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An Integrated User Experience and Usability Analysis of the Foreign Construction Worker Equivalency System Using the Five Planes Framework and Heuristic Evaluation

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ABSTRACT

The digitalization of Foreign Construction Worker Equivalency (TKKA) services at the Construction Services Development Board (LPJK) faces critical usability constraints that disrupt transnational bureaucratic efficiency. This study aims to optimize the user experience (UX) and usability of the web-based TKKA application by proposing a sequential integration of The Five Planes framework and Heuristic Evaluation. Data collection was conducted through user interviews and questionnaires to extract system requirements. The analysis synthesized 32 core UX specifications, which were subsequently mapped into the five architectural planes to guide the prototype redevelopment. Usability verification of the redeveloped system was executed through an expert-led Heuristic Evaluation combined with a user validation survey. The empirical results indicate favorable user perceptions of the evaluated system, achieving a Variable Index of 4.04 and an 80% satisfaction rate (Cronbach's Alpha = 0.981). This study confirms that integrating a structural design framework with expert heuristic screening effectively mitigates interface flaws, fulfills complex regulatory requirements, and accelerates digital public service workflows.

Keywords: E-Government, Heuristic Evaluation, The Five Planes, Usability, User Experience

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1. INTRODUCTION

Digital transformation in public service delivery has prompted government agencies to develop information systems that prioritize not only operational efficiency but also the quality of user experience and usability. According to the ISO 9241-210:2019 standard, user experience is defined as a person's perceptions and responses resulting from the use and/or anticipated use of a product, system, or service [1]. Meanwhile, the ISO 9241-11:2018 standard defines usability as the extent to which a product can be used by specified users to achieve specific goals effectively, efficiently, and with satisfaction within a specific context of use. E-government implementation serves as a key approach to enhancing service accessibility, transparency, and accountability using information technology [2] . In the construction services sector, the digitalization of administrative services plays a strategic role, particularly in supporting multi-stakeholder workforce competency management. One service requiring information system support is the competency equivalency process for Foreign Construction Worker Equivalency (TKKA), as mandated by Government Regulation Number 14 of 2021 concerning the Implementing Regulations of the Construction Services Law. The Construction Services Development Board (LPJK) operating under the Ministry of Public Works and Public Housing (PUPR) plays a central role in administering this competency equivalency service [3]. The process entails a complex workflow ranging from document submission, requirement checks, and competency verification to final validation that demands information accuracy and cross-boundary coordination. The complexity of the administrative process, the diverse backgrounds of international users, and the need for service reliability make user experience quality and usability decisive factors in the success of the TKKA competency equivalency web application. The web application for TKKA equivalency used within LPJK services—must accommodate the needs of users across various roles, ranging from business entity applicants (acting as employers) to the verifiers and auditors responsible for document inspection. User interactions with the system encompass data entry, the uploading of required documents, application status monitoring, and follow-up actions based on verification and validation results. The complexity of these interactions demands an intuitive interface, consistent navigation, clear information presentation, and a workflow that aligns with business processes. Discrepancies between the interface design and user

needs can lead to data entry errors, difficulties in understanding service stages, and obstacles in completing administrative procedures. Therefore, evaluating User Experience and usability is essential to identify gaps between user requirements, system functions, and interface implementation. This analysis is crucial because the success of a digital service system depends not only on feature availability and technical reliability but also on the ease with which users can achieve their goals through system interaction.

In the field of human-computer interaction, Heuristic Evaluation is a usability evaluation method used to identify interface issues based on a set of heuristic principles. Introduced by Jakob Nielsen, this method enables evaluators to inspect a system's interface based on aspects such as system status visibility, the match between the system and the real world, user control and freedom, consistency, error prevention, and recognition rather than recall. Heuristic evaluation helps identify interaction issues and classify their severity (severity rating), serving as a basis for formulating improvement recommendations [4]. Although previous research has extensively utilized Heuristic Evaluation (HE) to quickly and efficiently identify usability issues, most studies stopat problem identification without providing a structured path for design reconstruction. Conversely, The Five Planes framework (Strategy, Scope, Structure, Skeleton, and Surface) offers comprehensive guidance for user interface design but requires precise diagnostic input to determine existing system weaknesses. These limitations motivate the integration of Heuristic Evaluation and The Five Planes in this study. By integrating these two approaches, this research provides a framework that not only detects and prioritizes usability issues through heuristic principles, but also directly translates these findings into systematic design recommendations across all planes. Consequently, this approach ensures that every design decision is directly anchored in empirically identified usability issues rather than subjective assumptions.

One framework applicable to analyze user experience is "The Five Planes," proposed by Jesse James Garrett. This framework describes user experience through five interconnected levels: the Strategy Plane, Scope Plane, Structure Plane, Skeleton Plane, and Surface Plane. The Strategy Plane focuses on organizational goals and user needs, while the Scope Plane encompasses the determination of functional requirements and system content. Furthermore, the Structure Plane addresses information structure and interaction flow; the Skeleton Plane focuses on layout and interface design, and the Surface Plane covers the visual aspects that directly interact with the user [5] . This framework offers a systematic perspective for understanding the relationship between user needs and application design elements, spanning from conceptual aspects to visual implementation. However, applying The Five Planes as an analytical framework for an existing system requires empirical support; otherwise, the identification of needs and the formulation of recommendations would rely solely on the designer's assumptions [6] .

