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Utilizing Design Thinking and User Experience Research for Effective Agricultural Labor Recruitment Web Application Design

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Abstract

The agricultural sector faces a significant challenge in recruiting a skilled workforce, with both landowners and tenant farmers struggling to find new laborers. Factors such as inadequate rural infrastructure and facilities, coupled with limited technology adoption, have diminished the appeal of working in the agricultural sector. Consequently, agricultural productivity has declined due to a shortage of adequate labor. To address this issue, a prototype web application named "Partner Tani" was designed to facilitate labor recruitment for farmers. The application design process employed the Design Thinking methodology and the User Experience Questionnaire (UEQ) to thoroughly understand user requirements. The design outcomes encompass both user interface and administrator interface components, developed using Figma. The prototype application features functionalities such as login, account registration, profile management, job posting and search, and complaint reporting. Evaluation using the UEQ revealed that the prototype application achieved exceptional scores across all user experience dimensions: Attractiveness (average score: 2,11), Perspicuity (average score: 1,42), Efficiency (average score: 2,33), Dependability (average score: 1,50), Stimulation (average score: 1,75), and Novelty (average score: 1,67). Average scores for Attractiveness, Efficiency, Stimulation, and Novelty fell within the "Excellent" range, while Perspicuity and Dependability scores were above average. These findings indicate that the "Partner Tani" application prototype holds promise in delivering a satisfying and efficient user experience for agricultural labor recruitment.

Keywords: design thinking, farmer, prototype, recruitment, user experience questionnaire

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I. INTRODUCTION

The multifaceted roles of farmers in agricultural activities are highly dependent on their social status and land ownership. Farmers can be categorized into several groups, namely landowners, sharecroppers, and agricultural laborers. Landowners are individuals who hold ownership rights to agricultural land, while sharecroppers are those who rent or have contracts with landowners to manage and cultivate the land. On the other hand, agricultural laborers are individuals who work in agriculture without owning land and generally rely on wages as their primary source of income [1]. These differences in social status and land ownership also influence the division of tasks and responsibilities in agricultural activities, particularly in the rice cultivation process [2]. Managing a one-hectare paddy field requires the participation of approximately 136 workers per day or the equivalent of 136 person days [3]. Processes such as planting and harvesting require a significant number of workers, with the majority of workers coming from sharecroppers and agricultural laborers. Based on an interview with Puji Rahayu, S.Pt., staff of the Rakit

District Agricultural Extension Center, challenges arise when landowners and sharecroppers face difficulties in recruiting new farm workers, primarily due to the younger generation's preference for employment in non-agricultural sectors.

Several factors contribute to the low attractiveness of agricultural work, including inadequate facilities and infrastructure in rural areas. Additionally, the adoption of technology in agriculture remains uneven, resulting in a significant reliance on labor-intensive traditional methods among farmers. Consequently, an overall decline in the agricultural workforce has occurred, leading to difficulties for landowners in recruiting sufficient labor. The impact of labor recruitment challenges in agriculture can be exemplified in Rakit District, Banjarnegara Regency, Central Java, Indonesia. According to data from the Central Statistics Agency of Banjarnegara Regency, the region has experienced an increase in unemployment rates between 2021 and 2023, as shown in **Error! Reference source not found.** [4]. This challenge can be addressed through various efforts, including optimizing existing agricultural potential. Rakit District has significant agricultural potential that can be utilized to improve the living standards of the local community [5].

