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Development of a Mobile Application Using Scrum Pattern for Monitoring Project Information System

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Abstract

Project monitoring is an important aspect of project management that can affect project success. In interviews with PT Gerbang Sinergi Prima (GSP) stakeholders, project monitoring is still uses manual ways to make the process more efficient and accurate. As a result, it causes delays, cost overruns, or even project failure. Hence, this research aims to develop a mobile application for project monitoring at GSP. The development of the GSP project monitoring mobile application uses a Scrum pattern based on Agile methodology and testing with black-box and user accepted testing (UAT). The Scrum pattern could help the development team produce effective and efficient mobile application development according to changing project needs. The results showed that project monitoring using mobile applications has a positive effect on the effectiveness of project monitoring. Black box testing results showed 100% success on nine modules, ensuring all features functioned adequately. UAT showed 74% positive statements that met user needs and 46% negative statements indicating the application was quite convenient. Furthermore, the mobile project monitoring application is consistently and continuously used for all ongoing projects in the company. We suggested that it is necessary to conduct training for new users of the mobile project monitoring application.

Keywords: Agile Methodology, Black-box Testing, User Accepted Test (UAT), Mobile Application Development, Project Management, Project Monitoring, Project Failure, PT Gerbang Sinergi Prima (GSP), Scrum Pattern.

Abstrak

Pemantauan proyek merupakan aspek penting dalam manajemen proyek yang dapat mempengaruhi kesuksesan proyek. Dalam wawancara dengan pemangku kepentingan PT Gerbang Sinergi Prima (GSP), pemantauan proyek masih dilakukan secara manual sehingga prosesnya tidak efisien dan akurat. Hal ini dapat menyebabkan proyek mengalami keterlambatan, pembengkakan biaya, atau bahkan kegagalan proyek. Penelitian ini bertujuan untuk mengembangkan aplikasi mobile monitoring proyek untuk pemantauan proyek di GSP. Pengembangan aplikasi mobile monitoring informasi proyek PT GSP menggunakan pola Scrum berdasarkan metodologi Agile dan pengujian dengan black-box dan user accepted testing (UAT). Pola Scrum dapat membantu tim pengembang menghasilkan pengembangan aplikasi mobile yang efektif dan efisien sesuai dengan kebutuhan proyek yang berubah-ubah. Hasil penelitian menunjukkan bahwa aplikasi mobile monitoring proyek berpengaruh positif terhadap efektivitas monitoring proyek menggunakan Scrum dengan meningkatnya efisiensi, akurasi, dan ketepatan waktu dalam proses monitoring proyek Pengujian black-box menunjukkan keberhasilan 100% pada sembilan modul, memastikan semua fitur berfungsi dengan baik. Pengujian UAT menunjukkan 74% pernyataan positif yang memenuhi kebutuhan pengguna dan 46% pernyataan negatif yang menunjukkan bahwa aplikasi ini cukup nyaman.. Selain itu, perlu dilakukan sosialisasi dan pelatihan kepada pengguna aplikasi mobile project monitoring agar dapat memanfaatkan aplikasi secara optimal.

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Kata Kunci: Aplikasi Mobile Monitoring, Black-box Testing, Kegagalan Proyek, Metodologi Agile, Monitoring Proyek, Pemantauan Proyek, Pola Scrum, User Accepted Test (UAT),

I. INTRODUCTION

In the digital era, project success is highly dependent on the effectiveness of project management in supporting the company's project monitoring team [1][2]. Previous research shows that existing project monitoring systems are less effective because they are prone to data loss and are difficult to control. Therefore, project monitoring software can help companies overcome existing problems [3][4]. In this case, PT GSP, a pension fund company subsidiary of the Pension Fund of PT PLN (Persero), which is engaged in Digital Payment, Payment Gateway, Biller Aggregator, and ICT Services, has various business projects that must be managed properly to run as intended. However, based on the interview, the current monitoring project information system in GSP is still using the manual way like using Microsoft Excel, which causes the process to be inefficient and inaccurate. As a result, it causes several issues like the projects in delays, cost overruns, or project failure.

To overcome these issues, it is necessary to implement automatic monitoring, accelerate project monitoring schedules by following technological advances, and monitor projects in real time through mobile applications for monitoring company project information [5][6]. In detail, the mobile application is software that can be used with smartphone for tasks such as word and number processing at the user's command [7][8]. Many developers use Flutter framework to create applications or websites, so the mobile application will be created using the Dart or Flutter programming language in Visual Studio Code IDE [9][10]. By using monitoring applications, companies can collect accurate and up-to-date information on project status in real time, offer tools to control project scheduling, human resources, quality, and assist in project planning and supervision [1].