Given the characteristics of these two approaches, a methodological gap exists that can be bridged by integrating Heuristic Evaluation and The Five Planes into a unified analytical workflow. Heuristic Evaluation serves effectively as an instrument for problem discovery [4] . Yet, transforming the resulting list of interface issues into a solution architecture (solution mapping) within The Five Planes requires an intermediary tool capable of structurally dissecting the root causes of system failures. Consequently, this study incorporates the Fishbone (Ishikawa) diagram as a tool for root cause analysis. Through the Fishbone diagram, usability defects identified by experts are analyzed based on causal clusters—such as human factors (man), business processes (method), and technology (machine). The findings from this root cause analysis provide a valid empirical foundation for redesigning the system across each level of The Five Planes, ensuring that the reconstruction is not based merely on the designer's subjective assumptions. This study employs a sequential analysis approach that integrates Heuristic Evaluation, Fishbone diagrams, and the "Five Planes" framework within the context of administrative services for the equivalency certification of foreign construction workers. Its novelty lies in this tripartite hybrid integration procedure, which systematically links interface error diagnosis and the tracing of bureaucratic root causes to the formulation of an adaptive new system blueprint. Therefore, this study aims to integrate the Heuristic Evaluation method with The Five Planes framework to produce structured and evaluated user interface redesign recommendations for the Foreign Construction Worker Equivalency System, as well as to evaluate the extent to which this integration improves user experience and satisfaction.

2. RESEARCH METHODOLOGY

This study employs a mixed-methods approach with an exploratory sequential design. This approach combines qualitative and quantitative analyses in a phased manner to evaluate the user experience (UX) and usability of the Foreign Construction Worker Equivalency (TKKA) web application at the Construction Services Development Board (LPJK) under the Ministry of Public Works (PU). The qualitative stage is carried out through observation, interviews, and cause-and-effect analysis using a Fishbone diagram to identify initial problems. Next, a heuristic evaluation based on Nielsen's principles is used to identify usability problems, which are then mapped using The Five Planes framework to formulate UX improvement recommendations. The quantitative stage is carried out by grouping and calculating evaluation findings based on heuristic principles and relevant user experience aspects. The integration of both types of data is carried out by linking the results of qualitative problem identification with the results of quantitative measurements to determine problem priorities and develop more targeted UX improvement recommendations. The research stages include: (1) problem identification using a Fishbone diagram, (2) usability evaluation using heuristic evaluation, (3) mapping findings based on the The Five Planes framework, (4) quantitative analysis of evaluation findings, and (5) integration of qualitative and quantitative results to formulate recommendations for UX improvements [7].

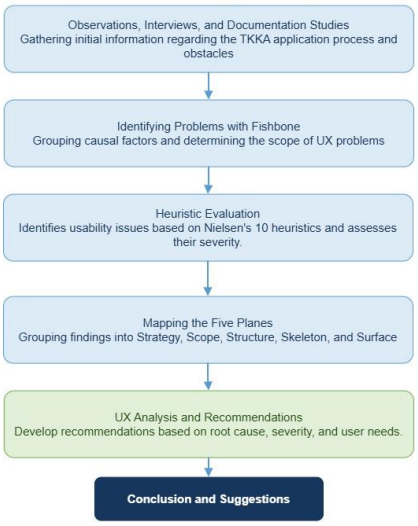


Figure 1 Research Method Flow

A. Participants and Data Collection

Data collection was conducted via a questionnaire involving 40 respondents who had used or possessed knowledge regarding the Foreign Construction Worker Equivalency (TKKA) System. The respondents consisted of 22 representatives from Foreign Construction Service Business Entities (BUJKA) acting as applicants, 16 personnel from the Construction Services Development Board (LPJK), and 2 personnel from the Directorate of Construction Competency and Productivity under the Ministry of Public Works. The selection of these respondents aimed to capture perspectives from both applicants and service providers regarding their experiences with the application [8].

Based on demographic characteristics, respondents were categorized by age and educational background. The age distribution included 15 respondents (37.5%) in the 20–30 age group, 17 (42.5%) in the 31–40 age group, and 8 (20%) in the 41–60 age group. Regarding educational attainment, 3 respondents (7.5%) held a high school or vocational diploma (SMA/SMK), 3 (7.5%) held a associate degree (D3), 27 (67.5%) held a bachelor's degree (S1), and 7 (17.5%) held a master's degree (S2). These characteristics describe the profile of the respondents who participated in the UX evaluation.

In addition to the questionnaire, this study employed observation and interviews to identify and confirm user experience issues. Requirement validation and proposed improvements were conducted through interviews with the head of the TKKA equivalency implementation team and two IT experts from the LPJK who have experience developing the Indonesian Construction Information System (SIKI). These interviews aimed to assess the alignment between user requirements and business processes, as well as the feasibility of implementing these requirements within the application.

B. Problem Identification Using the Fishbone Diagram

The initial stage of the research aimed to identify issues affecting the optimization of the TKKA equivalency application. Identification was carried out through observation of the application's usage process, interviews with stakeholders involved in the service process, and a review of existing documentation and previously identified issues. To ensure methodological transparency, the validity of initial indications regarding managerial constraints derived from internal agency data or reports was verified through this field observation.

