

## ***A User-oriented UI/UX Application Design Using The Integration of Quality Function Deployment (QFD) and Design Thinking Methods***

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### **Abstract**

*UI / UX is essential in designing an application or website due to its impact on the user. With a decent and user-oriented UI/UX, users will experience high conformance and interact easily with the application or website, hence increasing the intensity of product usage and providing a better experience for users. However, the users' requirements are often neglected, making it difficult for the applications or websites to obtain a constant user number. Furthermore, this research aims to create a novel method to design UI/UX for CRM, which aligns with the needs and specifications of users. The data are collected using primary data through direct observation and questionnaires at an IT company called Numazu and its users. These data aim to measure and determine user needs and expectations by the integration of the Design Thinking and Quality Function Deployment (QFD) method. This research contributes to creating innovative and user-relevant UI/UX design methods, especially for CRM systems. The findings of this research also show an improvement in user experience through a user-oriented UI/UX design.*

### **Keywords**

*Design Thinking, Quality Function Deployment, UI/UX, House of Quality, CRM*

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## **INTRODUCTION**

Customer satisfaction is the most important aspect of a business unit. A substandard service or product not only reduces customer interest but also destroys the business in general. Thus, the company must provide a good and satisfactory service or products for its customers [1]. However, some companies face difficulty in aligning the business and customers' interests despite its importance [2]. An integrated system can assist the company in managing projects and improving service quality. Information systems such as project management and Customer Relationship Management (CRM) can help improve service quality and customer relationships. [3].

PT Numazu Sistem Solusi is a service company that currently experiencing difficulties in managing existing projects, such as searching for bug files and new feature files recorded by project managers. For instance, printouts from document processing applications are often mis formatted. These problems cause a 1-month project tardiness on average. Furthermore, the company faces dozens of complaints from clients regarding the service quality every month. Therefore, it is necessary to analyze and improve the project management process of PT Numazu Sistem Solusi through the implementation of the CRM system starting from the development of user-oriented UI/UX design for PT Numazu's CRM system.

## UI/UX (User Interface/User Experience)

UI/UX (User Interface/User Experience) is essential for the information technology (IT) company due to its impact on user satisfaction with the company's products or services [4]. With an intuitive interface design and a pleasant user experience, customers will feel satisfied and tend to reuse the company's products or services [5]. In the competitive business world, owning a user-oriented UI/UX can be a competitive advantage. Products with attractive and user-friendly UI/UX are more attractive to users compared to similar products with poor UI/UX [6].

The definition of quality is diverse, covering various aspects, both conventional and more strategic. In the common view, quality is considered an interrelated concept and has a significant impact on the performance of a product in meeting customer expectations. According to Tjiptono [7], 8 (eight) dimensions of quality can be used as a framework for strategic planning and analysis in product development, namely Performance, Features, Reliability, Conformance to Specifications, Durability, Serviceability, Aesthetics, and Perceived Quality.

Norman [8] suggested that the approach of Design Thinking and Quality Function Deployment (QFD) can help understand user needs deeply and come up with innovative solutions that meet customer needs. According to Liu & Lu [9], a combination of methods of Design Thinking and QFD can provide advantages in building products or services that align with customer needs and desires with a creative, innovative, and scalable approach.

## Design Thinking

Design Thinking is an innovative approach commonly used to solve complex design problems with a focus on user experience [10]. This method is often used in several aspects, including business, education, and product development. In application or product development, this method guides an effective design process. Over time, the design process has undergone a significant evolution. In the method of Design Thinking, there are 5 stages: Empathize, Define, Ideate, Prototype and Testing [11].

However, Design Thinking is often used separately and rarely integrated with other methods, especially in designing UI/UX of a system. This issue is due to its uniqueness and user-focused approach. Design Thinking emphasizes empathy for end users and iterative processes, which may not always align with other methods such as Six Sigma, QFD, or data-driven management approaches. This issue also limits the use of Design Thinking in a broader scope and hinders the integration of different methods into a holistic approach.

In addition, Design Thinking is rarely used in UI/UX design, especially in more traditional environments. This is because design thinking methods may be less structured compared to certain UI/UX methods, such as User-Centered Design (UCD) or Human-Centered Design (HCD). Some UI/UX practitioners prefer to follow stricter guidelines and frameworks, focusing on elements specific to the user interface.

The main drawback of using Design Thinking without integrating other methods is the inability to measure results in a measurable and controlled manner. The exclusive use of Design Thinking often results in solutions that are more focused on innovation and user experience than efficiency and speed. Without the integration with other methods, such as QFD or Agile, this can lead to higher costs and delays in product development.

Brown [12] explained that excessive focus on user experience can overlook other aspects, such as operational efficiency and sustainability. Meanwhile, Martin [13] emphasizes the importance of integrating Design Thinking with more traditional business methods to ensure optimal results.

