed system.

Microservices Design

At this stage, the author designs based on the results of the analysis and modeling of project management in the previous discussion. The design is carried out according to the existing microservices design concept and framework, starting from domain analysis that has been obtained, entity analysis and design, aggregates, saga patterns, to services in the designed project management system. From the analysis and design carried out so that each service in the designed project

management system can be independent or independent, 12 entities, 6 aggregates, and 70 services are obtained.

The proposed Project Management System uses Microservices modeling, allowing for more ease in designing systems/software than monolithic models. Using the Microservices model, the system is designed based on services that stand independently.

The REST API is used or invoked by the system user from the front end, which will send a request to the associated service. In this Microservices model, there is an API Gateway which is a gateway or gateway to request that allows external systems such as initiative management systems, human resources management, and other XYZ Institute systems, to be able to interact with the designed project management system. This API Gateway will function as a management API that will direct requests from clients to certain API services, the API is in the form of a REST API. The API Gateway is provided primarily to be able to interact with systems or external APIs, outside of the IT project management system designed, such as the XYZ Institute's initiative management and human resource management systems, and other systems.

In a microservices architecture, the modules are broken down into many services based on specific functionalities and domains, and wrapped in containers that allow all components of the system to be combined into one, each of which contains a web server, database and cache.

CONCLUSION

Based on the research conducted, organizations encounter significant challenges in project management particularly from proposal creation through project closure primarily due to insufficient IT applications. The case study at XYZ Institute highlights these issues within the Research Department, prompting the proposal of a Project Management System designed with a *Domain-Driven Design* approach and the *PMBOK* project management framework, especially utilizing the Project Life Cycle *Agile* methodology. Employing a microservices architecture enables the system to clearly categorize services by business domain, reducing the risk of miscommunication between business and IT, accelerating feature development, minimizing dependency risks, and preventing system downtime. The shift from manual to automated processes, such as document management, leads to a paperless environment and centralized verification, addressing problems of document fragmentation or delays. Although the discussion of the 10 knowledge areas of *PMBOK* is limited, this system design offers a strong foundation for future research, which is recommended to explore in greater detail the technological and technical aspects of implementing microservices-based project management systems.

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