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Development of Customer Service Management using Design Science Research Methodology (DSRM) as support for the Implementation of Digital Transformation for the Property Management Industry in Indonesia

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ABSTRACT
Tenants or customers play a very important role in the property management industry. Their role is not only limited to tenants who live or use the property, but also includes various aspects that influence the operations, strategy and sustainability of the property management business. Digital transformation in the property management industry is increasingly becoming a necessity to increase operational efficiency and increase tenant or customer satisfaction. This research aims to develop a prototype Integrated Property Management System (IPMS) application designed to meet tenant/customer needs, as well as support digital transformation in this industry. The Design Science Research Methodology (DSRM) method is used to guide the development process from problem identification to evaluation of the resulting artifact. The research results show that the IPMS application prototype developed can increase tenant interaction and involvement, facilitate property management, and provide added value through automation and data integration. It is hoped that these findings can become the basis for further development and implementation of similar applications on a wider scale.
KEYWORDS: Digital Transformation, Property Management System, DSRM, Prototype,Tenant/Customer

1. INTRODUCTION

Digital technology has become an integral part of society and the economy. Across industries, management faces increasing pressure to make digital transformation a strategic priority and embrace the opportunities offered by emerging digital technologies [1]. The property management industry in Indonesia is experiencing a significant transformation along with the development of digital technology. This transformation is crucial for increasing operational efficiency, service quality and tenant or customer satisfaction [2]. In the digital era, tenants increasingly expect services that are fast, transparent and easily accessible via mobile devices. However, many property management companies in Indonesia still use traditional systems that are not integrated, so they are unable to meet the increasing expectations of tenants [3].

Adoption of cloud base digital technology such as Integrated Property Management System (IPMS) is becoming a necessity[4]. IPMS is a system that integrates various property management functions, such as tenant management, property maintenance, financial management, and communication between tenants and management. By combining all these functions in one platform that can be accessed via mobile devices, IPMS not only improves operational efficiency but also provides a better experience for tenants [5]

Several previous studies have shown that implementing an integrated property management system can increase tenant

productivity and satisfaction. However, in Indonesia, IPMS adoption is still limited and often not tailored to the specific needs of tenants[6]. Therefore, it is important to develop solutions that are more contextual and appropriate to the characteristics of the Indonesian market.

This research aims to develop a mobile-based IPMS application prototype specifically designed to meet the needs of tenants in Indonesia. The approach used in this development is Design Science Research Methodology (DSRM), which consists of the stages of problem identification, design and development, demonstration, evaluation, and communication of results. DSRM was chosen because this methodology is very suitable for research that aims to produce innovative technological artifacts that can be used to solve practical problems in real contexts [7].

Through this research, it is hoped that an application prototype can be produced that is not only technically relevant but can also be accepted and used effectively by tenants and property management in Indonesia. Apart from that, it is also hoped that this research can contribute to academic literature regarding the implementation of digital technology in property management and become a reference for property management companies that want to carry out digital transformation [8].

2. LITERATURE REVIEW

2.1 Digital Transformation

Digital transformation is not just about implementing new technology, but more about how that technology is used to transform the business. Westerman differentiates digital transformation into three core elements that must be integrated to achieve success [9].The main components in digital transformation are Customer Experience, Operational Process and Business Model. These three components in synergy will determine success in implementing digital transformation in an institution, including in the property management industry.

2.2 Property Management System (PMS) and Digital Transformation in Property Management

PMS is a system used by property managers to manage various aspects of the properties they manage, including tenant management, maintenance, finance, and reporting. An integrated system allows all of these functions to be managed in an integrated manner, reducing redundancy and increasing efficiency and is part of what is currently popularly called PropTech [10]. Currently, PropTech has entered the Propertech 3.0 phase according to research published by the University of Oxford, which consists of technologies such as drones, virtual reality tools, IoT and blockchain [11]. Digital transformation in property management includes the use of information technology to automate processes, improve interactions with tenants, and provide data analytics that support decision making. These technologies include IoT, big data, and AI integrated into property management systems.