During the application development process, there is always the possibility of changes or improvements to the system so that failures can occur. Hence, to monitor changes, the Agile method with the Scrum pattern is the right choice [11]. Scrum pattern is not only responsive to change, meaning it can accommodate and even leverage changes to improve the system, but also emphasizes iteration in each development cycle [12]. The Scrum pattern increases the chances of success in creating a business monitoring application that can be adapted to changes and user needs by developing and refining the application in stages [13]. The Scrum pattern in Agile methodology allows for flexibility and adaptability, which is critical in the dynamic mobile application development environment [14]. Furthermore, it could improve the development process by breaking it down into smaller, manageable tasks and emphasizing regular feedback and adaptation. On the other hand, the previous research states that mobile applications should be tested for quality from the point of view of both the development process and product deliverables [15]. Furthermore, an important step is system design using UML (Unified Modeling Language) visual modeling for system communication in object-oriented software development [7].

The company's project monitoring application is complex because it involves various components and functions that must work efficiently. After the system is developed, the system will be rigorously tested to ensure that the system is feasible to use and meets functional and non-functional needs. This comprehensive test aims to improve application quality, find bugs, reduce the risk of failure, and increase user satisfaction [16]. For example, testing could be using the UAT method and the decision table in black-box testing. UAT testing evaluates the system through respondents using questionnaires to ensure the system is accepted and meets user needs [17][18]. On the other hand, Black-box testing is an extensive approach that assesses an application's functionality without focusing on its internal mechanisms, guaranteeing that all application components operate as anticipated [19]. Further, black-box testing is an approach in which the tester does not need to know the inner mechanisms or structure of the product being tested. Instead, decision tables are used to determine the outcomes of different inputs. This approach particularly benefits testing systems with various possible inputs and outcomes [20]. In addition to functionality testing, non-functional testing ensures the mobile application works properly and accurately. Therefore, in this study we demonstrated step-by-step to implement the Scrum pattern in the development process of the mobile monitoring application with deeply analysis.

II. LITERATURE REVIEW

A. Project Management and project monitoring in GSP

In the opinion of Afsari et al. [1], the development of an Android-based application for scantling calculation can assist survey activities by providing real-time data input and processing, ensuring compliance with BKI rules. This application aims to help manage tasks in shipyards, including quality control, schedule planning, and HR management. This application has similarities with the project monitoring tool that PT GSP will use.

Previous studies [3][7] suggests that monitoring is supervising and examining an object within a certain time to provide information to project management, and stakeholders must evaluate project progress. The previous system could have been more efficient due to difficulties in monitoring project progress in detail, vulnerability to data corruption, and cost. Therefore, project monitoring is needed to provide more accurate and up-to-date information and identify errors earlier.

B. The development of Mobile Application with Scrum pattern in Agile methodology.

Based on previous research [16][21], an application is software that performs a specific task by converting input into output. Mobile applications run on mobile devices and mostly require the internet, although some can be accessed offline. Android SDK and Microsoft Visual Studio are used to develop Android applications. PT GSP's project monitoring application uses Flutter and Dart to create easy-to-use mobile applications. Flutter is an open-source platform for Android and iOS that offers performance comparable to native frameworks and provides material design libraries and consistent interface widgets. Dart, Google's object-oriented programming language, supports interfaces, classes, collections, generics, and optional typing [22][21]. UML is a communication tool that supports developers in designing software, communicating between software and business processes, describing systems for analysis, and documenting systems and running procedures [23].

In the development process of GSP's project monitoring mobile application and online sales application [5], the Agile scrum pattern was chosen because of its flexibility, accelerated production, and smaller team. Both studies use the Agile Scrum approach for effective and efficient application development according to project needs. The Agile methodology focuses on rapid development, cost reduction, and high-quality code generation through collaboration between developers and users. Agile principles such as customer involvement, incremental delivery, team autonomy, and acceptance of change are applied.

Therefore, Scrum pattern uses agile principles with three main roles, such as the Product Owner holds responsibility for the product, the Scrum Master helps the team achieve goals and overcome obstacles, and the Development Team is responsible for software development. Further, Scrum elements include Product Backlog as a list of product requirements, Daily Scrum as daily activities to evaluate progress, and Sprint as a fixed period to complete the product backlog, which consists of Backlog, Sprint Planning, Sprint Review, and Sprint Retrospective [5][24].