In situations where Design Thinking is not integrated with other methods, companies may run the risk of failing to achieve their business goals effectively and efficiently. Therefore,

it is crucial to understand that Design Thinking should be used as part of a broader approach to addressing various aspects of design, innovation, and product development.

### Quality Function Deployment (QFD)

Quality Function Deployment (QFD) is a method used to develop design quality to satisfy consumers and transform consumer demand into design targets and key quality assurance aspects for use at any stage of production [14]. It helps in designing products or services that meet customer expectations well. However, QFD is often not integrated with other methods, which may result in a mismatch between identified customer needs and the ability to produce innovative solutions that satisfy users.

### House of Quality (HOQ)

In the product development stage, House of Quality (HOQ) is often used, which consists of several elements (See Figure 1). Several steps (i.e., observations, interviews, questionnaires, etc.) will produce the data needed to build a HOQ matrix. To implement a product, vague consumer requirements often need to be transformed into actionable internal needs (i.e., design requirements) [15]. According to Ibrahim [16], Quality is an abstract word unless it is used to discover and measure the characteristics of a product. In many cases, QFD is less integrated with other methods due to its focus on analyzing customer needs and product characteristics. This can lead to difficulties in addressing rapidly changing customer needs, especially in the context of evolving UI/UX design.

Hence, this study contributes to a novel method that integrates Design Thinking and QFD methods to produce a user-oriented UI/UX for CRM applications. In general, this research utilizes the Design Thinking method to solve complex design problems produced by user experience. Whilst, QFD will have a more measurable output related to the customer requirements regarding UI/UX design.

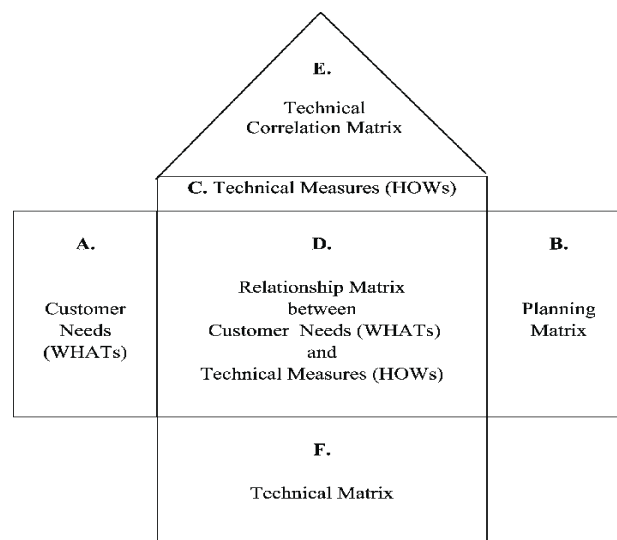


Figure 1. House of Quality (HOQ) [17]

## METHODS

This research is mixed method research because there is quantitative data in the form of observations from primary data collection (i.e., direct observations). Thus, it can facilitate research compared to recording observations with other tools. Qualitative data collected from questionnaire distribution to several employees and literature studies aims to obtain related issues raised in a study, such as documents from books and journals that discuss supporting

information if needed. Observations for this study were conducted at PT Numazu Sistem Solusi for 1 month (4 weeks) from January 9, 2023, to February 3, 2023. The research steps can be seen in [Figure 2](#).