2.3 CRM in Digital Transformation in the Property Management Industry

In the property management industry, customers or tenants play a very central and strategic role. Tenants, who can be individuals or companies, are the end users of the managed property, be it residential, commercial, or industrial property[12]. Tenants' needs and satisfaction greatly influence the success of property management, because well-managed properties can maintain high occupancy rates and generate stable income for property owners [13].Tenants are a vital part of the property management ecosystem, and technology has strengthened this relationship by making the management process more efficient, transparent and responsive. Technology gives tenants more control and convenience, while also enabling property management to improve their services, reduce operational costs, and maintain positive long-term relationships with tenants [14].

2.4 Design Science Research Methodology (DSRM)

DSRM is a research method used to design and develop artifacts (such as systems, models, or methods) that can solve practical problems. DSRM consists of several stages: problem identification, solution design, artifact development, demonstration, evaluation, and communication of results [7]. This research will use the Design Science Research Methodology (DSRM) method, which will start from the initialization stage. The initialization stage is the first step to determine on what basis this research was conducted and consists of 4 types of initializations, namely: problem centered initiation, objective centered solution, design & development centered initiation and client/context initiation. The integration of applications in the property management industry with IoT, blockchain and also Artificial intelligence [15] is quite a lot that has utilized the DSRM concept[16].

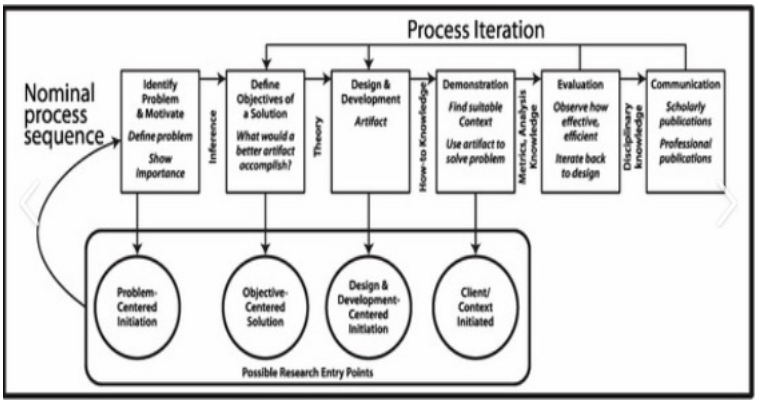


Figure 1 Design Science Research Methodology [7]

2.5 Software Quality

The Review Stage in developing a mobile-based Customer/Tenant Service Management application using the Design Science Research Methodology (DSRM) method is the stage where the quality of the application is evaluated comprehensively[17]. To do this, we can use the ISO 9126 standard, which provides a framework for evaluating software quality based on 6 (six) main characteristics and each characteristic will have an assessment point[18].

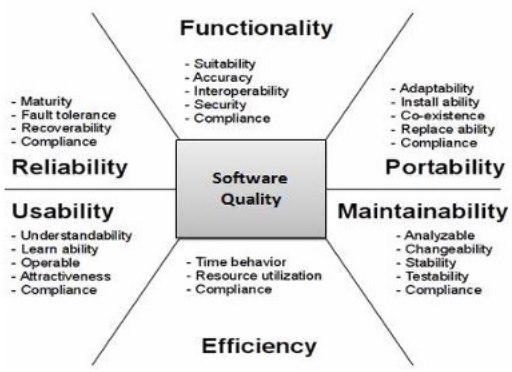


Figure 2. Characteristics of Software Quality using ISO 9126

3. MATERIAL AND METHOD

This research uses the DSRM method to develop an IPMS application prototype which will start from the initiation stage to determine the reasons why this research was conducted [7]. The DSRM stages are depicted in figure 1. The research was initiated because of problems complained by tenants/customers at several properties because of interviews with tenants and direct observations at several properties in Indonesia. Using a survey conducted on tenants and on the building management/property management team, several problems were found, namely:

- **Problem Identification:** Problem identification is carried out by analyzing tenant needs and the challenges faced by property management companies in managing interactions and services to tenants. The main problem identified was a lack of integration between various functions in property management and a lack of tenant involvement in the management process.
- **Define objectives of a solution:** At this stage, researchers focus on formulating specific objectives for the solution that will be developed based on the problems identified in the first stage. This stage clearly defines what will be achieved with the proposed Solution.
- **Artifact Design and Development:** This stage includes the design and development of an IPMS application prototype designed to integrate various property management functions such as service ordering, problem reporting, and rental payments. This application is also designed to increase tenant engagement through features such as automatic notifications, issue tracking, and a communication portal. In this development, UML will also be used as a tool to assist the design process [19].
- **Demonstration:** The IPMS application prototype was then tested in a simulation scenario to show how this application can be used by property managers and tenants. This demonstration is carried out to ensure that the application

functions as expected and meets the needs that have been identified.

- **Evaluation:** Evaluation is carried out using feedback from simulation users (tenants and property managers) as well as application performance analysis. Evaluation criteria include usability, efficiency, and user satisfaction. The results of this evaluation will be used to improve the prototype before wider implementation.

The results of this research will be communicated through academic publications, presentations at conferences, and reports to property management companies that are research partners. The aim is to disseminate the findings and open further discussion about the development and implementation of IPMS in industry

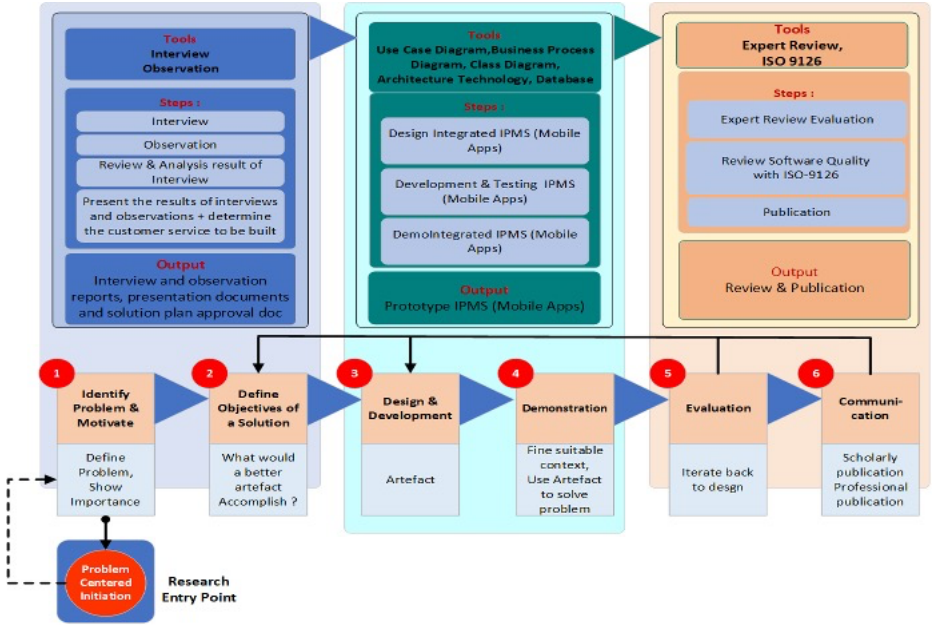


Figure 3. Design Science Research Methodology for Prototype Development IPMS

4. RESULT AND DISCUSSION

Using the existing stages of the Design Science Research Methodology (DSRM), this research uses 6 (six) stages in accordance with Figure 3.