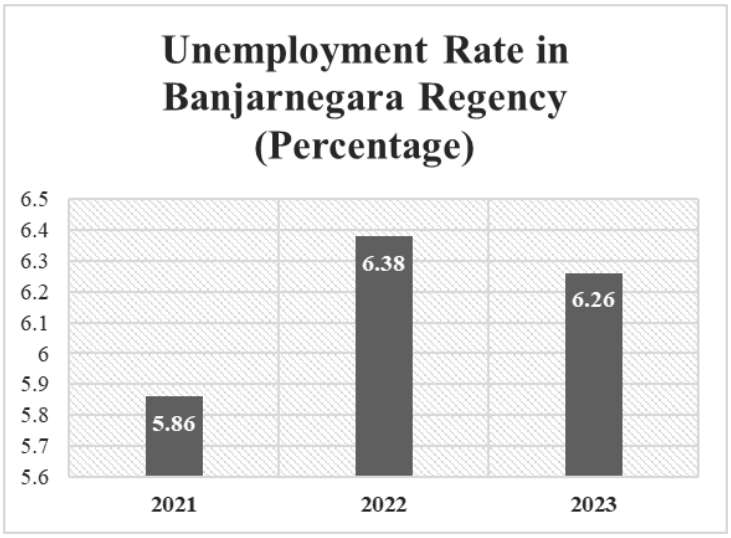

Fig. 1. Unemployment Rate in Banjarnegara Regency (Percentage)

However, labor recruitment constraints have led to a decline in agricultural production and productivity in recent years. Several factors contribute to the difficulty in recruiting agricultural labor, as corroborated by the interview with Mr. Hadi Karsan, the head of the Sumber Makmur Farmers Group. He stated that high price bargaining between landowners and agricultural laborers increases production costs for landowners if they have to pay higher wages to laborers; lack of coordination and communication between farmers and agricultural laborers; and lack of information on labor availability in surrounding villages. These findings highlight the need for a more structured and innovative approach to address this issue, such as modern labor recruitment platforms and mobile applications, as supported by previous research demonstrating their effectiveness in increasing labor availability and reducing production costs [6].

Based on the identified issues, the proposed solution is the design of a web-based Farmer Partner Application prototype that can understand the needs of farmers in recruiting agricultural labor. Designing the system before entering the system development stage is a must to ensure that the resulting solution is truly relevant and effective in addressing the problems faced by users [7], in this case, farmers who need agricultural labor. By utilizing the Design Thinking method and the User Experience Questionnaire (UEQ), the application design process becomes more focused and comprehensive, allowing for a deeper understanding of user needs and desires [8]. Stages such as designing system architecture and user interface and processes are crucial in ensuring that the application can be well-designed to provide a satisfying user experience. Evaluation through UEQ is also an important step in ensuring that the application can meet the expectations and needs of users to the maximum.

II. RESEARCH METHOD

This research employs the Design Thinking methodology to develop a web-based prototype application for agricultural labor recruitment, “Partner Tani”, which facilitates the transaction of labor services by farmers. Design Thinking offers a user-centered approach to web app prototyping [9], fostering creativity [10], early feedback [9], collaboration [10], and reduced development risk [9]. However, it can be time-consuming [10], resource-intensive [10], may have limited technical scope [11], and potentially

overemphasize low-fidelity prototypes [11]. The application is designed to understand the specific needs of farmers in recruiting agricultural labor in Rakit District, Banjarnegara Regency, Central Java, Indonesia. **Error! Reference source not found.** outlines the research phases, illustrating the progression of the study from inception to completion.

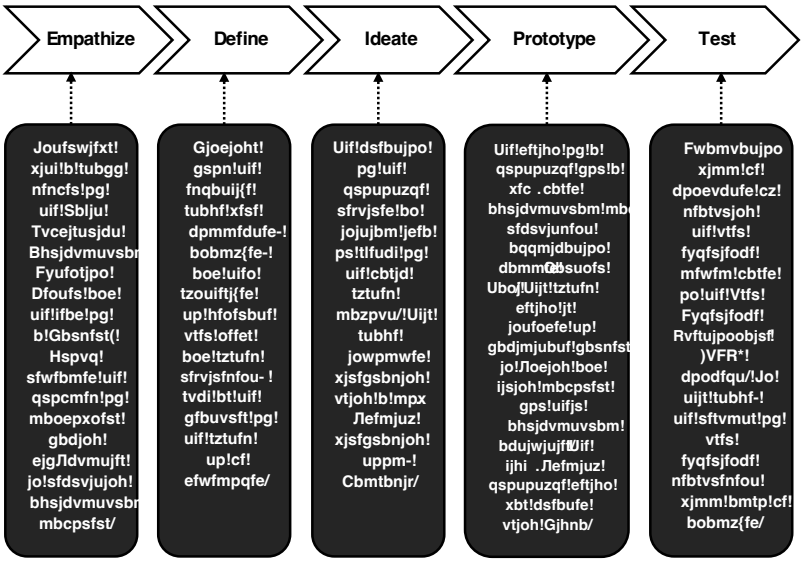

Fig. 2. Research Flowchart [12]