C. The mobile application testing

In the previous studies [16][25], the black-box techniques test the functionality of a system by taking certain inputs and examining the outputs without regard to implementation details. Decision tables aim to validate the external functionality and confirm that they comply with the system's requirements. Decision table testing uses a table with various combinations of inputs to determine the expected output, which is useful for testing complex business logic. According to the previous studies [17][18], the User Acceptance Test (UAT) ensures the system conforms to user needs and business requirements. UAT uses a questionnaire with rating categories with a value weight of 5 to 1. Positive statements ensure features meet user needs, while negative statements ensure user convenience. In UAT testing, users test the application to ensure that all features function according to their expectations, and user feedback is used to make further improvements.

The primary distinction between the two evaluation methods is that the black-box strategy checks the external functionality of the system. In addition, UAT confirms that the system meets the users' needs and is convenient for them. Black-box techniques are better at ensuring the system functions according to technical specifications. UAT is important for ensuring end-user satisfaction. However, the combination of these two testing methods

delivers real benefits to users, and the hard work of developers, testers, and project managers makes this possible.

III. Research Method

In the systematic problem solving, the application developer decided to use the agile Scrum pattern in the research, which is expected to avoid failures due to changes or improvements to the system when making mobile-based monitoring applications. This mobile application was developed using Flutter, a framework that makes it easy to create applications for various types of mobile devices [9][25]. The Scrum team table in planning shows the direction and prioritization of making the PT GSP project monitoring mobile application, starting from planning to the application testing stage. Table 1 serves as a guide for the development team, starting from the product owner to the development team, to determine the priority and order of development of the features of the PT GSP project monitoring mobile application.

TABLE I
Product roadmap

Product Owner	PT GSP
Scrum Master	Eko Darwiyanto
Development Team	1. Bulan Ayu Sari Muntai as a developer in the creation of PT GSP project monitoring mobile application 2. Daffa Arya Hutomo Putra as a developer in the creation of the backend dashboard admin monitoring project PT GSP 3. Rizky Sampoerna as a developer in the creation of the frontend dashboard user monitoring PT GSP Project
Project	Development of a mobile application for monitoring project information of PT GSP
Description	The PT GSP project monitoring mobile application aims to make it easier for users to monitor and analyze the data needed when carrying out project monitoring activities at PT GSP.
Sprint	4 times (1 sprint run for 24 days)

This mobile application will display project data in tables and graphs to facilitate monitoring and improve PT GSP's operational efficiency through easy access to data updates. The Scrum pattern was used with four sprints, each lasting 24 days, to complete the app features incrementally according to user requirements. The development team discussed with company stakeholders to ensure all user needs were met and the features developed were relevant to the project monitoring activities. After that, the team defines the steps required to develop the solution, formulates a strategy, and sets development goals to give the project a clear direction and focus. The Scrum team table shows the direction and prioritization of application development, from the planning stage to testing, with the steps of the Scrum pattern Agile method. Figure 1 shows the software development pattern with the Scrum pattern, consisting of several important stages performed iteratively and incrementally. The following is a more detailed explanation of each stage in the Scrum pattern.

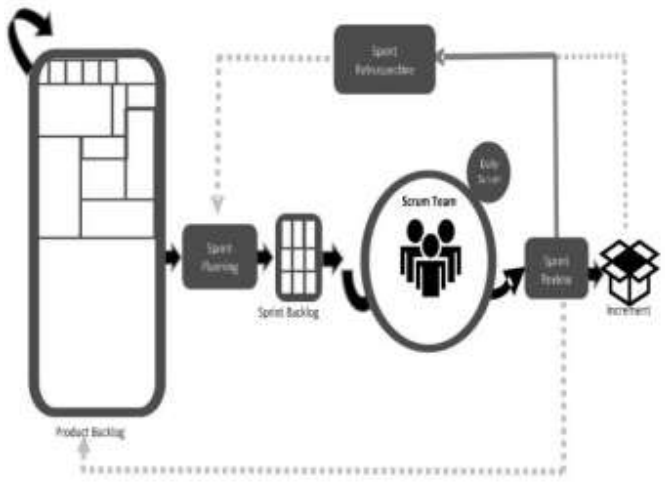


Fig. 1. Scrum Pattern [26]

1) Product Backlog
After formulating the problem and research objectives, the development team determined the product backlog to address the problem through analysis and discussion with stakeholders as product owners. Each product requirement in the backlog is assigned a priority and work weight to estimate the effort required. The team then created a list of requirements sorted by priority. Next, the team developed UML to facilitate overall system development.