4.1. Problem Identification

Prototype development will begin with the problem identification stage in accordance with the stages in DSRM. Based on the results of interviews and observations, the problems that occur with tenants/customers in property management in Indonesia are:

- Ineffective communication: One of the main problems is ineffective communication between property management and tenants. Important information regarding regulations, rental payments, maintenance and services is often not conveyed properly. This can lead to tenant dissatisfaction, delays in resolving issues, and even conflicts that could have been avoided with better communication.
- Low Tenant Satisfaction: Low tenant satisfaction is often caused by poor maintenance services, inadequate facilities, or a lack of quick responses to tenant complaints. This makes dissatisfied tenants more likely to move at the end of their lease, which can increase property vacancy rates and reduce income.
- Slow response from the property manager to handle complaints/requests: Running services that are not efficient or responsive can cause tenants to have to wait a long time for repairs. This can include problems such as leaks, damage to facilities, or security system failures and result in not only reducing tenant satisfaction but can also increase maintenance costs in the long term and damage the property management's reputation.
- Incompatibility of services with tenant/customer needs: The inability to tailor services or facilities to specific tenant needs can be a problem. For example, commercial tenants may require more advanced technology infrastructure, while residential tenants may want more recreational facilities.
- Inefficient management of tenant/customer data: Inability to effectively manage tenant data, including contact information, payment history, and complaints, can hinder daily operations. Data that is not properly organized can cause

errors in billing, loss of important data, or delays in responding to tenant requests.

4.2. Define Objectives of a Solution

Of the 5 (five) main problems that were discovered at the define problem stage, then with the results of discussions with top level management, a solution was approved with 3 developments in accordance with the digital transformation concept, namely:

- Development of human resources, especially the team in property management which is tasked with providing services to tenants/customers by improving better service through training and regular reviews to continue to monitor the satisfaction index through surveys that will be conducted.
- Process improvements and outreach to all stakeholders in property management, especially in terms of handling services to tenants/customers which are still impractical, take longer and are not in accordance with current conditions
- A technological approach by developing applications that can handle problems related to customer service that can be used by tenants/customers in real time and can be monitored by property management at an affordable cost

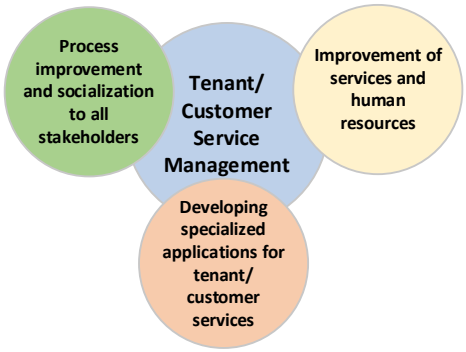


Figure 4. Solutions for tenant/customer handling and services in property management industry

Furthermore, in this section, the development of technology-based solutions will be emphasized, namely the development of special applications for services to tenants/customers, namely an application that will be built based on mobile apps because it is in accordance with the original goal so that tenants/customers can interact directly with the property management team without constrained by time and place.

The results of the development of this application prototype will be integrated and part of and connected to the Integration Property Management System (IPMS), showing that this system has succeeded in integrating various property management functions into one easy-to-use platform.

4.3. Design and Development

The Design & Development section will use several stages to provide an overview of how the system was designed and developed.

- Use case diagram: Use case diagrams are diagrams in the Unified Modeling Language (UML) that are used to describe system functionality from the perspective of the user or actor. In the context of Tenant/Customer Service Management application development in Property Management, use case diagrams play an important role by showing how users or tenants will interact with the system and what functionality is available.