A. Empathize

The initial phase of Design Thinking, Empathy, emphasizes the importance of deep user understanding [13]. In this context, participants are encouraged to adopt the user's perspective, set aside personal assumptions, and focus on their needs and perspectives. This aims to identify objective and targeted solutions. During this phase, interviews were conducted with one staff member of the Rakit District Agricultural Extension Center and the chairman of the Farmer Group. These interviews revealed the primary challenge faced, which is the difficulty landowners encounter in recruiting agricultural laborers.

B. Define

The second stage in design thinking is called “define”. In this stage, the focus is clearly defining the problem [13]. This step is typically done to ensure that the problem to be solved is well-formulated and agreed upon by decision-makers. By synthesizing the insights and findings from the Empathize stage, we can generate user needs and system requirements, such as the features that should be included in the prototype design of the system to be developed.

C. Ideate

The preceding two stages have established a user-centered foundation. The following stage, Ideate, employs brainstorming techniques to foster innovative design exploration [13]. Ideate encourages the broad exploration of diverse solutions as a springboard for creating user-testable models. Beyond common brainstorming methods like listing and task matching, design thinking also utilizes diagrams, arrows, and simple sketches to capture as many solution ideas as possible, regardless of format. Prototype development is grounded in the ideation of basic system layout sketches or concepts. This stage involves wireframing using low-fidelity wireframing tools like Balsamiq.

D. Prototype

This stage represents the most crucial step in this research [13], involving the creation of a high-fidelity prototype design for a web-based agricultural labor recruitment application called “Partner Tani”. This system design is intended to facilitate farmers in finding and hiring laborers for their agricultural activities.

The system will accommodate two types of users: farmers and administrators. The prototype design was developed using a high-fidelity interface and Figma, a collaborative web application for interface design.

E. Test

The final stage of design thinking, following the completion of the prototype design, is testing [13]. This testing phase will evaluate the user experience level using the User Experience Questionnaire (UEQ). The results of user experience measurement will be analyzed during this stage. The purpose of using this questionnaire is to rapidly evaluate the perceived user experience. UEQ is an evaluation method that employs six rating scales: attractiveness, clarity, efficiency, accuracy, stimulation, and novelty. UEQ comprises 26 question components and seven response options [14].

III. RESULTS AND DISCUSSION

This section will follow the research flow outlined in the methodology flowchart. The primary objective of this study is to design and implement a web-based application prototype named “Partner Tani”. The study participants are farmers located in Rakit District, Banjarnegara Regency, Central Java, Indonesia. The application will be utilized by these farmers to facilitate the process of finding and recruiting agricultural laborers to support their farming activities.

A. Driven Problem Understanding (Empathize)

During the Empathize stage, data was gathered through in-depth interviews with two key informants: Mr. Hadi Karsan, the chairman of the “Sumber Makmur” Farmers’ Group, and Ms. Puji Rahayu S.Pt., a staff member at the Rakit District Agricultural Extension Office. Two-way discussions were conducted to gain a comprehensive understanding of the Agricultural Extension Office's working system for farmers in the area, the challenges faced in finding agricultural laborers during the planting and harvesting seasons, and the difficulties in obtaining information about labor availability in other villages due to a lack of reliable contacts. Additionally, other issues raised included the difficulty for agricultural laborers to find employment due to a lack of connections with farmers and landowners, and the fact that agricultural laborers are not yet registered as members of farmers' groups. The estimated number of farmers required for agricultural work is around 15-20 workers for a 0,5-hectare plot or around 30 workers for a 1-hectare plot. Furthermore, difficulties in determining the wage system were also revealed, with labor prices tending to spike two to three times the original price due to price negotiations.