2) Sprint Planning
After completing a sprint, the development team sets targets for the next sprint based on the list of requirements from the product backlog, ensuring no bottlenecks exist. The team develops time estimates for each sprint stage, affecting the entire process. The sprint backlog determines and times each stage, such as interface design, programming, and system testing, and monitors progress to ensure timely completion.

3) Sprint Review
In the product testing stage, functionality is tested per the requirements, and user data interactions are viewed to determine the impact on the system results. This process uses a decision table testing method, such as decision table testing in black-box testing. Before testing, the development team creates test cases that describe various data conditions according to predefined rules, with successful or unsuccessful results, to ensure the product works properly. After decision table testing, UAT testing was conducted by users using a questionnaire consisting of five answer categories with 5 Likert scales, such as strongly agree (5), agree (4), moderate (3), disagree (2), and strongly disagree (1). Afterwards, stakeholders answered the statements in this questionnaire directly after testing the mobile application.

4) Sprint Retrospective
At the end of the sprint, the team conducts an evaluation to assess the work results. If obstacles or unmet needs are found, the team reorganizes the product backlog, creates a new sprint backlog, and plans to improve efficiency.

IV. Results And Discussion

A. System Requirements Analysis

1) Functionality Analysis
The project monitoring mobile application in this research is designed to be operated by users who can monitor and analyze project data. Users have full access to the features in the application. The main

purpose of the user is to monitor the project's progress in real-time by viewing data processed in the form of tabular and graphical displays. Users can automatically know if any data has been updated or added through the notification feature. In addition, users can use the calendar feature, which is equipped with a task feature that allows users to add personal notes. The following is a table analyzing the functionality of the mobile project monitoring application that covers user needs. Furthermore, Table II lists user activities, codes, descriptions, and requirements. This list can make it easier for developers to create and customize features on mobile applications. Therefore, the developer created nine activities and 32 features.

TABLE II
FUNCTIONALITY ANALYSIS

No	Section (S)	Description	User Requirements
1	Log in page (S1)	Users can log in using the data registered in the database.	Data security and quick access at login
2	Register page (S2)	Users can register to register data into the database that will be used for login	Data security and quick access when registering
3	Home page (S3)	On the home page, the first three boxes display data related to the total assessment of RKAP (recapitulation), actual, and contract/year. Then, the next three boxes display each data as a bar chart in the project box, a pie chart in the product box, and the number of customers in the customer list box. Each box will direct the user to the project, product pages, and customer list. In addition, there is a calendar for checking dates and tasks for the user's records	Understanding of data trends and patterns, quick access to up-to-date information, time management, and personal records
4	Projects page (S4)	The projects page, it displays a bar chart in the form of total projects based on work status and a projects table in the form of detailed data for each project, where each job name in the projects table will direct users to the project details page	Understanding of data trends and patterns and quick access to up-to-date information
5	Detail projects page (S5)	The project details page displays a toggle task button containing a data table that displays each task development according to the selected job name	Understanding of data patterns, as well as quick access to the latest information display
6	Products page (S6)	The products page displays a pie chart in the form of a total service name based on product data and a product table with detailed data for each product	Understanding of data trends and patterns and quick access to up-to-date information
7	List customers page (S7)	The list customers page displays a list customers table in the form of detailed data for each customer	Understanding of data patterns, as well as quick access to the latest information display
8	Inbox notifications page (S8)	The inbox notifications page, users can see the data in the table that was changed or added by the admin from the database.	Quick access to notifications when data information is updated
9	Profile page (S9)	The profile page displays the user's account data information and the option to log out of the account	Personal data information and account access

B. System Design

The UML is very important during the development of mobile application monitoring project information because it helps describe, define, build, and document object-oriented software systems through various diagrams such as use case diagrams, activity diagrams, ERDs, and class diagrams [24]. In addition, applying the Scrum pattern in the development process is iterative and incremental. Hence, it allows user feedback to be received and implemented quickly in each sprint and ensuring application development remains adaptive and responsive to user needs and environmental changes.

