Development of User Interface/User Experience using Design Thinking Approach for GMS Service Company

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Abstract

Information systems have an important role for firms to increase productivity. A service company located in Bontang, East Kalimantan, Indonesia (GMS), is engaged in scaffolding installation services and scaffolding rentals. The company has steadily experienced annual increase in the number of customers over the years. However, due to the still in manual-way of managing the scaffolding material, the increase of workload has also led to the increasing number of material handling human error cases and inefficient service processing time. As a company that provides B2B services, the management (user) then needs a website-based system for scaffolding material management that is tailored to their service operations and suits their special needs to support their operation. Thus, this study analyzes the suitable user interface/user experience using the Design Thinking method, which consists of 5 steps, namely Empathize, Define, Ideate, Prototype and Test. It serves as the initial phase of information system building to make sure that the design of the website based information system will suit the needs of their management. After conducting empathize stage using interview techniques and questionnaires and also conducting the define stage to gain insights on the required needs, it was known that the website system needed particular features, namely the availability of customer data, material data, user data, work partner data, transaction reports, invoices, integration with whatsapp and email, as well as a dashboard to visualize data such as the amount of material rented, available materials, and transaction history. In the prototype development stage, online UI/UX design tools are used. Using the prototype, the testing stage was then carried out, using the System Usability Scale (SUS) method. As a result, a value of 80.86 was obtained, meaning that the system created has good usability and can be used on an ongoing basis.

Keywords: UI/UX prototype, design thinking, SUS

1. INTRODUCTION

Technology is often used to facilitate business activities. It is suggested that Information Technology (IT) capabilities contribute directly to improved organizational processes such as coordination, transaction specific investment,

absorptive capacity and monitoring. These in turn contribute to strategic and operational performance outcomes [1].

PT Graha Mandala Sakti (GMS) is a company that provides scaffolding installation services and scaffolding rentals located in Bontang, East Kalimantan, Indonesia. In their scaffolding service management, GMS records incoming and outgoing materials as well as send invoices for customers. In the last 5 years, the company has experienced a steady annual increase in the number of customers. While it is good for company revenue, this condition also leads to the increase of human error and inefficient service processing time due to the manual-based administration within scaffolding material management. This condition necessitates GMS to develop a web-based information system for scaffolding material management so that they can increase their capabilities in handling their services, eventually make the processing time more efficient and human error be minimized.

As IT is often best suited to play the role of a resource multiplier, an enhancer of existing capabilities, or an enabler of new capabilities for firms seeking a competence advantage from investment in resources [2], the support of information system is expected to be able to improve the organization capabilities of GMS. However, an information system that is not being used or even rejected by their user can hardly improve organization performance. Thus, aligning user demand with the requirement of the information system is necessary. Therefore, in preparing a web-based information system (IS), stakeholders need a prototype design for the scaffolding material management first. To provide the best user experience (UX) in material management activities, GMS wants to create a prototype for the user interface (UI) of the web-based scaffolding material management information system.

One way to get a good UI/UX is to use the Design Thinking method because this method supports innovation that is based on the customer or user. This method is regarded as a system of three overlapping spaces, in which *viability* refers to the business perspective, *desirability* reflects the user's perspective, and *feasibility* encompasses the technology perspective. Innovation increases when all three perspectives are addressed [3]. The decision of using web-based IS was coming from management of GMS. Based on existing problems and the needs of users, this study proposed designing web-based UI/UX for rental service company GMS using a design thinking approach to support scaffolding material handling management, so that GMS can provide scaffolding rental and scaffolding installation services efficiently.

2. METHODS

2.1. Research Methods

Designing a user interface/user experience prototype requires structured steps to make sure that the design is good. Several approaches have been known and applied in the industry, such as waterfall [4] or scrum [5]. Design thinking approach also helps designers to provide innovative solutions through several stages [3]. There are 5 stages in Design Thinking, namely *empathize, define, ideate, prototype*, and *test*. The design thinking method is known as a comprehensive thinking process that concentrates on creating solutions that start from a process of empathy for human-centered needs and towards a continuous innovation based on the needs of its users [6]. A large number of design methods and tools facilitate the design thinking innovation process [1]. Therefore, we investigated literature related to this to decide which tools and methods that can be applied in this case as shown in Table 1. All relevant methods and tools found from the investigation are then used in this study.

2.2. Organizing Data Collection

Several data collection methods are conducted in two different stages of the design thinking process. In the empathize stage, there is an interview with questions that have been prepared using 5W + 1H questions, then there is the distribution of questionnaires to support primary data collection. The purpose is to explore the problems that the user has and what the user wants and needs in order to develop the system.