B. Comprehensive Problem Identification (Define)

The Problem Analysis section aims to analyze the system and user requirements for the web-based “Partner Tani” application. This application is designed to assist farmers in Rakit District in connecting with agricultural laborers and obtaining information related to agricultural services. To effectively address the identified problems and challenges, a comprehensive system and user requirements analysis was conducted. This involved understanding the agricultural business processes in Rakit District and **identifying functional and non-functional requirements** for the “Partner Tani” application.

1. Identifying Functional Requirements

Functional requirements define the specific tasks and actions that the application must perform. These requirements were identified through an analysis of business processes in Rakit District and user interviews. The key functional requirements include:

a) ***User registration and login:*** Users must be able to register and log in to the application to access its features.
b) ***Profile management:*** Users should be able to manage their profiles, including personal information and contact details.
c) ***Service posting and searching:*** Landowners and farmers should be able to post service requirements, while agricultural laborers should be able to search for available services.
d) ***Chatting and negotiation:*** Users should be able to communicate with each other through chat to discuss service requirements and negotiate prices.
e) ***Booking and payment:*** Landowners and farmers should be able to book service from agricultural laborers, and payments should be processed securely through the application.

f) ***Reporting and feedback:*** Users should be able to report any issues or provide feedback to the application administrators.

2. Identifying Non-Functional Requirements

Non-functional requirements define the quality attributes of the application, such as performance, security, and usability. These requirements were also identified through user interviews and analysis. The key non-functional requirements include:

a) ***Performance:*** The application must be responsive and efficient, even with a large number of users.
b) ***Security:*** The application must protect user data from unauthorized access and ensure secure transactions.
c) ***Usability:*** The application should be easy to use and navigate, even for users with limited technical skills.
d) ***Reliability:*** The application must be reliable and available to users at all times.
e) ***Maintainability:*** The application should be easy to maintain and update.

C. Generating Creative Design Concepts (Ideate)

Following the identification of user needs, the subsequent step in the Ideate stage of design thinking involves software modeling using Unified Modeling Language (UML) as the primary tool. Use case diagrams are employed to illustrate the interactions between users and the system, as exemplified in **Error! Reference source not found.**, which depicts the use case diagrams for the Partner Tani web application.

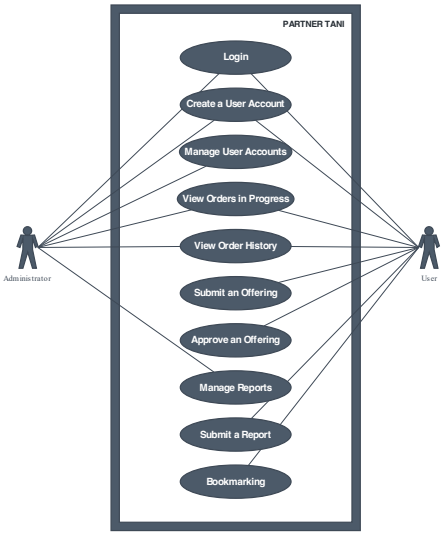

Fig. 3. Use Case Diagram for the Web-Based Partner Tani Application

The preceding stages have established a user-centered foundation. The subsequent stage, Ideate, utilizes brainstorming techniques to stimulate innovative design exploration. Ideate encourages the broad exploration of diverse solutions as a springboard for creating user-testable models. Prototype development is grounded in the ideation of basic system layout sketches or concepts. This stage involves wireframing using low-fidelity wireframing tools like Balsamiq. Low-fidelity wireframes depicting user interactions for browsing available job offers and initiating the approval process are presented in **Error! Reference source not found.**.