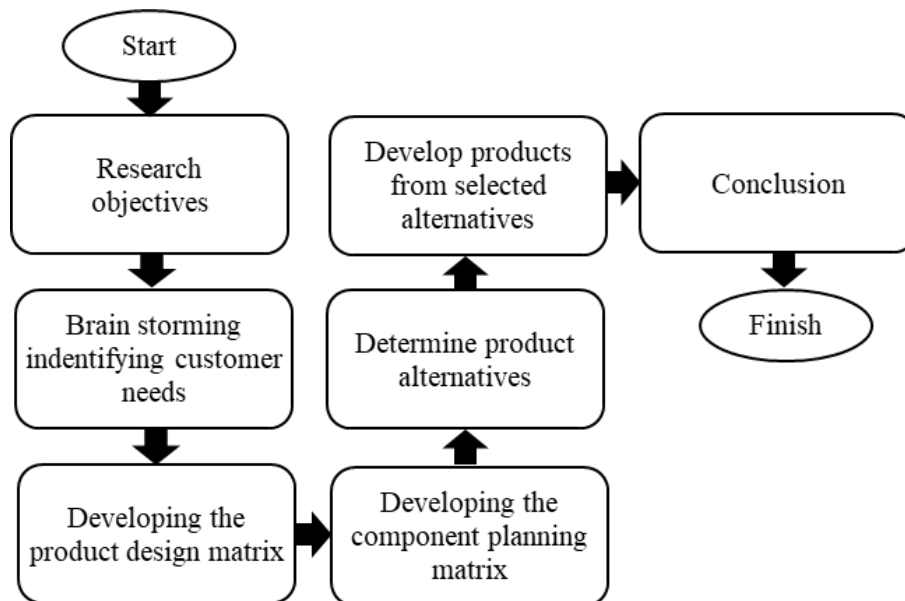


Figure 2. Research Methods

The next section is Research Methods. In this section, several steps will be explained, which consist of i) the methods used in conducting research, ii) a brief description of the object of study under study, iii) a brief description of how the data is collected, (iv) a flowchart of the research process carried out and or the design of the developed tool.

## RESULTS AND DISCUSSION

### Customer Needs Identification

In the process of analyzing consumer needs, the authors use an effective objective tree method to describe and understand their needs in more detail and comprehensively.

Integration between 8 dimensions of quality, as identified by Garvin [15], by method Design Thinking Provide a holistic framework for quality product development. The stages of the method Design Thinking, namely Empathize, Define, Ideate, Prototype, and Test can be used to pay attention to and ensure every relevant quality dimension in the product design process. The following are the stages in the method: Design Thinking.

1. In the Empathize stage, quality dimensions such as performance, and durability, can be considered by understanding the needs of users and their expectations of the core product and its visual characteristics.
2. In the Define stage, quality dimensions such as reliability and conformance to specifications can be established as standards that must be met by the product, by identifying associated problems and challenges.
3. The Ideate stage provides an opportunity to think about new concepts and ideas that can enrich the additional features or features of the product, as well as consider aesthetic factors that appeal to users.
4. At the Prototype stage, the serviceability aspect can be considered by designing a prototype that is easy to repair and considering good customer service during the sales and after-sales process.

5. The Test phase allows users to test products to obtain perceived quality feedback, which includes user perceptions of product image and corporate responsibility.

By integrating quality dimensions into each stage of the Design Thinking method, companies can achieve more comprehensive product development, meet user needs and expectations, and create significant value for the market. Figure 3 below is the result of identifying consumer needs using the objective tree method from the top level to the bottom level.