At the test stage, a trial was carried out on the prototype that has been made. The test of usability was carried out by distributing assessment questionnaires to potential users who are working in the field of scaffolding material management.

2.3. Theoretical Background

Our investigation to the literature related to tools and method and design thinking has found several tools and method that has been used, namely:
1. Design thinking
2. Interview (5W+1H)
3. Empathy Map
4. User Journey Map
5. User Persona
6. User Task Flow
7. Flowchart
8. Questionnaire
9. User Case Diagram
10. System Usability Scale (SUS)

11. Mockup/Wireframe
12. Prototype

Except for the mockup/wireframe [7], which is similar in purpose but less informative compared to the prototype, all the methods are applied in the stages of design thinking approach. There are 5 stages in Design Thinking, namely empathize, define, ideate, prototype, and test. In each stage, we applied different methods:

1) The Empathize stage is the initial stage of the Design Thinking approach. This stage is at the heart of the whole approach. At this stage there is an Interview with questions that have been prepared using a 5W + 1H guide. Then, there is the distribution of Questionnaires to capture insights from the user. The data collected is processed and shown as an Empathy Map [8]. Empathy map as a benchmark to measure consumer satisfaction [9]. Empathy map consists of 4 components: says, does, thinks, and feels [10].

2) The Define stage formulates the problems and needs that have been obtained and determined from the empathize stage. At this stage, the problem is narrowed down to become a point of view. In this stage, several methods had been used, namely User Persona [11], and User Journey Map [11]. A User Persona is created to know the characteristics of the user. The user persona technique is one of the techniques to explore needs [11, 12]. Next, User Journey Map is used to define every problem that exists in the workflow of the current scaffolding material management. User Journey Map is a method used to design and assess user experience in the field of UI/UX [11, 13]. Therefore, a workflow in the operation of the company needs to be known first. The workflow is useful to help in mapping the company's business processes and procedures [14].

3) The Ideate stage is the stage of finding ideas or solutions to problems discovered. This solution will be the basis for the development of the system to be created. At this stage is the stage of brainstorming, recording all the ideas obtained. The methods used are Use Case Diagram, Flowchart and Business Requirement Document. The use case diagram is used to find out an overview of the interaction that occurs between the user and the web-based information system [15]. Meanwhile, a flowchart is a chart that shows the flow in a program or system procedure logically. Flowcharts are used to describe the workflow of the web-based information system in detail [16]. The last method used is the Business Requirement Document to define the requirements to design the UI/UX prototype. BRD (Business Requirements Document) is a document that details requests from users for the desired system/feature/process/data item available on the Company's IT system [17].

4) The Prototype stage provides a prototype design of the system that will be made based on the discovery of existing ideas [18-22]. In the design of

the UI/UX prototype, an online application was used, namely Figma (www.figma.com). Figma is a cloud-based design application and is a prototyping tool for digital projects.

5) The Test stage carried out a trial on the prototype that has been made. The test was carried out by distributing an assessment questionnaire regarding the usability of the prototype to several users who are experienced in the field of material scaffolding management. Usability is the level of a product can be utilized by users to achieve specific goals effectively, efficiently and provide satisfaction [23]. Then, the result was acquired using the System Usability Scale (SUS) method. System Usability Scale (SUS) is a questionnaire to measure the level of usability of a system because it is able to provide a subjective perception of the user [24, 25].

The investigation can be summarized as shown in Table 1.

Table 1. Tools and method to conduct Design Thinking approach

Author	Tools and Method											
	1	2	3	4	5	6	7	8	9	10	11	12
Razi, Mutiaz, & Setiawan (2018)	√					√	√	√				√
Sari, et al. (2020)	√						√					√
Abdurrohman & Trisnawati (2021)	√											√
Wibowo & Setiaji (2020)	√											√
Amalina, Wahid, Satriadi, Farhani, & Setiani (2017)	√								√			√
Rabbani (2021)	√								√		√	
Andrian, Putri, Wiryandhani, & Rizaldi (2021)	√	√										√
Nadimsyah, JaFar, & Pribadi (2022)	√								√			√

Suyanto & Ependi, (2019)			√
Allah, Ismail, and Elrobaa (2021)	√		
Aziza (2020)		√ √	

2.4. User Interface (UI)/ User Experience (UX)

User Interface (UI) is one part of the program that touches and interacts directly with users [26]. Meanwhile, User Experience (UX) is all aspects related to a user's experience in using a product, how easy it works to understand, how it feels when using the product, and how users achieve their goals through the product [27]. As UX is a Human Computer Interaction (HCI) related concept that is widely applied. It is not only applied in software and hardware development, but also in services, products, processes, society and culture [28]. Therefore, using UI/UX prototype to make sure that development of the GMS web-based scaffolding material management system that will be used to support the service company is deemed suitable.