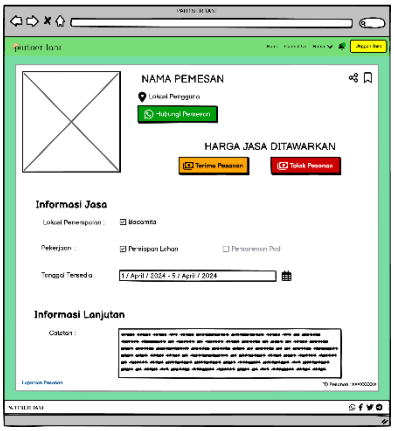

Fig. 4. Low-fidelity design of users receiving Job Offers and initiating the Approval Process

The subsequent low-fidelity wireframe depicting the landing page, which comprises an application description, job categories, and a contact us for user-admin communication, is illustrated in **Error! Reference source not found.**.

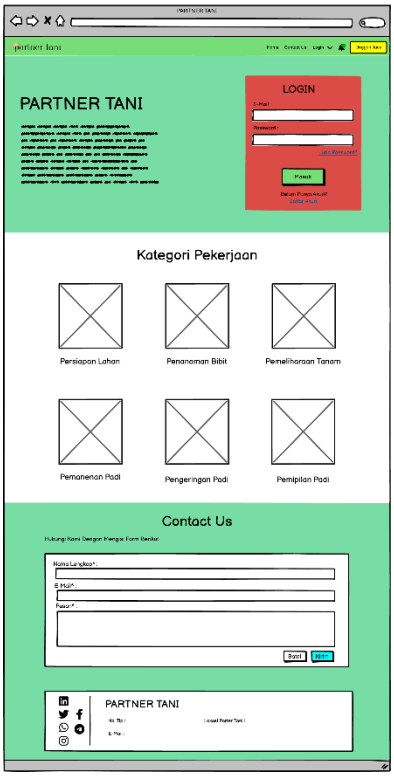

Fig. 5. The low-fidelity homepage design features an application description, job categories, and a contact us

D. User Interface Prototyping

The development of a high-fidelity prototype design for a web-based agricultural workforce recruitment application aims to facilitate farmers' sourcing and recruiting labor for their agricultural activities. The system design caters to two user categories: farmers and administrators. The prototype design was crafted utilizing a high-fidelity interface through the Figma application. The web-based prototype design encompasses various features including user registration and login, profile management, service posting and searching, chatting and negotiation, booking and payment, as well as reporting and feedback functionalities. Presented herein is the high-fidelity prototype design of the Job Offering Page, as illustrated in **Error! Reference source not found.**, featuring farmer photographs, service availability information, and accept and decline service request buttons. Furthermore, the Homepage display, as depicted in **Error! Reference source not found.**, encompasses login options, job categories, and contact information.