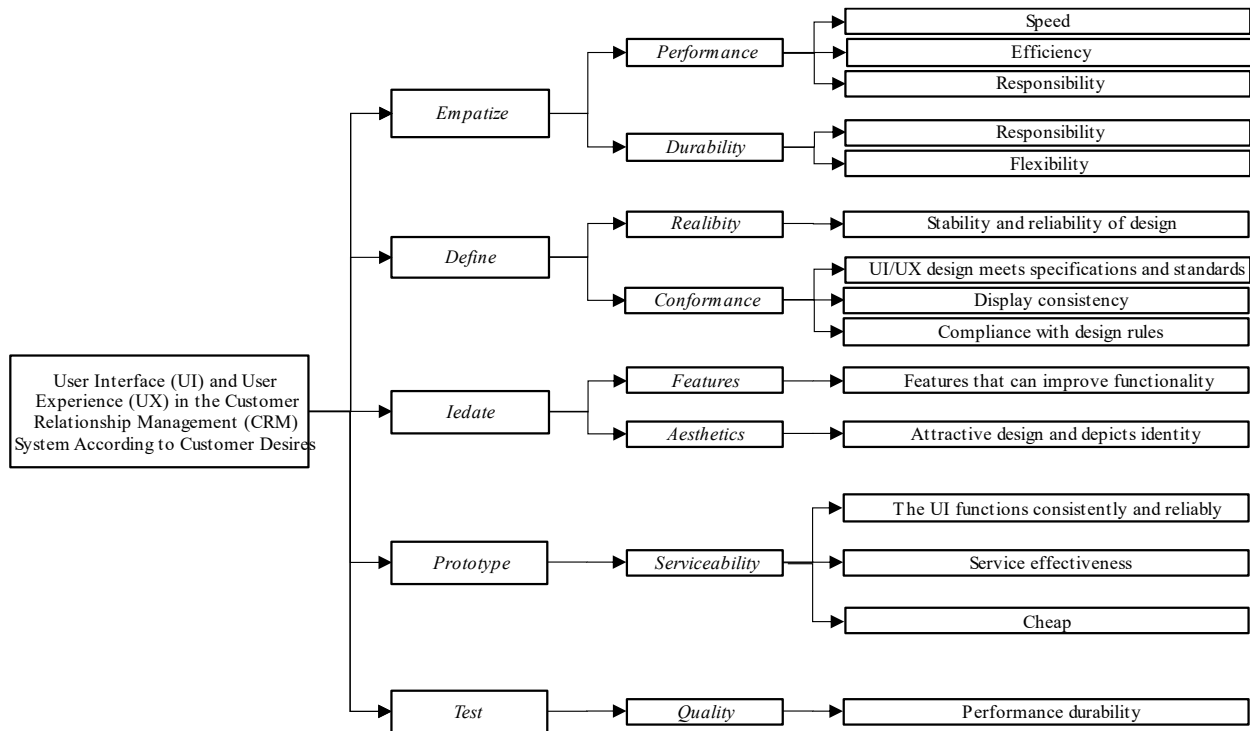


Figure 3. Objective Tree Diagram

### Determination of Technical Characteristics

At this stage, the technical characteristics needed to meet the Customer Needs that have been obtained previously are determined. Determination of technical characteristics aims to find out how the company meets customer needs. Technical characteristics are obtained by brainstorming with PT. Numazu and benchmarking technical characteristics owned by another competitor company, Odoo.

After defining the needs and desires of consumers into terms of product attributes in Table 1, the author then grouped product attributes into component characteristics based on related expert theories including the following.

1. Optimal Performance

Optimal performance in the user interface is the main goal to be achieved. In Hick's Law theory, it is argued that reducing the number of choices and complexity of user interfaces will speed up decision making by users [18].

2. Multiplatform Support

In the context of user interface design, supporting Multiplatform becomes very important. Responsive Design Theory states that user interfaces must be able to adapt to various platforms and devices with Responsiveness its good [19].

3. Good Readability:

Good readability in a user interface involves fulfilling design rules governing the size, contrast, and placement of design elements. Visual Design Principles and Visual Hierarchy provide guidance for achieving optimal legibility [20].

*Table 1 Defining Consumer Needs and Wants into Product Attribute Terms*

Primary	Secondary	Tertiary	Product Attributes
Empathize	Performance	Speed Efficiency Responsiveness	Optimal Performance Efficient Use Multiplatform Support
	Durability	Attractive Design Flexibility	Intuitive Navigation Multiplatform Support
Define	Reliability	Design stability and reliability	Multiplatform Support
	Conformance	UI/UX design meets specifications and standards Display consistency Compliance with design rules	Good Readability Multiplatform Support Good Readability
Ideate	Features	Features that can enhance functionality	Integration with related applications and services
	Aesthetics	Design that is attractive and portrays identity	Attractive Aesthetics
Prototype	Serviceability	UI works consistently and reliably	Intuitive Navigation
		Service effectiveness Cheap	Efficient Use Maintenance Fees
Test	Perceived Quality	Performance resilience	Optimal Performance

#### 4. Attractive Aesthetics:

Attractive aesthetics in user interface design include the use of attractive colors, typography, and composition and simultaneously portray the identity of a brand or product. The principles of Visual Design play an important role in creating an attractive aesthetic [20].

#### 5. Maintenance Cost

In the development and maintenance of user interfaces, maintenance costs are an important consideration. In this case, the application of cost management principles and efficiency can help optimize overall maintenance costs.

#### 6. Intuitive Navigation

Intuitive navigation in a user interface involves a user's understanding of the system's consistent and reliable mental order. The Theory of Mental Order, as proposed by Norman and Rumelhart [8], discusses the importance of intuitive navigation in achieving a good user experience.

#### 7. Integration with related applications and services

User interface integration with related applications and services has an important role to play in improving functionality. The System Integration Principles provide guidance in integrating efficiently, taking into account compatibility, standards, and appropriate protocols [21].

The following is a summary of the grouping of product attributes into component characteristics contained in Table 2.

Table 2 Defining Consumer Needs and Wants on Product Engineering Characteristics

No	Technical characteristics	Component Characteristics
1	Optimal Performance	Speed
2	Multiplatform Support	Responsiveness
3	Good Readability	Compliance with design rules
4	Attractive Aesthetics	Design that is attractive and portrays identity
5	Maintenance Fees	Cheap
6	Intuitive Navigation	UI works consistently and reliably
7	Integration with related applications and services	Features that can enhance functionality

**Developing a Product Design Matrix**

The designer explains the degree of strength of the relationship between consumer needs and engineering characteristics by recording it in matrix cells. Relationship assessment can be done using the numbers 9 (for very strong relationships), 3 (strong relationships), 1 (weak relationships) or it can also be by using symbols. The strong symbol means that the variable cannot be realized in the absence of the characteristics of the associated components. A moderate relationship means that variables can still be realized without the characteristics of the related components, but the results obtained cannot be maximized. A weak relationship means that the variable does not depend on the characteristics of that component. Figure 4 shows the matrix of identifying relationships among product attributes and Figure 5 shows the interaction of relationships among engineering characteristics.