3. RESULTS AND DISCUSSION

3.1. Empathize

In this first stage, interviews were conducted to find out what problems GMS had, especially in the field of scaffolding material management. The interviews were conducted with 3 experienced people, namely the Project Manager, Project Control and the Head of Finance & Accounting. The interview was conducted using a 5W + 1H guide. Then, the results of the interview are used to design a questionnaire that is distributed to 16 users (50% of the total number of employees in related departments). Lastly, an empathy map was made to find out the needs of the user or its users according to the questionnaire collected. Figure 1 is the example of results of the empathy map that capture the needs and wants of the GMS users.

Says

What are users saying about current materials management?

- Users need a lot of time during implementation because the number of customers continues to increase.
- Human error occurs when writing invoices or travel documents.

Does

What needs to be done so that scaffolding material management does not run manually anymore?

- Creating a web-based information system to control the amount of stock material available and rented as well as a supporting system to find out the amount of customer invoices so there is no need to check the warehouse regarding the amount available.
- Making a system feature to control the number of customers who make rentals and customer order history.
- There is a feature in the system that can warn customers about the payment deadline. So that employees can minimize warning customers regarding payment deadlines.
- The system can view customer order history so that companies can view customer history through the system without being manually typed again
- Features that are integrated between orders with travel documents and bills.

Thinks

What do users think about material management today?

- Customers continue to increase, so time does not run efficiently.
- More energy expended extra.
- The need for the addition of a web-based digital information system.
- The need to maintain the accuracy of the amount of material stock with a system that is no longer manual.
- System management that was originally manual can be more neat and organized because there is an automation system.

Feels

How do users feel about material management today?

- Experiencing stress when customers don't make payments on time because it takes extra time to chat customers one by one via whatsapp.
- Experiencing confusion when the material stock runs out because it is still calculated manually.

Figure 1. GMS Empathy Map

3.2.   Define

In the define stage, user persona is used to represent each user and their problems, frustrations, and expectations. Figure 2 shows an example of the user persona used in this study. It came from each employee/user related to the scaffolding material management. With, human-centered design can be implemented because the insight gathered is in a deeper personnel level.

Gamel

Age: 32 Years
Position: Project Control (5 years)
Location: Balikpapan

BIO

Gamel is a project control who has worked at PT. GMS for 7 years. In the first 2 years, Gamel worked in the workshop section or inspecting materials.

NEED & EXPECTATIONS

There is a system that can control the list of customers who rent or collaborate with PT. GMS. Then, there is a history of customer orders to the company.

GOALS

Doing work more efficiently because the information system is web-based and the system does not run manually anymore.

FRUSTRATIONS

Difficulty in controlling the amount of material and the due date of customer payments.

Sasa

Age: 29 Years
Position: Head of Financial & Accounting (3 years)
Location: Balikpapan

BIO

Sasa is a leader in the Financial & Accounting division who has worked at PT. GMS for 6 years. In the first 3 years served as a member in the Financial & Accounting department and the next 3 years as a leader in the department.

NEED & EXPECTATIONS

There is a system or database for sending invoices to customers and storing invoice history. In addition, there is a system for making travel documents.

GOALS

Can control the number of invoices to customers efficiently by having a system for storing invoices and a system for sending them to customers so as to minimize paper usage.

FRUSTRATIONS

There was a human error when making invoices and travel documents because it was still done by handwriting or manually.

Figure 2.GMS User persona

After presenting the user persona, the next step is creating a User Journey Map. User Journey Map (UJM) is a process to map the journey of users in interacting when running management scaffolding that is still running manually. The relationship between the user persona and the user journey map is very close and interrelated. Figure 3 shows an example of UJM application for the first three steps of the 10 steps in the user journey.

Figure 3. GMS User Journey Map

All analysis in the Define stage is then converged into *point of view* as shown in Table 2. It clearly defines the issue, the possible root cause, and even the potential solution.

Table 2. User problem formulation

No.	Type Of Issue	Root Cause	Expectation
1.	Increased workload	The absence of a system that helps in checking the amount of material at PT. GSM	Creating a system in which there is a feature to find out the amount of stock material available, and rented
2.	Inefficient time	Calculation of materials that are still manual	

3.	Checking and calculating the amount of material that is done repeatedly	There is no supporting system for checking the amount of material	
4.	Lots of wasted time due to late payment	Vendors don't pay bills on time	Creating a system in which there are features that can warn customers regarding the payment deadline. So that employees can minimize warning customers regarding payment deadlines.
5.	Piled up invoices and travel documents	There is no system or database that stores billing history or travel document history	Create a system for billing to customers so as to minimize paper stacks.