The identified issues were analyzed using a Fishbone diagram. The fishbone diagram, also known as the Ishikawa diagram or cause-and-effect diagram, is a quality management tool used to identify the various possible causes of a problem [9]. This diagram was used to categorize potential causes based on cause-and-effect relationships, thereby providing an overview of the factors contributing to obstacles in the TKKA equivalency process. Identified factors encompassed aspects such as human resources, service processes, information technology, and the application itself. The human resources aspect covered staff responsiveness and auditor experience, while the information technology aspect included the availability of system management resources. Regarding the application, the analysis focused on ease of use, the clarity of the submission workflow, the presentation of verification status information, and the availability of features and documents required by users.

The results of the Fishbone analysis served as the basis for defining the scope of the UX evaluation. This research specifically focuses on issues directly related to the application, such as navigation difficulties, form completion, information delivery, and access to process output documents. Meanwhile, organizational and human resource factors serve as supporting context and are not analyzed further as primary research variables.

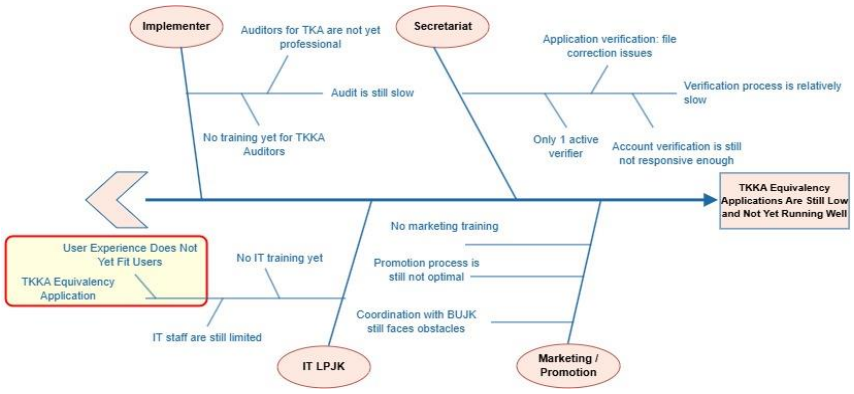


Figure 2 Implementation Fishbone Method

C. Usability Evaluation Using Heuristic Evaluation

After identifying initial problems using a Fishbone diagram, the next step is to conduct a usability evaluation using the Heuristic Evaluation method based on Nielsen's ten heuristic principles. The evaluation is conducted by evaluators with an understanding of usability, human-computer interaction, or experience using digital service applications. The number of evaluators is determined based on the availability of those who meet competency criteria to mitigate bias from single subjectivity. The evaluators explore the main flow of the TKKA equivalency application, from system login, submission, document upload, status monitoring, to the verification process and access to the resulting documents. Each problem finding is recorded and classified based on relevant Nielsen heuristic principles, namely: (1) Visibility of system status, (2) Match between system and the real world, (3) User control and freedom, (4) Consistency and standards, (5) Error prevention, (6) Recognition rather than recall, (7) Flexibility and efficiency of use, (8) Aesthetic and minimalist design, (9) Help users recognize, diagnose, and recover from errors, and (10) Help and documentation [10]. The severity of each problem is assessed using a severity rating scale of 0–4. The severity score is used to determine the problem's priority level. The evaluation results are presented in the form of a list of findings that includes a description of the problem, related heuristic principles, location or application stage, and severity level.

D. Mapping Issue Using The Five Planes Method

The evaluation and mapping of user experience in this study are guided by "The Five Planes" framework developed by Jesse James Garrett (2010). This method aims to transform and visualize user experience patterns across layers defined by specific scope boundaries, which are then synthesized into recommendations for system design [11]. The reconstruction of the User Experience (UX) architecture for the LPJK TKKA equivalency application is examined in depth through the following five hierarchical stages:

1. Strategy Plane
   Gathering comprehensive information to extract fundamental user needs through semi-structured interviews, initial questionnaires, and Focus Group Discussions (FGD), followed by analysis and validation of empirical data.
2. Scope Plane
   Defining functional specifications and information content elements that the system must provide, based on the synthesis of user needs data from the previous stage.
3. Structure Plane
   Mapping users' mental models regarding system interaction through the design of Information Architecture and adaptive Interaction Design.
4. Skeleton Plane
   Creating the layout of information components and low-fidelity wireframes that represent the proposed interface structure for the TKKA equivalency application.
5. Surface Plane
   Designing the final high-fidelity visual aspects in the form of an interactive prototype of the TKKA equivalency application proposed for the Construction Services Development Board (LPJK) [12].

3. RESULT AND DISCUSSION

This section presents the results of the empirical analysis and the discussion regarding the reconstruction of the existing system, utilizing "The Five Planes" framework and Heuristic Evaluation. The restructuring effort aims to extract and align specific User Experience (UX) requirements, thereby producing a valid interaction blueprint for the Foreign Construction Workforce (TKKA) Equivalency web application managed by the Construction Services Development Board (LPJK). The multi-layered analysis process, based on the five hierarchical levels of "The Five Planes," is detailed below. In this study, the Five Planes framework is employed to map findings from the heuristic evaluation while guiding the design of a UX improvement prototype. Usability findings are linked to user needs and translated into design recommendations, which are then operationalized across the Strategy, Scope, Structure, Skeleton, and Surface planes. In this manner, the

framework systematically integrates problem analysis with prototype design, with each layer serving a distinct yet interconnected conceptual function.