				Optimal Performance	Multiplatform Support	Good Readability	Attractive Aesthetics	Maintenance Cost	Intuitive Navigation	Integration with related applications and service
User/Worker Needs			Ei	No. Urut Kebutuhan Teknis						
				1	2	3	4	5	6	7
Empatize	Performance	Speed	3	●	○	○			△	○
		Efficiency	3	○	●					●
	Responsiveness	2	●	●	○	○			○	△
Durability	Attractive Design	1	△	○	●	●			○	
	Flexibility	3	○	●						●
Define	Reliability	Design stability and realibility	1		●	●	△	△	○	
		UI/UX design meets specifications and standards	2	○	△	●	●		○	
	Conformance	Display consistency	2	△	●	●	○			
		Compliance with design rules	3			●	●			○
Ideate	Features	Features that can enhance functionality	5					○	○	●
	Aesthetics	Design that is attractive and portrays identity	4			○	●		○	
Prototype	Serviceability	UI works consistently and reliably	2	○	●		●	○		
		Service effectiveness	3		●				●	●
		Cheap	5	●				●		○
Test	Perceived Quality	Performance resilience	1	●	●			○		

Figure 4. Matrix Identification of Relationships Among Product Attributes

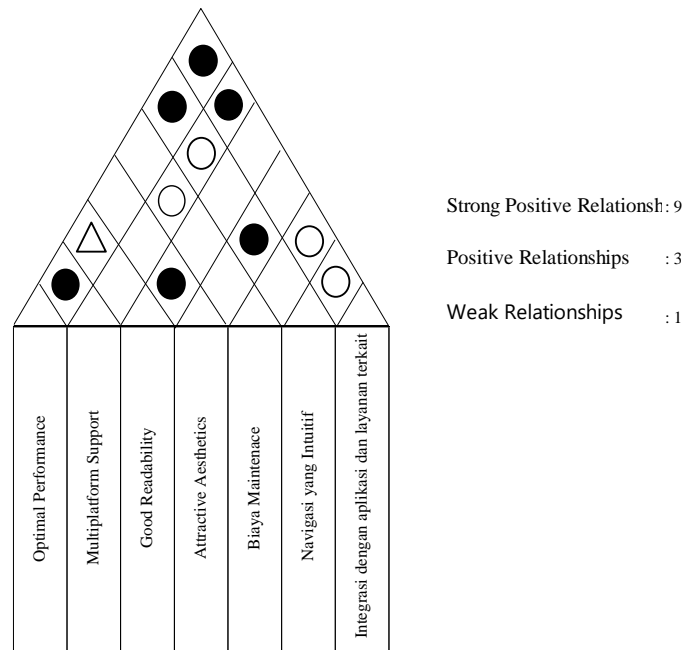


Figure 5. Interactions Among Engineering Characteristics

### Develop Technical Description Priorities

1. Technical Absolute Weight

The absolute weight for the technical description is formulated by:

$$a_j = \sum_{i=1}^n r_{ij}c_i \tag{1}$$

With:

$A_j$  = Line vector of absolute weight in the description technically

$R_{ij}$  = Weight specified on the relationship matrix

$C_i$  = Vector column of interest towards the customer-on-customer requirements

$m$  = number of descriptions technically

$n$  = number of customer requirements

2. Relative Weight

Similarly, the relative weight for description is technically given by substituting the importance of customer requirements with absolute weights on customer requirements:

$$b_j = \sum_{i=1}^n r_{ij}d_i \tag{2}$$

With:

$B_j$  = Line vector of absolute weight in the description technically

$R_{ij}$  = Weight specified on the relationship matrix

$d_i$  = Vector column of interest towards the customer-on-customer requirements

$m$  = number of descriptions technically

$n$  = number of customer requirements

The higher the absolute and relative level identifies the areas in which engineering effort needs to be concentrated. The main difference in such weights is that relative weights also include information in scale and sales factors. Figure 6 is the Product Planning Matrix (Phase 1) after calculating absolute weight and relative weight.