Thus, by connecting the dots, we arrive at the formulation of the features that are required for the UI/UX design. The features that will be given to the system must include:

1) The system has to have features to enter customer data, material data, user data, and work partner data which will be integrated with dashboard features and incoming transactions and outgoing transactions.
2) There is a need for a user data feature, to control the users who can use the website.
3) The system has to have features that can control and track changes in the amount of material available and rented.
4) The system has to have a dashboard feature that can be easily seen by the user regarding the number of transactions, the amount of material available in different warehouses, the amount of materials rented, the number of users, and the number of customers.

5) The system has to have a feature to track and find out the amount of customer bills and payment dues.
6) There is a need for a system that is integrated with whatsapp and email for customer bills and commemorates the billing period.
7) Features that are integrated between orders with travel documents and bills.
8) The system has to have features to find out the list of customers who make rentals and customer order history.

3.3. Ideate

After being clear about the problems, the next step in the Ideate stage is to make a potential solution to develop the system. It started with defining the workflow for future work supported by the GMS website as shown in Figure 4.
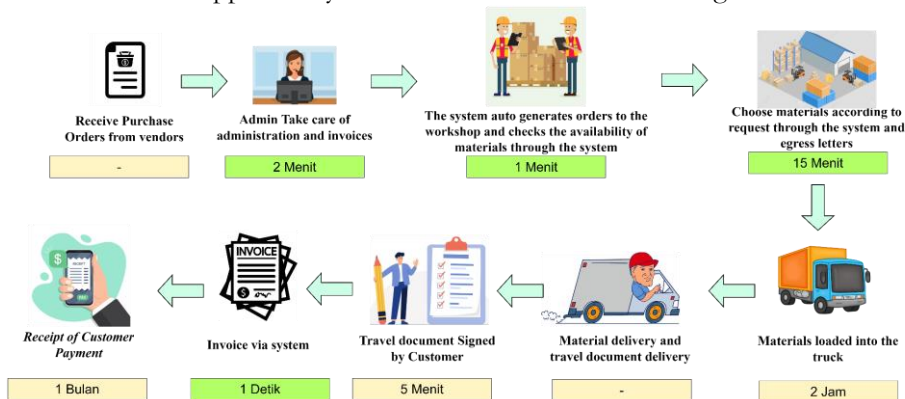
Figure 4. GMS new operation workflow

The features in the UI/UX prototype will have 2 actors, namely: *editing* and *view* (as a viewer only). In editing actors, there are 5 types of use case diagrams and flowcharts, including:

1. Use case diagram/flowchart dashboard menu.
2. Use case diagram/flowchart menu of data user, work partner, customer data, and material data.
3. Use case diagram/flowchart menu of incoming goods.
4. Use case diagram/flowchart transaction menu.
5. Use case diagram/flowchart menu report.

Figure 5 shows an example of flowchart for the flowchart menu data user, work partner, customer data, and material data. This flowchart will explain the process of operating the GMS website.
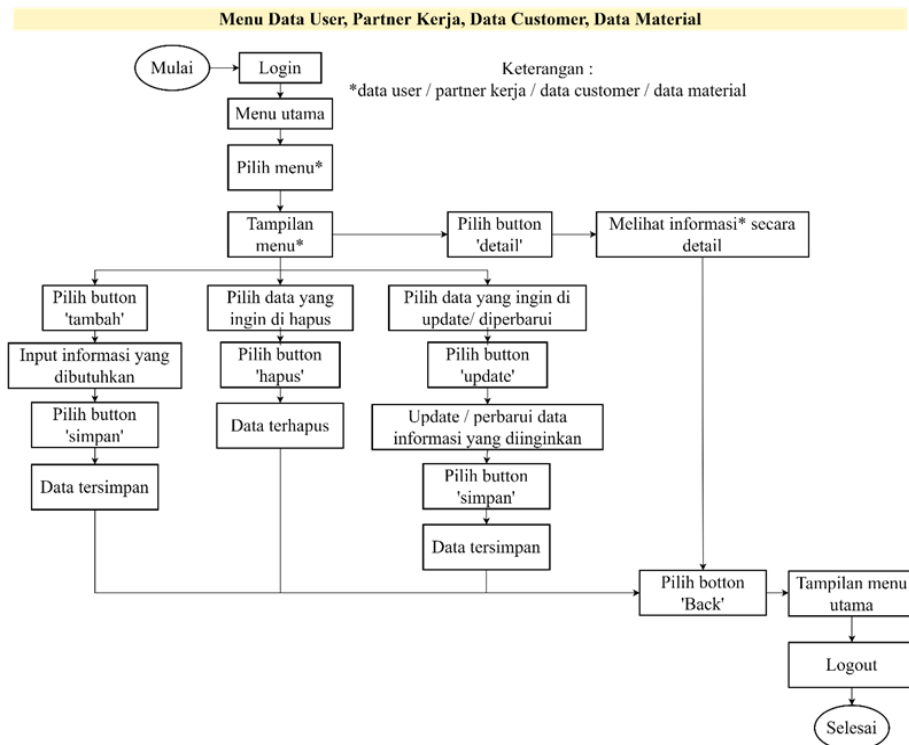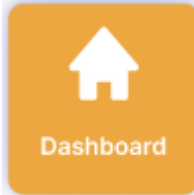
Figure 5. GMS flowchart menu of data user, work partner, customer data, material data.