A. Strategy Plane

At this initial stage, the analysis focuses on synchronizing user questionnaire data, product development objectives from the stakeholders' perspective, and actual user needs in the field. The formulation of product development objectives is aligned with LPJK's vision of establishing an ideal e-government ecosystem. The primary goals of this system are redesigned center on three crucial parameters: ensuring ease of use (usability), ensuring the functional accuracy of digital features (utility), and achieving optimal user satisfaction when executing transnational administrative services. The analysis of user needs for the TKKA Equivalency application is derived from primary data collected via open-ended questionnaires distributed through Google Forms. The qualitative data gathered from respondents was subsequently analyzed using the Hermeneutic Phenomenology method. This method was adopted to identify themes, patterns, and the essence of substantive user experiences, which were then interpreted in depth to understand real-world challenges in the field[13]. The analysis procedure involves comprehensively understanding the input text and then categorizing the data into two main groups: (1) positive data, representing system elements that meet user expectations; and (2) negative data, representing anomalies or interface aspects that fail to meet usability standards. Once data categorization is complete, the next step is to develop a structured coding scheme to precisely map requirement specifications Functionalitas Use Experience (FUX), as follows:

Table 1. Functionalitas Specifications

Final Code	Feature	Description
FUX1	Email Notification	The application can send email notifications for new audit assignments and TKKA application submissions.
FUX2	Save Button	The application can save verification/audit data before it is sent to the next process.
FUX3	History Menu	Displays the results of verification/audit.
FUX4	Print Official Report (BA) Menu	The Official Report (Berita Acara, BA) can be printed through the system.
FUX5	Determination Menu	A menu for determinations made by the Steering Chair when the outcome differs from the auditor's findings.
FUX6	Option Button	Answer options can be provided for applicant data that is unclear.
FUX7	Flexible/Responsive Display	The interface is made more flexible and better organized so that it can be read intuitively.
FUX8	Equivalency Information & Process Menu	Displays equivalency results and ongoing equivalency processes on the dashboard page, along with a holistic data view.
FUX9	User Guide	An explanatory menu presenting guidance or the sequence of data entry (displayed on the login form).
FUX10	Tooltips, Search Feature, Help	Makes the application easier to use and provides information to users.
FUX11	Interface Improvement	The interface needs improvement: a simple menu that is not overloaded with graphics, yet not monotonous.
FUX12	Color/Differentiator Feature	Distinguished processed from unprocessed foreign worker data in the RPTKA & Job Position menu.
FUX13	Numeric (Integer) Format	The Head Office phone number field accepts numeric input only.
FUX14	Province/Regency Search	Makes it easier to select a province and regency.
FUX15	NIB File Edit	An edit button for users who uploaded incorrect Business Identification Number (NIB) data.
FUX16	Tab/Enter Feature	Tab/Enter key navigation when filling in applicant data.
FUX17	Selection Feature	The implementation year field is converted into an option list generated automatically by the system.
FUX18	Coding Efficiency	Reduces page loading time.
FUX19	Color Icons	Icons are chosen to match the action performed (e.g., check and cross icons) and are color-coded to be more appealing.

Final Code	Feature	Description
FUX20	Automatic Data Fill Feature	After document checking is complete, the system can directly conclude "compliant" or "non-compliant".
FUX21	Assignment-Based Data Display	Displays applicant data according to the audit assignments made by the Executive Chair.
FUX22	Update/Edit Foreign Worker (TKA) Data	Updates data of foreign workers who have previously undergone equivalency when they extend their RPTKA and Vitas/ITAS.
FUX23	Text Area Fields	Input fields use a text area format so that their content is fully visible.
FUX24	File Upload	Improves the document submission process, as some PDF documents fail to be submitted.
FUX25	Filter Feature	A filter for the business entity list.
FUX26	Country of Origin Display	Adds a display of the country of origin of the foreign workers undergoing equivalency.
FUX27	Data Bank Feature/Display	Data is presented in a form viewable by all users as a data bank of TKKA Equivalency activities.
FUX28	Export to Excel	Retrieves TKKA data through the TKKA Equivalency application.
FUX29	Bilingual Language	Bilingual language support in the Job Position menu.
FUX30	Track Record Feature	A track record of information on issued decrees (SK).
FUX31	Validity Period Feature	Information on the RPTKA validity period.
FUX32	Edit RPTKA, ITAS	The system can update a foreign worker's latest RPTKA number when an extension occurs.

B. Scope Plane

In the Scope Plane phase, usability issues identified through Heuristic Evaluation and user needs analysis are translated into functional requirements and content scope for improving the Foreign Construction Worker Equivalency (TKKA) application. This phase ensures that every improvement recommendation is directly linked to identified issues, user needs, and specific system functions that require enhancement or development. The mapping process connects usability findings derived from questionnaires and interviews to corresponding functional requirements. For example, when evaluation findings indicate that users experience difficulties during application submission or verification, these issues are converted into functional requirements to provide clear, accessible status notifications. This process illustrates how empirical usability issues are transformed into actionable system specifications, ensuring that implementation recommendations remain grounded in actual evaluation data.

In addition to mapping functional requirements, the Scope Plane accounts for the overall scope of the web-based application, user requirements across submission and verification workflows, and necessary informational content at each service stage. The formulated requirements were evaluated for alignment with TKKA equivalency business processes and technical feasibility. To validate these aspects, qualitative interviews were conducted with key stakeholders, including the head of the TKKA equivalency program and two IT experts from the LPJK involved in developing the SIKI. This validation verified the alignment of proposed features with organizational policies, workflow mechanics, and technical implementation constraints.