Ada 4 actors yang terlibat yaitu Tenant/Customer, Property Owner, Technician dan bank. Untuk actor

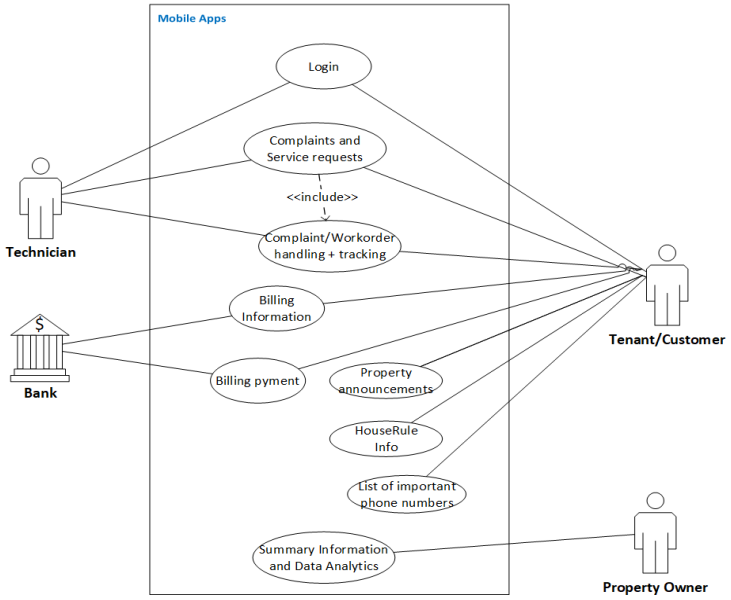


Figure 5. Use case Diagram for Tenant/Customer Service Management

• A Business Process Diagram (BPD): A visual tool used to model, analyze, and document business processes. In the context of Tenant/Customer Service Management application development in Property Management, BPD functions to map workflows and interactions between various entities involved in tenant service management, enabling developers and stakeholders to understand, design and optimize business processes to be automated. by application.