Meanwhile, in view actors or as viewer only, it only has one type of use case diagram and flowchart form, which is User as Viewer.

Lastly, at the end of the ideate stage, all the requirements of the system are documented in the business requirement document. Those requirements can be classified into four, namely: general/base functionality, security requirement, reporting requirement, and usability requirement. Table 3 shows an example of a requirement for each category.

Table 3. GMS website UI/UX requirement

Problems / User Requests	Improvement	Proposed Design	Impacted Stakeholders
General/Base Functionality			
Main page			

• Inefficient time due to manual calculation of materials and material management. • There is no system to determine the amount of material available, so it must be checked and calculated the amount of material repeatedly.	There is a dashboard feature to view the overall data visualization contained in a website-based system.		● Development team. ● Workshop department. ● Department projects.
Dashboard Page			
• Inefficient time due to manual calculation of materials and material management. • There is no system to determine the amount of material available, so it must be checked and calculated the amount of material repeatedly.	There is a dashboard feature to make it easier for users to see: • Amount of materials available and rented, • Total types of materials, • The amount of material in warehouses 1 and 2.		● Development team. ● Workshop department. ● Department projects.
Customers do not pay bills on time so it takes a lot of time to bill.	There is a dashboard feature to view: • Remaining contract time		
Security Requirement			
Main page			
Restrictions for users who can enter the system. Only users are registered in the system and only FA department, project dept. and workshops dept.	On the login page, enter the username and password registered in the system.		● Development team. ● Departmental workshops. ● Department projects. ● Dept. Financial & accounting

			(Dept. FA)
There are 2 actors in the website system, namely editing and view.	On the user data page, there is a user level table, namely editing which can make changes to the data and the view is only limited to viewing.	<table><tr><td>Jabatan</td><td>Level</td></tr><tr><td>Admin Dept. Workshop</td><td>Editor</td></tr><tr><td>Administrasi</td><td>Editor</td></tr><tr><td>Admin FA</td><td>Editor</td></tr><tr><td>FA Manager</td><td>View</td></tr><tr><td>Project Manager</td><td>View</td></tr></table>	• Development team.
Reporting Requirement			
The system will generate monthly and annual reports of cooperation income from customers to streamline the scaffolding material management process.	Create a report menu which is integrated with the customer data menu, material menu, incoming material menu and transaction menu.	<table><tr><td>No</td><td>Nama Customer</td><td>Tanggal Kerjasama</td><td>Kode Material</td></tr><tr><td>1.</td><td>PT. Pupuk KalTim</td><td>01 Jul 22 s/d 14 Feb 23</td><td>M-0160 M-0340 M-0340</td></tr><tr><td>2.</td><td>PT. Badak</td><td>20 Jul s/d 20 Nov 22</td><td>M-0240 M-0340</td></tr><tr><td colspan=2>Nama Material</td><td>Jumlah Material Satuan</td><td>Total Pemasukan</td></tr><tr><td colspan=2>Base Plate</td><td>200 Buah</td><td></td></tr><tr><td colspan=2>EndFrame</td><td>150 Buah</td><td>Rp 300.500.000</td></tr><tr><td colspan=2>Pipa 2 Meter</td><td>250 Buah</td><td></td></tr></table>	• Development team. • Department projects. • Dept. Financial & accounting (Dept. FA)
Usability Requirement			
The interface designed for the manufacture of a scaffolding material management system must be responsive, the right display on laptop and desktop devices, which with the basic colors match the company logo.	Preparation of website layout and website design forms, arranged according to user approval.		• Department projects. • Dept. Financial & accounting (Dept. FA)

3.4. Prototype

At the stage of making a prototype of the Scaffolding Material Management website, we have developed a UI that is tailored to the wants and needs of users. As GMS is an Indonesian based company with the majority of the employees being Indonesian, the language in the prototype is using Bahasa. The following is the appearance and explanation of the website prototype design:

The login page as shown in Figure 6 is a page for users to log in to the scaffolding material management website. On this page will fill in the username and password that have been registered into the system.