Based on the identification, mapping, and validation processes, a total of 44 UX-related requirements were formulated. Of these, 32 requirements were determined to be feasible for implementation, whereas 12 were classified as infeasible within the current development scope. Key implementation constraints for the deferred requirements included the need for cross-agency policy authorization for system integration, lack of approval for an SMS gateway infrastructure (restricting notifications to email), resource constraints for multi-language localization, and potential user confusion resulting from consolidating three application modules. These outcomes demonstrate that scope definition requires balancing user-centric needs with policy readiness, operational workflows, and technical feasibility.

C. Structure Plan

Once the system scope and boundaries have been established, the structure plane defines the conceptual framework of the application. This plane encompasses interaction design (IxD) and information architecture (IA), which together govern the operational patterns, the sequence of actions, and the flow of information presented to users. Structuring the application in this way helps align system behavior with users' mental models and reduces cognitive load during complex data transactions. Interaction Design. Interaction design focuses on the pathways and choices involved in carrying out and completing administrative tasks. It maps anticipate user behavior and define how the system responds to

user input. By providing predictable feedback and clear error-recovery states, the design supports collaboration among multiple users across all verification checkpoints.

Conceptual Model and Operational Activity Workflow. A conceptual model is effective only if users can readily interpret and navigate its logic. The model may represent a single interactive component or the operational architecture of the system, and consistency must be maintained throughout the interaction design. Table 4 presents the conceptual model and activity flow of the Foreign Construction Workforce (TKKA) Equivalency web application. The core workflow is a sequential process carried out by five administrative actors: the employer or sponsoring company (Badan Usaha Jasa Konstruksi, BUJK), the LPJK Secretariat, the Executive Board (Pelaksana), the Advisory Board (Pengarah), and the LPJK Chairman. To keep the model lean and focused on user-facing interactions, two backend stages, internal archival logging and the automated delivery of signed digital certificates, are omitted from the activity map and handled as automated background services.

Table 2. Conceptual Activity Diagram

Step	Administrative Actor	Interface Interaction / Task Description	System Response / Output
1	Employer/Sponsoring Company (BUJK)	Document upload and foreign certificate registration.	Automated format validation and real-time upload progress.
2	LPJK Secretariat	Initial compliance screening and completeness audit.	Status indicator switches to "Awaiting Expert Review."
3	Executive Board (*Pelaksana*)	Detailed technical assessment and competency verification.	Data logging of expert scores and recommendations.
4	Advisory Board (*Pengarah*)	Policy alignment check and final validation approval.	Triggering of the electronic signature authentication gateway.
5	LPJK Chairman	Authorization and secure digital signing of certificates.	Generation of an encrypted QR code on the final document.

D. Skeleton Plane

At the Skeleton Plane stage, the system blueprint is transformed into an interface component layout design in the form of low-fidelity wireframes. The development of these wireframes is strictly guided by the validated User Experience (UX) requirements established in the preceding phase. Design analysis at this layer focuses on meeting user expectations for a minimalist and intuitive system visualization that presents information clearly and instantly, thereby reducing cognitive load. As a representation of the structural implementation, Figure 2 illustrates the wireframe design for the main dashboard of the new TKKA (Foreign Worker Competency Equivalency) application. This dashboard is specifically designed to highlight critical metrics in real-time, including the total number of pending foreign worker (TKA) applications, the cumulative number of issued equivalency documents, and a dynamic panel for tracking the status of active applications. The arrangement of navigation components and the information hierarchy within this dashboard framework are structured to ensure efficient multi-party interaction when monitoring digital bureaucratic processes within the LPJK environment.

1. Equalization process display wireframe (FUX7, FUX8, FUX11)
   The image above shows a wireframe design based on the user experience analysis for the new proposed category. In the previous design, the dashboard display only provided incoming and outgoing messages, thus not fully presenting information related to the TKKA equivalency process. Based on user feedback, features were added to the da shboard to improve the completeness of the information and support monitoring of the TKKA equivalency process.
2. Wireframe of business entity menu display (FUX27)
   Wireframe of the business entity menu that functions to display all BUJKA that have registered in the TKKA equivalency application system and to find out the TKKA that have been submitted.
3. Wireframe of the TKKA equalization results menu display (FUX30, FUX11)
   Wireframe of the TKKA equalization results menu, which serves as information on TKKA data that has completed the issuance of equalization results, both for compliance and non-compliance.
4. Assessor Appointment Display Wireframe (FUX21)
   Wireframe of the assessor appointment menu, which functions as the process for assigning audits for equivalency applications that have completed the verification process. The addition of this assessor appointment menu simplifies the audit team's (executors') systematic portfolio audit process, and the chief executive can download the assignment letter previously created using Microsoft Word.
5. Wireframe Assessor Appointment Process Display Wireframe (FUX21)
   The Assessor Appointment Process Wireframe displays the assessor appointment process menu, allowing the chief executive to select the assessors to be assigned.
6. Wireframe of the TKKA Equivalency application dashboard

Developed based on user experience feedback. The dashboard presents holistic information through a summary of total applications and the status of the TKKA equivalency process, allowing users to quickly and centrally monitor application status.

E. Skeleton Plane

At the Surface Plane level, the design focus shifts to the final visual execution of the system by transforming low-fidelity wireframes into high-fidelity prototypes. The interface development process at this level includes defining visual aesthetic elements such as typography, agency color contrast, iconography, and interface readability based on the ISO 9241-210:2019 standard [CITASI]. The visualization of the new TKKA Equalization web application was specifically designed to mitigate usability flaws in the visual surface layer that directly interacts with the user's eyes.