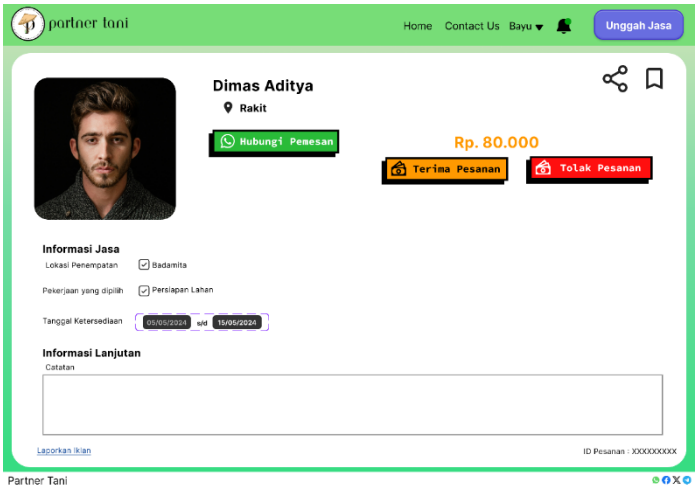

Fig. 6. High-fidelity prototype of the Job Offering Page

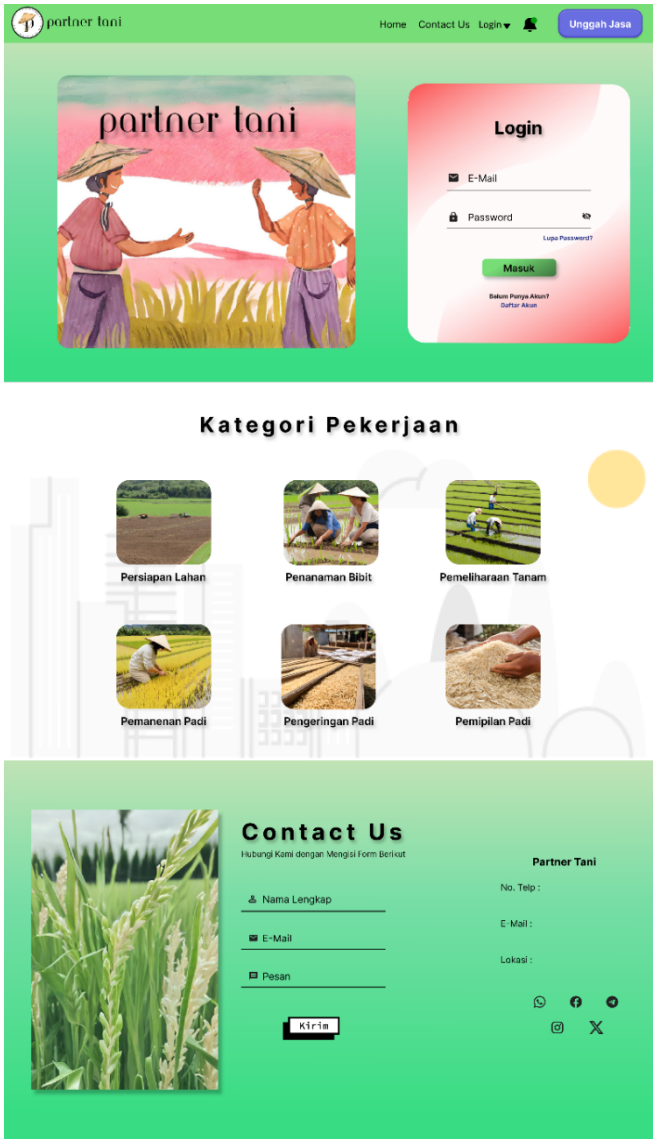

Fig. 7. High-fidelity prototype of the Homepage display

E. User Experience Evaluation (Test)

The evaluation of user experience concerning the high-fidelity prototype design of the web-based Partner Tani application was carried out by distributing questionnaires to actively engaged farmers in the Rakit District, Banjarnegara Regency, Central Java, Indonesia. This testing phase involved assessing the user experience level utilizing the User Experience Questionnaire (UEQ). A total of three farmers participated in the questionnaire completion process. The data obtained from the questionnaires were then entered into the UEQ Data Analysis Tool Version 12. The results of the UEQ data processing are illustrated in **Error! Reference source not found.**.

TABLE I. PRAGMATIC AND HEDONIC QUALITY

	UEQ Scale Scores	User Experience Variable	UEQ Scale Scores
Attractiveness	2,11	Attractiveness	2,111
		Perspicuity	1,417
Pragmatic Quality	1,75	Efficiency	2,333
		Dependability	1,500
		Stimulation	1,750
Hedonic Quality	1,71	Novelty	1,667

Error! Reference source not found. presents the UEQ scale scores for the Attractiveness, Pragmatic Quality, and Hedonic Quality dimensions, respectively, as 2,11, 1,75, and 1,71. Based on these results, it can be concluded that the Partner Tani application is positively evaluated in terms of its attractiveness dimension with a score of 2,11, indicating good acceptance of the design, aesthetics, and features presented. However, the pragmatic quality aspect of the application, indicated by a score of 1,75, is rated slightly below average, suggesting potential for improvement in terms of usability, efficiency, and overall performance. Similarly, the hedonic quality dimension, which received a score of 1,71, indicates that there is room for improvement in providing emotional satisfaction and sensory experiences to users of the Partner Tani application.