Figure 6. "Log In" Page Prototype

After logging in, the user will be directed to enter the main page or homepage on the website as shown in Figure 7.
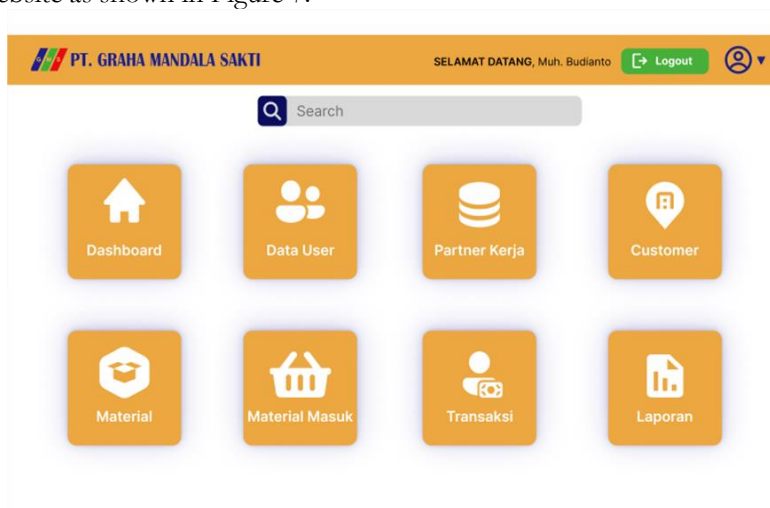

Figure 7. Prototype "Main" Page

On the dashboard page will display a data visualization from the website as shown in Figure 8. Graphical visualization is also available as shown in Figure 9.

Figure 8. Dashboard Page Prototype 1
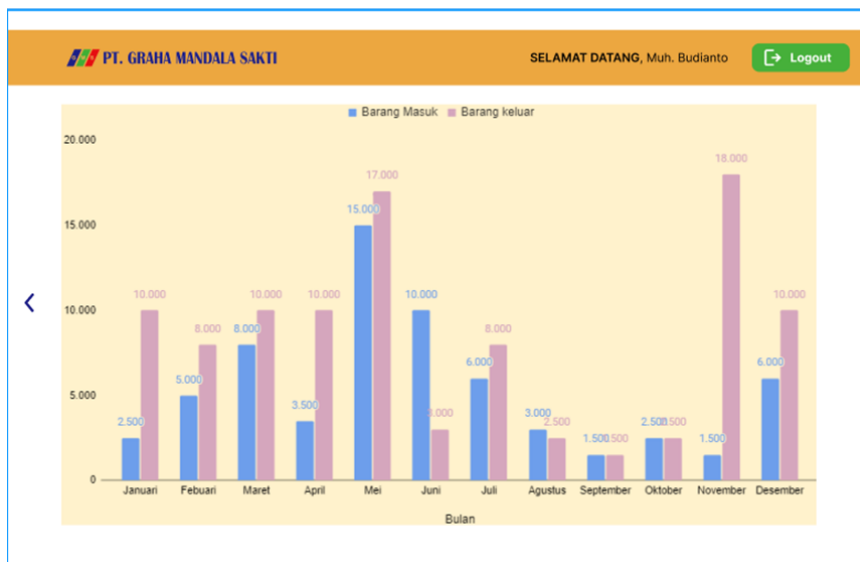
Figure 9. Dashboard Page Prototype 2

The user data page is to display users who are allowed access to the website as shown in Figure 10. Users are divided into 2 actors, namely editor level and view level. Each with a different level of authority.
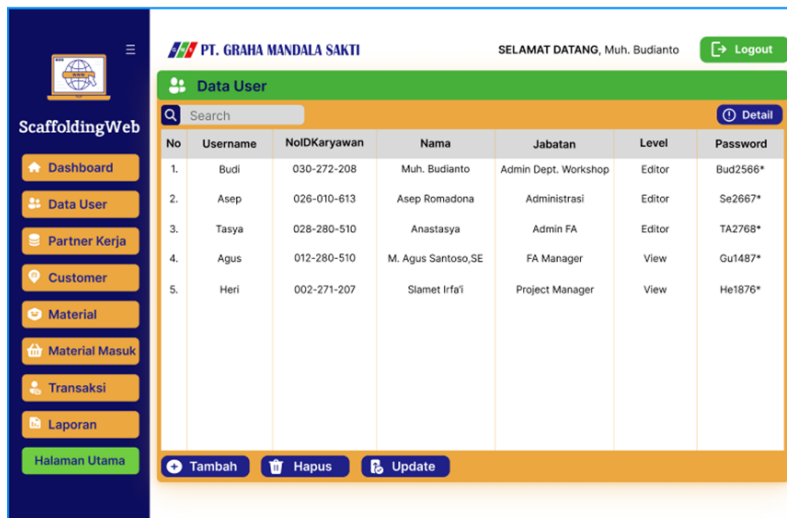
Figure 10. Prototype of "User Data" Page

On the user data page there is an 'add' button to add user data which can be done by editing actors. Figure 11 shows the data information that needs to be entered if want to add users.