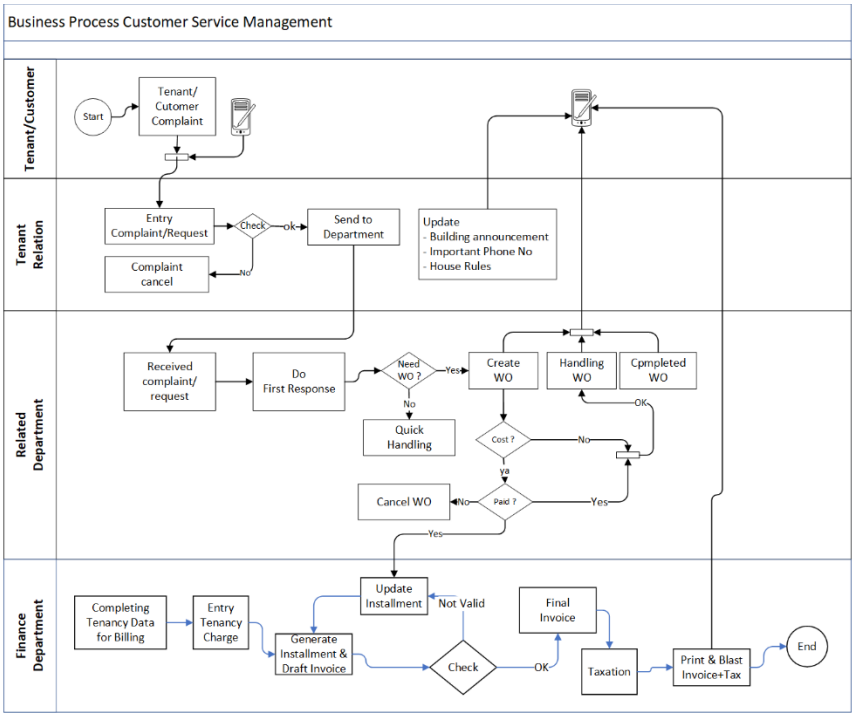


Figure 6 Business Process Diagram Customer Service Management

- **Application Prototype:**

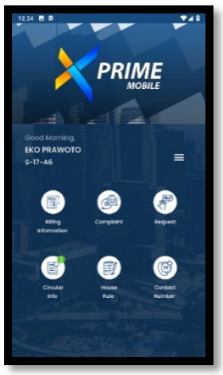
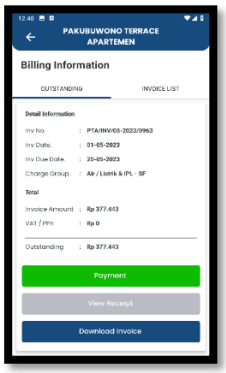
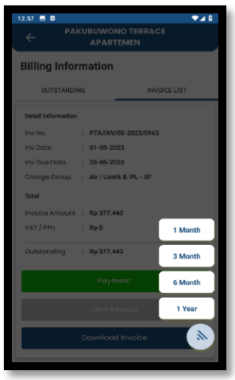
Function: "Billing Information" menu for external user roles in the main menu		
		
User selects the "Billing Information" menu	Display after the user selects the "Billing Information" menu	Display after the user selects the "Billing Information" → "Invoice List"
Function: • User choose the "billing information" menu	Function: • Users can view billing information/outstanding bills (unpaid/unpaid) • Users can make payments for outstanding billings, can download billings and proof of payment in .pdf format	Function: • Users can view billing information/bills that have been paid for a certain period of time (1 month, 3 months, 6 months and 1 year previously)

Figure 7. Billing Information Features

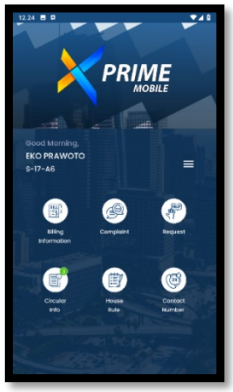
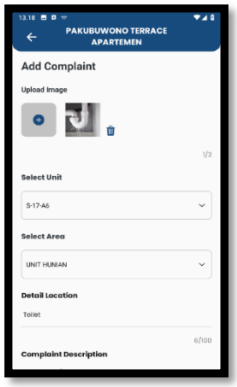
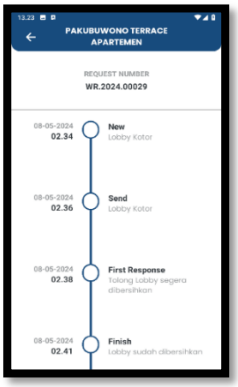
Function: "Complaint" menu for external user roles in the main menu		
		
User selects "Complaint" menu	Users register "Complaint" data	Users can see the status of complaints made (tracking)
Function: • *User* selects "*Complaint*" menu	Function: • Users can see a list of complaints that have been made (history) • Users can enter/collect complaint data from the property manager	Fungsi : • Users can see information on the status of complaints made and see tracking

Figure 8. Complaint & Request Features

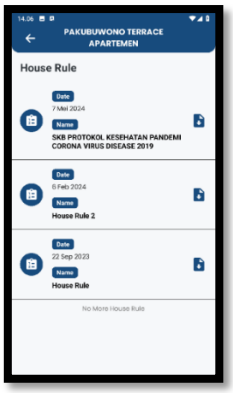
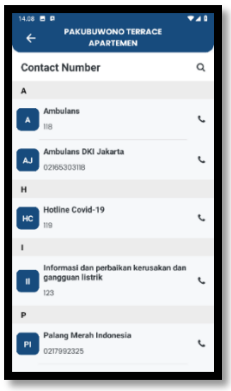
Function: "Circular Info", "House Rule" and "Contact Number" menus for external user roles in the main menu		
		
User selects “Circular Info” menu	User selects “House Rule” menu	User selects “Contact Number” menu
Function: • Users select the "Circular Info" menu and the application will display a list of active announcements from Building/Propery Management • Users can also download the announcement document in PDF format	Function: • The user selects the "House Rule" menu and the application will display a list of active house rule information from Building/Propery Management • Users can also download house rules documents in PDF format	Function: • User selects the "Contact Number" menu and the application will display a list of Contact Number information that has been registered from Building/Propery Management • Users can also directly contact these numbers if needed

Figure 9. Circular Info,House Rule, Contact Number Features

4.4. Demonstration

The Demonstration stage in developing a Mobile-based Customer/Tenant Service Management application using the Design Science Research Methodology (DSRM) method focuses on testing application prototypes to show how the solution that has been designed is able to meet needs and solve previously identified problems.