1) Use Case Diagram

Use case diagrams show the interaction between users and functions in the application, describing the relationships between users, systems, use cases, and relationships. These diagrams help developers understand user needs and ensure functions are appropriate for effective and efficient monitoring of project information [24][25]. Figure 2 illustrates the features of the project monitoring application system. To access these features, users must first log in. After logging in, users can access the main page, which displays a calendar, project table, project graph, and other information. Users can also view project details, customer lists, and user profiles and receive notifications. In addition, there are features to add notes to tasks and view charts and product lists. To display data on all these features, the miner requires data access to authenticate through an Application Programming Interface (API) created by the backend admin. The accessed data is stored in the server-side database. The API serves as a go-between for the application developer and the backend administrator, allowing the developer to access or save information in the database through API requests to the backend.

Fig. 2. Use Case Diagram of Mobile Application User

2) Activity Diagram

An activity diagram is a modeling technique used to describe the sequence of activities in a business process and the main activities of users of an application or system. This diagram groups the sequence

of application views, helping to understand and visualize the process and interactions between use cases [24][23]. The following is one of example of the activity diagrams such as when the users perform login activities.

Fig. 3. Login Activities

3) Entity Relationship Diagram (ERD)

The following is the ERD of the data created in the PT GSP project monitoring mobile application.

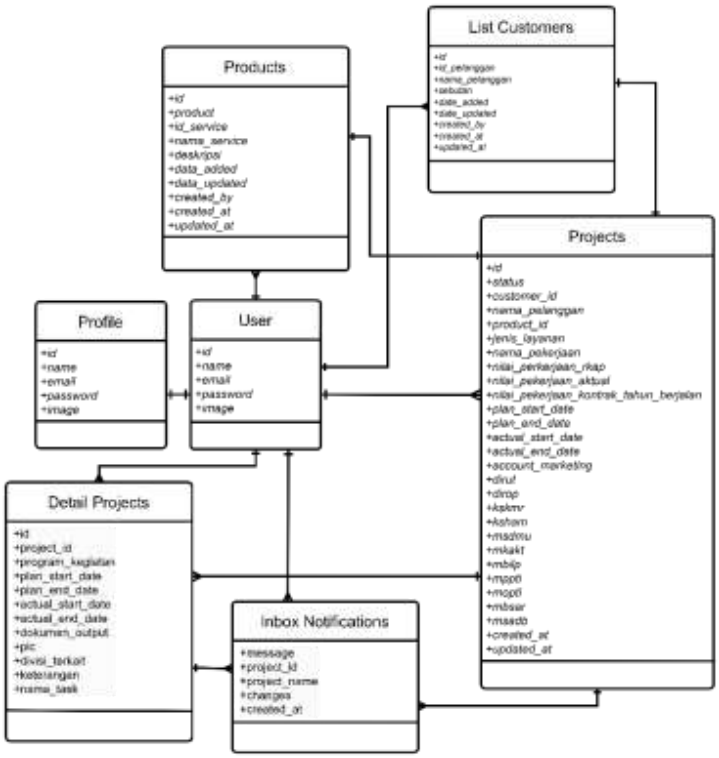


Fig. 4. Entity Relationship Diagram (ERD) on Mobile Application

4) Class Diagram

The following is a class diagram made in the PT GSP project monitoring mobile application.