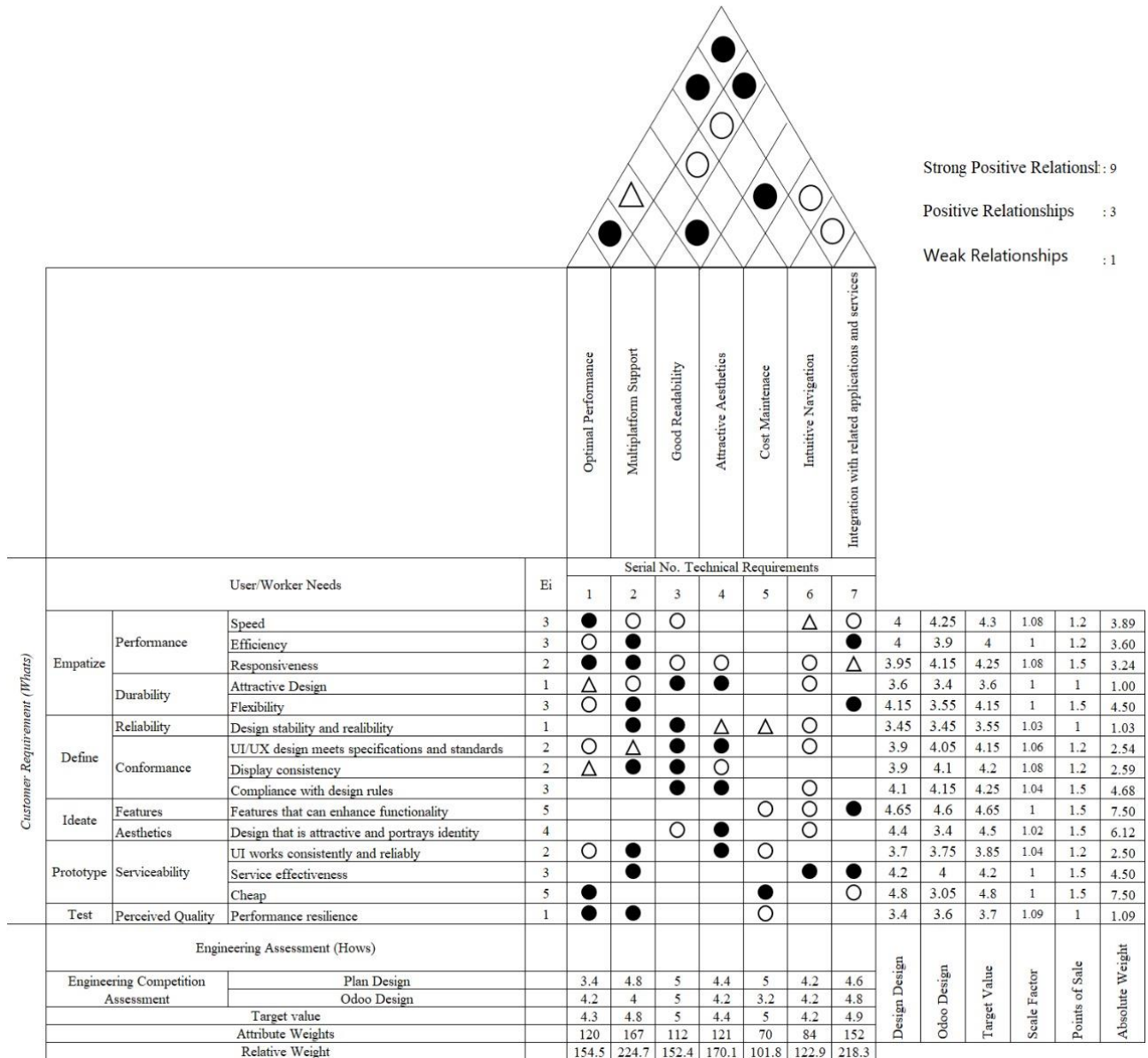


Figure 6. Product Planning Matrix (Phase1)

### Develop Technical Description Priorities

1. Drawing a matrix of engineering characteristics as opposed to component characteristics.

Product attributes form matrix rows and component characteristics form matrix columns. Each cell matrix shows a potential relationship between component characteristics and consumer needs. The matrix of engineering characteristics opposite to component characteristics can be seen in Figure 7.

2. Identify the relationship between component characteristics and engineering characteristics.

The designer explains the degree of strength of the relationship between consumer needs and engineering characteristics by recording it in matrix cells. Assessment of relationships can be done using numbers i.e.,

9: for very strong relationships

3 : for strong relationships

1 : for weak relationships

			Component Characteristics (Hows)						
			Speed	Responsiveness	Compliance with design rules	Attractive design and depicts identity	Cheap	The UI functions consistently and reliably	Features that can improve functionality
Product Attributes (Whats)	Optimal Performance	154.49							
	Multiplatform Support	224.66							
	Good Readability	152.43							
	Attractive Aesthetics	170.08							
	Cost Maintenance	101.8							
	Intuitive Navigation	122.87							
	Integration with related applications and services	218.31							
	Absolute Level of Importance								

Figure 7. The matrix of engineering characteristics is opposite to the characteristics of the components

Determine the level of absolute importance: The higher the absolute identify the characteristics on which generating alternatives needs to be concentrated. For the component design matrix (phase 2) can be seen in Figure 8.