1. Demonstration Environment

a. By using the User Acceptance Test (UAT) method, the application prototype is tested in an environment that is close to actual operational conditions, involving various actors such as tenants, property managers, and the property management team which includes a team of staff from the Tenant Relations Department and Engineering staff.

b. Several main usage scenarios are prepared to simulate common activity interactions between tenants and property management, such as submitting complaints or service requests, rent payments, tracking complaint status, and direct communication between tenants and the property management team.

2. Prototype Implementation

a. Complaint & Service Request Submission: Tenants can submit service requests via the application interface, which are then automatically forwarded to the maintenance team.

b. Bill payment (Billing System and Payment): Tenants can view the bill provided and then make rent payments online, with automatic confirmation and transaction records stored in the system.

c. Request Status Tracking: Tenants can monitor the status of their service requests in real-time, from the time the request is submitted until it is completed.

d. Information regarding announcements of activities at the property/building that are generally known by tenants/customers

e. Displays information about house rules or regulations that are agreed upon between building managers and tenants/customers

f. Displays information on important numbers that can be contacted by tenants/customers in certain and urgent situations

4.5. Evaluation

To be able to see how a mobile-based Customer/Tenant Service Management application that uses the Design Science Research Methodology (DSRM) method can be accepted by users, after the Demonstration stage it is continued with a review using a questionnaire. The questionnaire questions are based on the ISO 9126 standard, which provides a framework for evaluating software quality based on 6 (six) main characteristics, namely: Functionality, Reliability, Usability, Efficiency, Portability and Maintainability.

The questions for the review asked were as follows and were asked by 35 (thirty-five) respondents, with the following categories:

Tabel 1. Type of Respondents for evaluation

1. No.	2. Respondence	3. Total of Respondents
4. 1	5. Tenant/Customer	6. 23
7. 2	8. Tenant Relation staff	9. 5
10. 3	11. Engineering staff	12. 7

Tabel 2. Result of evaluation with ISO 9126 using Likert Scale

13. No.	14. Characteristics	15. Results and Conclusions
16. 1	17. Functionality	- This characteristics for the statement strongly agrees and agree gets a percentage of 51.18%, for the statement quite agree gets: 38.24%, if quite agree (cs) and combined with strongly agree and agree as a positive statement, the value is 89.42% entered as a statement and statements strongly disagree and disagree get 10.59% percentage. - This means that for the "functionality" characteristic, with 5 sub-characteristics, this application can run well, with the value of those who disagree only being: 10.59% and those who say strongly agree, agree and quite agree of: 89.42%, with the sub-characteristic "functionality". compliance" got the highest score of: 94% of respondents/users who stated that they strongly agreed, agreed and quite agreed. - The opinion given by several respondents is that in general the application prototype has functions that suit the needs of internal users
18. 2	19. Reliability	- The reliability characteristics of the application prototype received a good assessment from respondents on two sub-characteristics, namely "maturity" and "recoverability", but on the sub-component "fault tolerance" only 49% gave positive statements and 51% gave negative statements. - Opinions from 4 (four) respondents/users who gave negative marks (Strongly disagree and disagree) this is because when testing was carried out, the test was carried out by simulating network disconnection to the cloud server and the application prototype had not been anticipated by not informing about the type of problem and the prototype the application does not work and when the network connection is reactivated, the user has to log back into the application, this is what causes some respondents/users to give greater negative statements than positive statements. - But if we add up the total scores for these characteristics, we still get an overall positive score with a score of 79.90% of respondents who gave positive statements (strongly agree, agree and quite agree)
20. 3	21. Usability	- The "usability" characteristic gives an idea of how easy this application prototype can be understood, studied, used/operated and interesting. Respondents/users who tested the application prototype gave the highest score to this characteristic, namely 72.43% who stated strongly agree and agree and 24.63 % said they quite agreed and only 2.94% gave negative statements. - With a very high positive statement value, the application prototype can be accepted by respondents as an application that is not complicated, easy to use and operate in property management in Indonesia.