Figure 11. 'Add User' Page Prototype

Work partners are companies that collaborate with GMS. Partner data can be added by the user at the editing level or as an editing actor. The UI is similar to the customer data page. On the 'customer' page, is a prototype display to display customer data that has made transactions within the company as shown Figure 12. Adding new customers is also possible here.
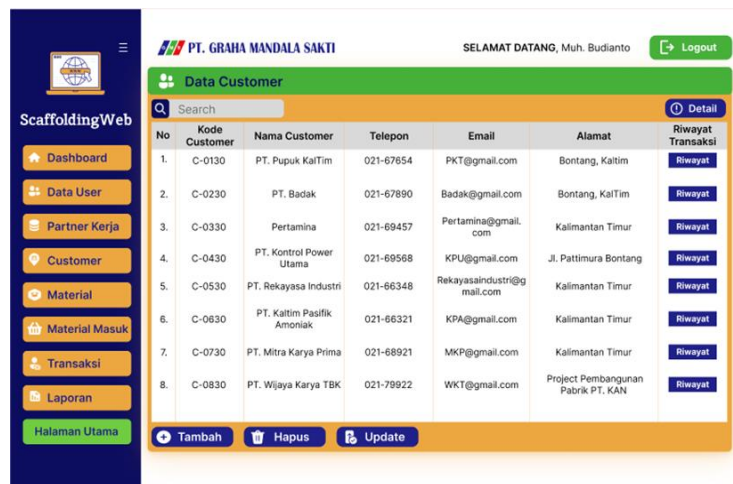
Figure 12. 'Customer' Page Prototype

Connected to the customer data, a detailed history of transactions for each customer can quickly be acquired. This action will pop-up the page as shown in Figure 13. On the 'material' page as shown in Figure 14, is a UI prototype to display material data or material types available at GMS.

Figure 13. Customer Page Prototype 'Transaction History'

Figure 14. Prototype Page 'Materials'

The 'material entry' page, is to display material data that has been returned by the customer during the rental period or the contract period with the company as shown in Figure 15. When there is scaffolding material that is returned from services, it will be recorded here. Thus, the control towards the material can be made clear.

Figure 15. 'Incoming Material' Page Prototype

On the 'transaction' page, is to display transaction data made between the company and the customer as shown in Figure 16. Every time a customer rent the service,

the number of material, from which warehouse, and the total transaction nominal can be monitored easily.

Figure 16. 'Transaction' Page Prototype

Figure 17 shows the history of travel documents and also how to make a new one, while Figure 18 shows the printed travel documents. With this, delivery administration will be easier and faster.

Figure 17. Prototype Transaction Page 'Input Information for Travel Documents'

Figure 18. GMS Travel Document

Figure 19 shows how to send an invoice via Whatsapp, while Figure 20 shows invoice via email. The different options make sure that customers can be reached in different ways. Thus, it will reduce the risk of payment delay.
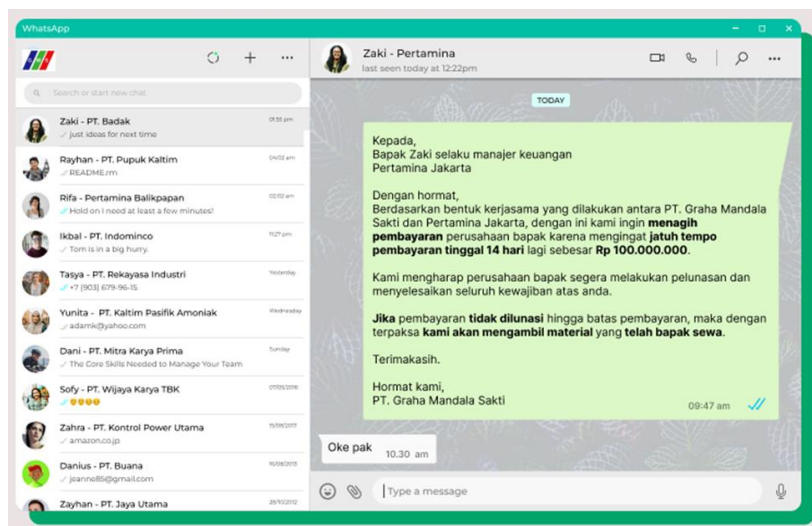
Figure 19. Billing via Whatsapp