			Component Characteristics (Hows)						
			Speed	Responsiveness	Compliance with design rules	Attractive design and depicts identity	Cheap	The UI functions consistently and reliably	Features that can improve functionality
Product Attributes (Whats)	Optimal Performance	154.49	●	●			●	○	
	Multiplatform Support	224.66	○	●				●	
	Good Readability	152.43	○	○	●	○			
	Attractive Aesthetics	170.08		○	●	●		●	
	Cost Maintenance	101.8					●	○	○
	Intuitive Navigation	122.87	△	○	○	○			○
	Integration with related applications and services	218.31	○	△			○		●
	Absolute Level of Importance			3299.48	4966.8	3271.2	2356.6	2961.5	4321.5

Figure 8. Component Design Matrix (Phase 2)

**Morphological Map**

Morphological Map in the form of a matrix table, columns in the table are characteristics of product components, while rows in the matrix are solutions. The morphological map can be seen in Table 3.

**Table 3** Morphological Maps

No	Component Characteristics (KK)	Solution [S]		
		Solution 1	Solution 2	Solution 3
1	Responsiveness	Multiplatform Support	Implementation of the asynchronous method	Use of image compression technology
2	UI works consistently and reliably	Improved user testing	UI design consistency	Careful functional testing
3	Speed	Optimize image size	Use of server-side rendering technology	Implementation of caching techniques
4	Compliance with design rules	Use standardized design guidelines	Use of time-tested design patterns	Good use of font size and type
5	Cheap	Use of open-source resources	Economical selection of components and technology	Use of UI/UX design tools
6	Features that can enhance functionality	Integration with social media platforms	Development of additional modules	Integration with third-party services
7	Design that is attractive and portrays identity	Use of animations and transitions	Customization of colors, typography, and other design elements according to identity	Use of microinteractions

From the solutions above, several alternative choices are obtained regarding the desired product. Alternatives can be seen in [Table 4](#)

**Table 4** Product Alternatives

No	Component Characteristics (KK)	Alternative		
		Alternative A	Alternative B	Alternative C
1	Responsiveness	S1	S3	S2
2	UI works consistently and reliably	S2	S1	S3
3	Speed	S1	S3	S2
4	Compliance with design rules	S3	S1	S2
5	Cheap	S1	S3	S2
6	Features that can enhance functionality	S3	S2	S1
7	Design that is attractive and portrays identity	S2	S1	S3

### The Weighted Objective Method

#### 1. Data collection of design objectives

Develop a structure of assessment criteria (performance specifications) from objectives that have been determined at the beginning of the point determination process. The selected design objectives (largest value) can be seen in [Table 5](#)

**Table 5** Design Objectives

No	Consumer Needs and Wants Criteria	Absolute Importance
1	Responsiveness	4966.8
2	UI works consistently and reliably	4321.5
3	Speed	3299.5
4	Compliance with design rules	3271.2
5	Cheap	2961.5
6	Features that can enhance functionality	2638.8
7	Design that is attractive and portrays identity	2356.6

#### 2. Objective weighting process of design

Where all priorities are compared with others in pairs in a matrix, then the matrix cells are filled with the value 1 (one) if the pairs that make up the row matrix have an absolute

weight greater than the needs and desires of consumers who form a column and are given a value of zero if vice versa. The objective weighting of the design can be seen in Table 6.

Table 6 Design Objectives

Characteristics of Consumer Needs and Wants	Multiplatform Support	Intuitive Navigation	Optimal Performance	Good Readability	Maintenance Fees	Integration with related applications and services	Attractive Aesthetics	Total Series	Weight
Responsiveness	-	1	1	0	0	1	0	3	0.30
UI works consistently and reliably	1	-	1	0	0	0	1	3	0.25
Speed	1	1	-	0	0	1	0	3	0.20
Compliance with design rules	0	1	0	-	0	0	1	2	0.12
Cheap	1	0	1	0	-	1	0	3	0.08
Features that can enhance functionality	1	1	0	0	0	-	0	2	0.05
Design that is attractive and portrays identity	0	0	0	0	0	0	-	0	0.0
<b>Sum</b>								<b>16</b>	<b>1.00</b>

3. Determination of performance parameters for each purpose

Objective statements are converted into measurable parameters. The simplest scale usually has 5 levels that can describe the performance of CRM website design which can be seen in Table 7

Table 7 Levels of Objective Circumstances

Condition	Score
Far Below Average (Very Low)	1
Below Average (Low)	2
Average (Medium)	3
Above Average (High)	4
Well Above Average (Very High)	5

4. Calculate and compare the use values of design alternatives.

The final stage in the assessment is to consider each proposal using an alternative evaluation weighting map which can be seen in Table 8