The interface design at this Surface Plane stage was comprehensively developed into three categories of user dashboards tailored to the access rights and business processes within the LPJK environment:

1. Applicant Dashboard
   Designed for Construction Service Business Entities (BUJK) or guarantors to input data, upload multilingual files, and monitor application status timelines in real time.
2. Secretariat Dashboard
   Specifically designed for the internal verification team to conduct initial screening, check administrative completeness, and validate registration document formats efficiently.
3. Implementation Dashboard
   Provided for auditors or expert teams to conduct technical competency assessments, provide legal recommendations, and process the authentication of the LPJK Chairperson's digital signature.

F. Heuristic Evaluation

The prototype of the TKKA equivalency application was designed based on usability and utility parameters. Subsequently, the prototype was evaluated by applicants using a questionnaire distributed by the author to assess the level of user satisfaction. The analysis of the test results utilized a questionnaire based on the 10 Heuristic Evaluation principles proposed by Nielsen (1994): visibility of system status, match between system and the real world, user control and freedom, consistency and standards, error prevention, recognition rather than recall, flexibility and efficiency of use, aesthetic and minimalist design, helping users recognize, diagnose, and recover from errors, and help and documentation. Data collection was conducted via a questionnaire completed by 40 respondents. Instrument validity testing aimed to determine the accuracy of the instrument in collecting research data and to ensure that each question item met validity criteria. The type of validity employed in this study was construct validity, based on the alignment of the instrument with the theoretical concepts underpinning the measurement [14] . Validity testing was analyzed using Microsoft Excel and IBM SPSS Statistics version 26. The formula used for the validity test is as follows:

$$r_{xy} = \frac{n(\sum xy) - (\sum x \sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

Notes:

1) rxy = Correlation coefficient
2) n = Number of samples
3) x = Score of the statement item
4) y = Sum of scores for the statement item
5) Σx = Sum of scores for the statement item
6) Σy = Sum of total scores for the statement items
7) Σxy = Sum of the products of x and y

The basis for this Pearson validity test is as follows:

1. Comparing the calculated r-value (r-count) with the table r-value (r-table)
   a. If r-count > rtabel = Valid
   b. If r-count < rtabel = Invalid
   Determining the r-table value for N=40 at a 5% significance level using the statistical r-table distribution yields a value of 0.312.
2. Observing the significance value (Sig.)
   a. If the significance value < 0.05 = Valid
   b. If the significance value > 0.05 = Invalid
3. Questionnaire results data
   The data obtained from the data collection process using the questionnaire method are as follows:
   1) Res represents the respondents participating in the study, with a total of (n) = 40 individuals.
   2) Q1 through Q15 represent the questions asked.
   3) X represents the value assigned to each question.
   4) Y represents the total of Q1 through Q15.

4. Questionnaire data testing
   To determine the validity value, we look for
   1) ∑Y = Total Y1 + Total Y2 + Total Y3 + …….. + Total Y 40
      ∑Y = 2.424
   2) N = 40
   3) $\sum Y^2$ = 2.424^2 = 150.968
   4) N$\sum Y^2$ = 40 x 150.968 = 6.038.720
   5) $(\sum Y)^2$ = 150.968 ^2 = 5.875.776

5. Implementasi Nilai Correlation coefficient (r_{xy})
   The implementation process for the correlation coefficient formula:

$$r_{xy} = \frac{n(\sum xy) - (\sum x \sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

Table 3. Result Correlation coefficient (Rxy)

Question	n∑Xy-∑X∑y	N$\sum X^2 - (\sum X)^2$	N$\sum y^2 - (\sum y)^2$	r_{xy}
Q1	9.256	959		0,740
Q2	8.208	1.151		0,599
Q3	13.208	1.311		0,904
Q4	10.360	895		0,858
Q5	9.128	831		0,784
Q6	11.696	1.164		0,849
Q7	11.448	976		0,908
Q8	12.376	1.184	162.944	0,891
Q9	13.488	1.511		0,860
Q10	12.088	1.116		0,896
Q11	11.664	1.024		0,903
Q12	10.856	999		0,851
Q13	12.016	1.079		0,906
Q14	4.992	1.456		0,324
Q15	12.160	1.200		0,870

6. Implementation of the Correlation Coefficient (r_{xy})
   The results obtained from the calculation process using Microsoft Excel and SPSS Version 26 were then converted into a validity test by comparing the calculated r and r table. The criteria for calculated r > r table = Valid, while calculated r < r table = Invalid. A significance value (Sig) < 0.05 = Valid, while a significance value (Sig) > 0.05 = Invalid.

7. Validity Test Results
   The validity of the questionnaire was tested using SPSS version 26. Each item was evaluated by comparing its correlation coefficient with the critical value of 0.312 at a 5% significance level, based on 40 respondents. An item was considered valid if its correlation coefficient exceeded 0.312 and its significance value was less than 0.05. As shown in Table 4, all 15 questionnaire items exhibited correlation coefficients greater than 0.312 and significance values below 0.05, confirming that they met the statistical criteria for validity. Notably, item Q14 recorded the lowest correlation coefficient (0.324) with a significance value of 0.041.