Figure 20. Email Billing

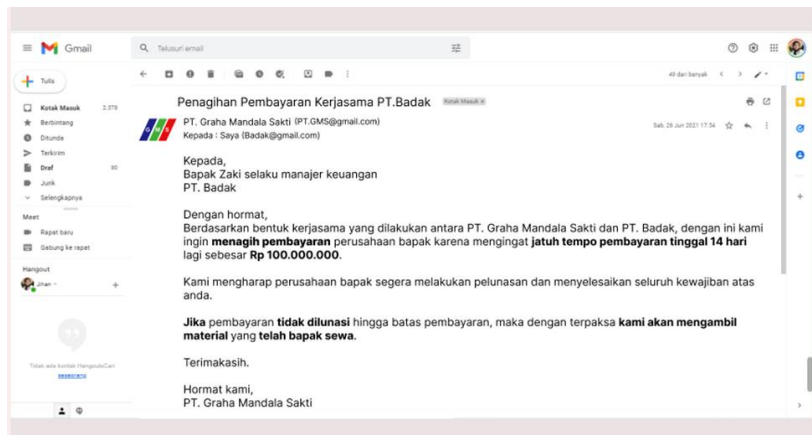The report menu page as shown in Figure 21 is a prototype display for users to view monthly or annual reports on the rental of scaffolding materials.

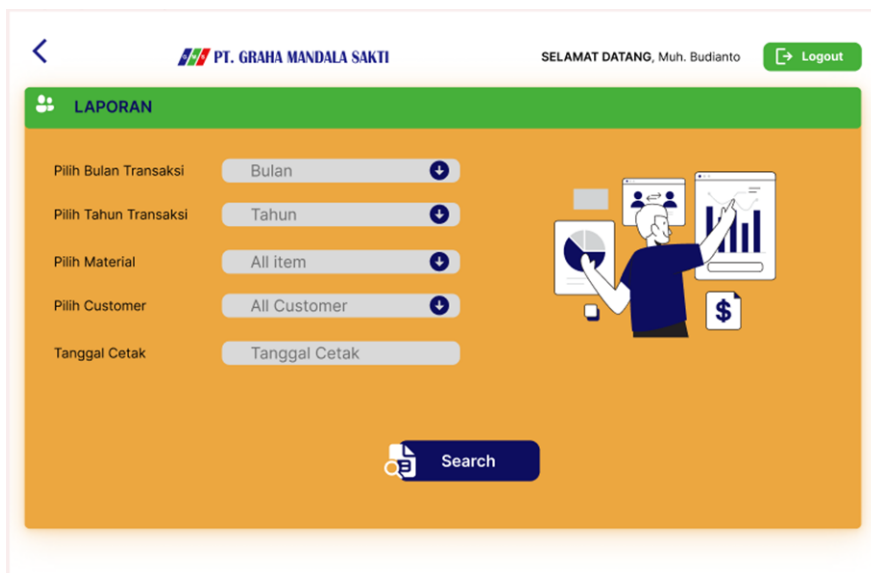
Figure 21. Report Page Prototype

After entering the desired choice of information, the website system will display the information as shown in Figure 22. In the report menu there is a 'print' button to print the company's transaction report.

Figure 22. Report Page Prototype 2

3.5. Test

Before carrying out the testing stage, a 'use case scenario' is made first to find out the stages of the proposed website design. Then, after creating a use case scenario, questionnaires were distributed to evaluate the web-based UI/UX that had been designed. A total of 32 people participated. The questionnaire uses a Likert scale statement of 1-5 (Strongly Disagree – Strongly Agree), which consist of 10 statements/questions:

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very awkward to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

Then, the questionnaire was processed based on the System Usability Scale (SUS) method. The results show that the total average value of SUS is 80.86. According to these results, the Adjective Rating is included in the excellent category, from the grade scale side it is included in group B. Then, from the Acceptability side, it

is in the acceptable group. So, it can be concluded that the system created has good usability and can be used sustainably.

4.   CONCLUSION

According to the development of the UI/UX prototype following the design thinking approach in this study, it is concluded that the problem formulation of the UI/UX development were obtained from the results of Empathize, Define stage, by utilizing empathy map, user persona, and user journey map. The requirement is then clarified in Ideate using Use Case Diagram and Business Requirement Document. The requirements are divided into: general/base functionality, security requirements, reporting requirements, usability requirements. The Prototype design of the UI/UX for web-based scaffolding material management is made using figma tools to give better visualization and experience. As for the Test of usability, it was found that the total average SUS value was 80.86. According to these results, it can be concluded that the system created has good usability and can be used on an ongoing basis.

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