TABLE II. COMPARISON TO BENCHMARK

Scale	Mean	Comparison to benchmark	Interpretation
Attractiveness	2.11	Excellent	In the range of the 10% best results
Perspicuity	1.42	Above Average	25% of results better, 50% of results worse
Efficiency	2.33	Excellent	In the range of the 10% best results
Dependability	1.50	Good	10% of results better, 75% of results worse
Stimulation	1.75	Excellent	In the range of the 10% best results
Novelty	1.67	Excellent	In the range of the 10% best results

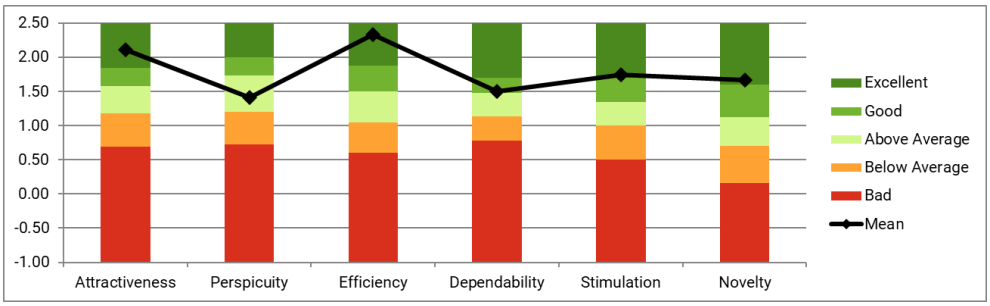

Fig. 8. Mean Comparison Chart for UEQ Benchmarking

The average UEQ scores presented in **Error! Reference source not found.** will be compared to the benchmark values provided in **Error! Reference source not found.**. This comparison aims to gain a deeper understanding of each score within the context of the User Experience Questionnaire (UEQ). In other words, comparing against benchmark values helps in interpreting the extent of the user experience quality of a product or application. The UEQ scale measurement is then compared to the benchmark values listed in **Error! Reference source not found.**, which can be found in **Error! Reference source not found.**. Based on this comparison, we can evaluate the application's performance in each aspect measured by the UEQ. For instance, when examining the results for the Attractiveness aspect with a score of 2,11 recorded

in Table 1 and its interpretation in Table 2 as “Excellent” falling within the top 10% of results, this indicates that the application has a very high level of attractiveness according to UEQ standards. Similarly, interpretations for other aspects such as Perspicuity, Efficiency, Dependability, Stimulation, and Novelty will provide more detailed insights into the application's performance in each dimension. Thus, comparing with the benchmark values in **Error! Reference source not found.** helps in providing a more detailed and contextual understanding of the UEQ scale measurement results, and helps in identifying areas that require improvement or enhancement in the user experience of the application.

IV. CONCLUSION

The design outcome of the "Partner Tani" web-based application for agricultural workforce recruitment aims to facilitate farmers in sourcing and recruiting labor for their agricultural activities. This system design caters to two user categories: farmers and administrators. The prototype design was crafted utilizing the Figma application interface. The web-based prototype design encompasses various features, including user registration and login, profile management, service posting and search, chat and negotiation, booking and payment, as well as reporting and feedback functionalities.

Evaluation conducted using the User Experience Questionnaire (UEQ) revealed outstanding scores across all dimensions of user experience for the prototype application: Attractiveness (average score: 2,11), Perspicuity (average score: 1,42), Efficiency (average score: 2,33), Dependability (average score: 1,50), Stimulation (average score: 1,75), and Novelty (average score: 1,67). Average scores for Attractiveness, Efficiency, Stimulation, and Novelty were categorized within the “Excellent” range, while Perspicuity and Dependability scores surpassed the average. These results signify the potential of the “Partner Tani” application prototype in delivering a gratifying and effective user experience for agricultural labor recruitment.

This study garnered positive responses from farmers in the Rakit District, Banjarnegara Regency, Central Java, Indonesia. As a recommendation, further research could focus on implementing the design by transitioning to the application coding phase to enable utilization by farmers in the Rakit District, Banjarnegara Regency, Central Java, Indonesia. Additionally, a more in-depth investigation into Design Thinking methodologies is warranted to facilitate the ongoing development and enhancement of the conducted research in the future.

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