Table 4. Validity Test of the Research Instrument for the Satisfaction Parameter

Kode	rhitung (r_{xy})	rtabel 5% (40)	Sig	Kriteria
Q1	0.740	0.312	0.000	Valid
Q2	0.599	0.312	0.000	Valid
Q3	0.904	0.312	0.000	Valid
Q4	0.858	0.312	0.000	Valid

Kode	rhitung (r_{xy})	rtabel 5% (40)	Sig	Kriteria
Q5	0.784	0.312	0.000	Valid
Q6	0.849	0.312	0.000	Valid
Q7	0.908	0.312	0.000	Valid
Q8	0.891	0.312	0.000	Valid
Q9	0.860	0.312	0.000	Valid
Q10	0.896	0.312	0.000	Valid
Q11	0.903	0.312	0.000	Valid
Q12	0.851	0.312	0.000	Valid
Q13	0.906	0.312	0.000	Valid
Q14	0.324	0.312	0.041	Valid
Q15	0.870	0.312	0.000	Valid

As shown in Table 4, all questionnaire items (Q1–Q15) met the validity criteria, with correlation coefficients exceeding 0.312 and significance values below 0.05. Although Q14 had the lowest correlation coefficient (0.324; p = 0.041), it still met the validity criteria based on the Pearson correlation analysis.

8. Realibility Tes

Following the validity test of the research instrument—which utilized a Likert scale—a reliability test was conducted. The reliability test aims to assess the reliability of the data used in this study by examining the Cronbach's Alp ha value for each variable being tested [15]. The fundamental concepts of the Cronbach's Alpha reliability test are as follows:

a. A research questionnaire is considered high-quality if its validity and reliability have been proven.
b. The reliability test is performed after the questionnaire items have been confirmed as valid.
c. The reliability test aims to determine whether the questionnaire demonstrates consistency when measurements are repeated using that same instrument.
d. The reliability test can be conducted collectively on all questionnaire items within a specific research variable..

Regarding the criteria for the Cronbach's Alpha reliability test, Nikolaus Duli [9] states in his book, Metodologi Penelitian Kuantitatif. Beberapa Konsep Dasar Untuk Penulisan Skripsi & Analisis Data Dengan SPSS* (Quantitative Research Methodology: Basic Concepts for Thesis Writing & Data Analysis with SPSS), that a questionnaire is considered reliable if the Cronbach's Alpha value is greater than 0.6. The analysis results obtained using SPSS Version 26 are as follow s::

Table 5. Case Processing Summary

Case Processing Summary			
		N	%
Cases	Valid	40	100.0
	Excluded[a]	0	.0
	Total	40	100.0

The value for the case processing summary—representing the questionnaire respondent data used in the study to assess satisfaction levels—consists of 40 items. Subsequently, the Cronbach's Alpha reliability value is determined using the formula : $r = \left[\frac{n}{(n-1)}\right][1 - \frac{\sum\sigma_b^2}{\sigma_t^2}]$ atau r = (n/n-1)*(1-Sum Varians/Total Varians), explanation:

1) r = Instrument reliability coefficient (Cronbach's Alpha)
2) n = Number of question items
3) $\Sigma\sigma_b^2$ = Totalitems *varians*
4) σ_t^2 = Total variance [16].

To determine the Cronbach's Alpha value, data was obtained from the questionnaire results in Table 4.9; the processing results using Microsoft Excel are as follows::

1) n = 40
2) $\Sigma\sigma_b^2$ = 10.805

Table 6. Total Item Variance

Pernyataan	Varians Butir
Q1	0.615
Q2	0.738
Q3	0.840
Q4	0.574
Q5	0.533
Q6	0.746
Q7	0.626
Q8	0.759
Q9	0.969
Q10	0.715
Q11	0.656
Q12	0.640
Q13	0.692
Q14	0.933
Q15	0.769
Total Var Butir	10.805

3) $\sigma_t^2 = 104.451$
4) $r = \left(\frac{40}{39}\right)\left(1 - \frac{10.805}{104.451}\right) = 0.961$

Table 7. Reliability Statistics

Reliability Statistics	
Cronbach's Alpha	**N of Items**
.961	15

Based on calculations using SPSS version 26, Cronbach's Alpha value is 0.961. Further calculations were performed to determine the Scale Mean, Scale Variance, and Cronbach's Alpha value per item, as follows:

Table 8. Item-Total Statistics

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Q1	56.33	93.199	.703	.959
Q2	56.53	94.666	.541	.962
Q3	56.53	88.358	.885	.955
Q4	56.48	91.743	.836	.957
Q5	56.53	93.281	.755	.958
Q6	56.45	90.203	.823	.957
Q7	56.40	90.400	.893	.956
Q8	56.70	89.344	.871	.956
Q9	56.78	88.128	.831	.957
Q10	56.65	89.669	.878	.956
Q11	56.50	90.154	.887	.956