Table 8 Alternative Evaluation Weighting Map

Objective	Weight	Parameters	Alternative A			Alternative B			Alternative C		
			Condition	Score	Value	Condition	Score	Value	Condition	Score	Value
Responsiveness	0.30	Multiplatform Support	Very High	5	1.50	Tall	4	1.20	Low	2	0.60
UI works consistently and reliably	0.25	Intuitive Navigation	Tall	4	1.00	Keep	3	0.75	Low	2	0.50
Speed	0.20	Optimal Performance	Very High	5	1.00	Keep	3	0.60	Keep	3	0.60
Compliance with design rules	0.12	Good Readability	Tall	4	0.48	Tall	4	0.48	Tall	4	0.48
Cheap	0.08	Maintenance Fees	Very High	5	0.40	Tall	4	0.32	Tall	4	0.32
Features that can enhance functionality	0.05	Integration with related applications and services	Very High	5	0.25	Keep	3	0.15	Tall	4	0.20
Design that is attractive and portrays identity	0.00	Attractive Aesthetics	Tall	4	0	Tall	4	0	Keep	3	0
<b>Total Use Value</b>					<b>4.63</b>	<b>3.50</b>			<b>2.7</b>		

The usability value of each objective is obtained by multiplying the score by the weight value, while the total usability value is the result of summing the objective values in an alternative design. The best alternative is to have the highest value, namely alternative A with a total use value of 4.63.

## Product Images from Selected Alternatives

Figure 9 is a dashboard menu view of the CRM system from Product Compatibility Component Characteristics and Selected Solution Alternatives:

1. Responsive and fast display in loading data (KK1[S1], KK3[S1]).
2. The consistent user interface design (KK2[2]) ensures users can easily navigate and access the necessary information.
3. Use of good font size and type (KK4[S3]).
4. Efficient user interface design (KK5[1]) optimizes the use of display space to ensure reports can be clearly and easily understood.
5. This integration provides additional features that enhance system functionality (KK6[3]) by allowing users to meet and collaborate with teams virtually.
6. Attractive user interface design and in accordance with brand identity (KK7[S2]) is implemented with the use of attractive visual design elements.

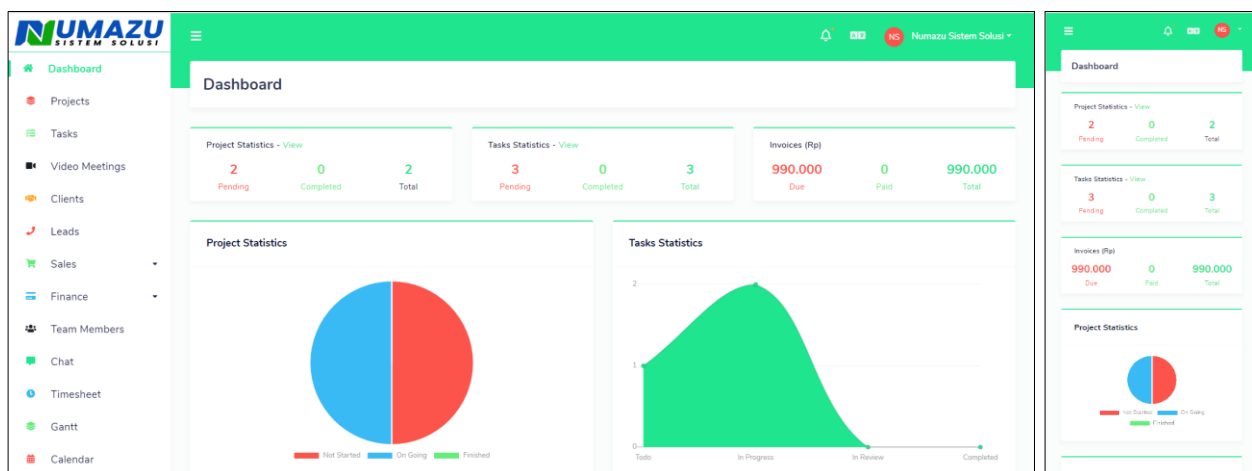


Figure 9 Dashboard Menu Display

## CONCLUSIONS AND ACKNOWLEDGEMENT

### Conclusion

This study has successfully identified the needs and specifications of UI/UX desired by CRM users of PT. Numazu System Solutions. The Design Thinking and Quality Function Deployment (QFD) utilization ensures that user requirements are accommodated by the company. The features expected by users from the CRM application have been successfully identified. This allows designing UI/UX that is more precise and according to user needs. Integration of Design Thinking and Quality Function Deployment (QFD) methods in the process of identifying and designing UI/UX CRM PT. Numazu System Solutions has made a significant contribution in ensuring that the resulting UI UX design is by user needs and preferences.

It is important to keep abreast of technological developments and UI/UX design trends and dig deeper into user needs and expectations. For future research, the utilization of machine learning to scrap data on the internet to design a broader user-oriented UI/UX is currently underway. This future research aims to fulfil a broader number of CRM users.

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