22. 4	23. Portability	- This characteristic is to see whether the application prototype can be moved/transferred from one environment to a different environment or the ability of the application prototype to adapt to a particular environment, for example whether the property management mobile application prototype can be directly run on the Android OS in all versions. , can be run from Android OS to iOS with the same results. - Survey results from respondents/users who carried out the test gave an average value for positive statements of: 56.62% and 33.46% for quite agree and only 9.93% for negative statements. - There is one sub-characteristic, "Coexistence", which gets a negative score of 37% for the questionnaire question "Application prototypes can run by sharing resources with other applications", some respondents/users think that applications must be independent, so that if they are combined they will have the effect of decreasing performance , but when combined for positive statements, this sub-characteristic still has a higher percentage compared to those who gave negative responses, namely 63%.
24. 5	25. Maintainability	- Maintainability has 4 sub-characteristics, namely "Stability", "Analysability", "Changebility" and "Testability". All got good scores except for the sub-characteristic "Testability" which received a negative statement with a percentage of 50%. - Some users think that testing using tools is more inaccurate than manual testing using "scenario tests" and almost no users have experience carrying out tests automatically/using tools, this affects the test results of the "testability" sub-characteristic. - Overall, the 4 sub-characteristics in the "maintainability" characteristic received a good score, the positive percentage value was 55.51% for the statements strongly agree and agree, and 31.25% which stated quite agree.
26. 6	27. Efficiency	- The last characteristic is "Effiency" which is one of the characteristics to obtain efficiency from the application prototype being tested. Two sub-characteristics, "Time Behavior" and "Resources Behavior" received very good positive responses from respondents. Even for time behavior, it got a perfect score, namely 100% of respondents gave positive statements and 92% for "resources behavior" and this is the characteristic with the highest score.

4.6. Communication

Submission of results and findings from application development to various stakeholders. The goal is to ensure that the knowledge gained during the development process and the results of the application can be understood, evaluated, and applied by relevant audiences, whether in academic settings, industry, or within the organization itself. Academically, these results are published in a reputable international journal so that later they can be used as a reference for further development and for the industrial environment, the Customer/Tenant Service Management prototype can later be implemented in the property management industry in Indonesia and developed further, even integrated and collaborated with applications. others by using REST-API technology as standardization.

5. Conclusion And Future Work

The development of a Mobile-based Customer/Tenant Service Management application using the Design Science Research Methodology (DSRM) method has succeeded in fulfilling the main objective, namely providing an effective solution to support tenant service management in the property industry. Through the systematic approach adopted in DSRM, these applications are developed by identifying specific user needs, designing and developing relevant technical solutions, and evaluating those solutions to ensure compliance with business needs.

In the development process, DSRM helps ensure that every stage, from problem identification to implementation and evaluation, is carried out with a strong evidence-based approach. As a result, this application is able to increase operational efficiency, speed up responses to tenant requests and complaints, and increase the transparency and accuracy of information provided to tenants. Apart from that, this application also provides significant benefits in increasing tenant satisfaction, which in turn can contribute to increasing tenant loyalty and retention.

Overall, the use of DSRM in the development of this application has proven effective in producing innovative and practical

solutions, which not only meet current needs but can also be adapted to future needs. With this application, property management can focus more on developing value-added services, while tenants can enjoy a more responsive and user-friendly service experience. Implementation of this application also opens further opportunities for digital transformation in the property management industry, which is an important step towards efficiency and competitive advantage in the digital era.

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