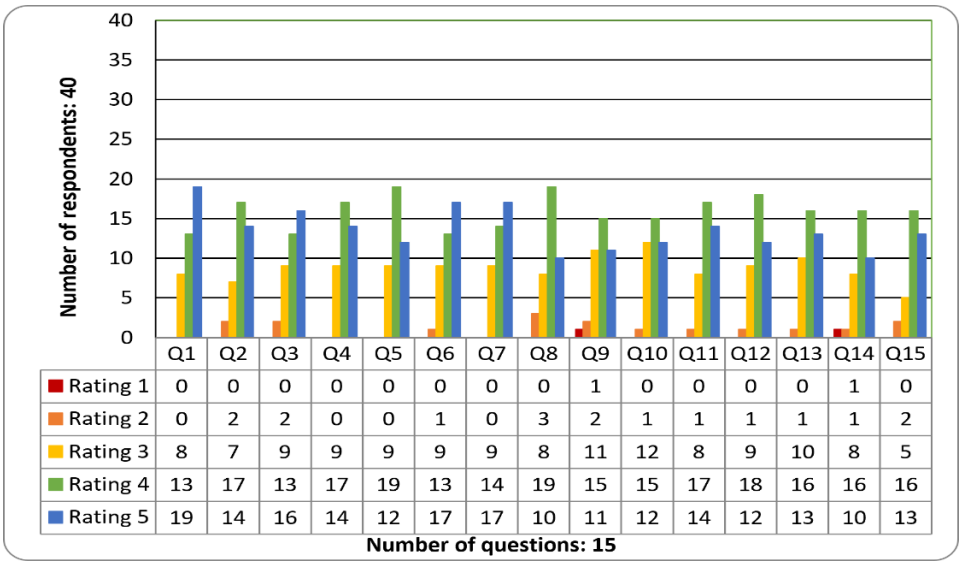
Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Q12	56.58	91.174	.827	.957
Q13	56.58	89.738	.890	.956
Q14	56.80	98.985	.236	.970
Q15	56.60	89.631	.846	.956

The figures obtained from the analysis of the open-ended questionnaire (Likert Scale) research instrument based on satisfaction parameters tested for reliability using SPSS version 26 showed that the Cronbach's Alpha value for all items was >0.6. Therefore, the questionnaire items are considered reliable and can be used in research.

4.2.1 Satisfaction Level Results After Development

User satisfaction following system development was evaluated using a five-point Likert scale (ranging from 1 = strongly dissatisfied to 5 = strongly satisfied). The questionnaire comprised 15 items (Q1–Q15) and was completed by 40 respondents. Figure 9 illustrates the distribution of satisfaction ratings across all items.

Figure 3. Satisfaction Rating Distribution by Question



Descriptive statistical analysis using SPSS version 26 yielded a minimum score of 2.93, a maximum of 5.00, a mean of 4.04, and a standard deviation of 0.68 (Table 9).

Table 9. Results of Mean Calculation (Index Variable) Using SPSS

	N	Minimum	Maximum	Mean	Std. Deviation
Variabel_Q	40	2,93	5,00	4,0400	0,68134
Valid N (listwise)	40				

The mean satisfaction score of 4.04 corresponds to 80.8% of the maximum possible Likert score, calculated as (4.04/5) × 100%. This result reflects a generally high level of user satisfaction following system development. While the questionnaire findings capture quantitative user perceptions, the interview results and heuristic evaluations offer complementary qualitative insights by identifying usability issues and areas for improvement. The respondents in this study were 40 people. The values were obtained from: Variable_X = (Q1 + Q2 + Q3 + Q4 + Q5 + Q6 + Q7 + Q8 + Q9 + Q10 + Q11 + Q12 + Q13 + Q14 + Q15) / 15.

The results obtained were a minimum value of 2.93, a maximum value of 5.00, a mean value of 4.04, and a standard deviation value of 0.68. The next step was to find the factor loading value for each question item and determine the level of satisfaction by considering the Crobach's Alpha and Variable Index values, as shown in the following table:

To determine the level of satisfaction from the presentation values above, the next step was to convert the data based on the following table:

Table 10. Satisfaction Rate Percentage

Mean Value	Percentage (Mean × 20%)	Percentage Range	Description
1	20%	0%-<=20%	**Very Unsatisfactory**
2	40%	21%-<=40%	**Unsatisfactory**
3	60%	41%-<=60%	**Neutral**
4	80%	61%-<=80%	**Satisfactory**
5	100%	81%-<=100%	**Very satisfactory**

Based on calculations using the SPSS application, the user satisfaction level following the system development was found to be 80%, falling into the "Satisfactory" category.

4. CONCLUSION

This study evaluated and redesigned the user experience (UX) and usability of the web-based Foreign Construction Workers Equivalency (TKKA) application at the Construction Services Development Board (LPJK). By integrating heuristic evaluation, Fishbone analysis, and The Five Planes framework, this research established a systematic workflow for translating identified usability defects into 32 core UX specifications. This integration offers a structured approach that explicitly bridges usability problem identification with user-centered interface redesign. An evaluation involving 40 respondents yielded a mean satisfaction score of 4.04 out of 5 (80.8% of the maximum possible score), while the survey instrument demonstrated strong internal consistency (Cronbach's alpha = 0.981). Although these findings reflect highly positive user perceptions of the redesigned prototype, they do not independently prove enhancements in operational efficiency or administrative performance.

Several limitations of this study should be noted. First, because the evaluation was conducted with 40 respondents, the generalizability of the findings remains contingent upon the sample's representativeness relative to the broader user population. Second, the investigation focused specifically on the TKKA equivalency platform at LPJK; thus, the results may not be directly transferable to other digital public service systems. Third, in the absence of a comparative pre- and post-redesign usability test, the precise extent of usability improvement cannot be conclusively established. Consequently, the satisfaction scores should be interpreted as a measure of user perceptions rather than direct empirical evidence of enhanced service performance.

Future research should incorporate a larger, more diverse participant sample and implement comparative usability testing to quantify the redesign's impact. Incorporating objective metrics—such as task completion time, success rate, error frequency, and administrative processing duration—would provide more robust empirical evidence regarding usability and operational gains. Furthermore, subsequent studies could explore the adaptability of this integrated framework to other public service domains and benchmark its efficacy against alternative UX evaluation methodologies.

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