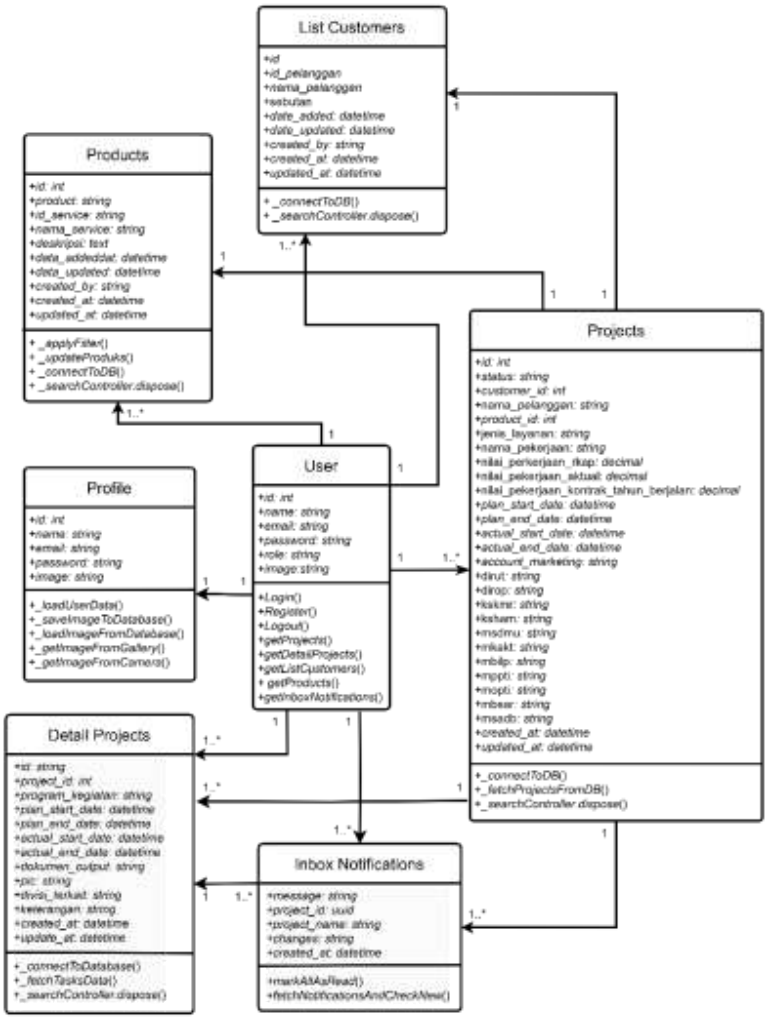


Fig. 5. Class Diagram on Mobile Application

C. *Scrum Implementation*

1) Product Backlog

Product backlog is the process of determining the need for features in making applications based on user stories and setting the processing time [5][24]. Determining the backlog according to the development team's role is necessary to ensure the application meets user needs, as shown in Table 3.

TABLE III
PRODUCT BACKLOG

No	Product Backlog	Period
1	Create a display for the login page, and connect the login page to the database	
2	Create a display for the register page, and connect the register page to the database	
3	Create a display for the home page and features on the home page, as well as	

	connecting to the database to retrieve the data needed	March 17, 2024 - June 20, 2024
4	Create a display for the projects page, search feature on the table, and connect to the database to display the bar chart and projects table	
5	Create a view for the projects detail page, and connect to the database for the display of data for each selected job name, and toggle tasks containing data table views of each task development	
6	Create a view for the products page, search feature on the table, and connect to the database for the pie chart and products table	
7	Create a view for the list customers page, search feature in the table, and connect to the database for the list customers table view	
8	Create a view for the inbox notifications page, search feature in the table, and connect the notification to the API data that has been added or changed by the admin	
9	Create a display for the profile page, connect to the database for user data display, and profile photo, as well as a logout feature	
10	Build the .apk file for the application so that it can be shared	

2) Sprint Planning

Sprint planning is the planning stage in which a predefined product backlog, called the sprint backlog, is planned [24]. In the first step, sprint planning determines what products should be created based on the product backlog for sprints 1-4. Table IV describes the product backlog each sprint.

TABLE IV
SPRINT PLANNING I-IV

No	Sprint Planning	Product Backlog	Section	Period
1	Sprint Planning I	Create a display for the login page, and connect the login page to the database	1. There are fields to fill in, email and password	March 17, 2024 – April 10, 2024
			2. Connects the login page to the database created	
			3. Connects to the home page if the login is successful	
			4. It gives a message if the email or password entered is wrong and still directs to the login page	
		Create a display for the register page, and connect the register page to the database	1. There are fields to fill in username, email, password, and role/position	
			2. Connects the register page to the database created	
			3. Connects to the initial login page if the account register is successful	
		Create a display for the home page and features on the home page, as well as connecting to the database to retrieve the data needed	1. There is a project data display feature in the form of 3 initial boxes in the form of total RKAP, actual, and contract/year assessment data	
			2. There is a data display feature in the form of 3 further boxes in the form of data display	

			from the database, in the form of bar charts in the projects box, pie charts in the products box, and the number of customers in the list customers' box. If the user presses the "view" button on one of the boxes, the system will direct the user to the page according to the user's choice	
			3. Connecting all data views to the database according to the data needed	
			4. There is a feature to check the calendar	
			5. There is a task feature for personal notes	
2	Sprint Planning II	Create a display for the projects page, search feature on the table, and connect to the database to display the bar chart and projects table	1. There is a feature to display project data in the form of a bar chart	April 11, 2024 - May 5, 2024
			2. There is a project data display feature in the form of a table	
			3. Connecting all data views to the database according to the data needed	
			4. In the projects table, the data content on the job name is connected to the project details page	
			5. There is a search feature to display the contents of the table data according to the job name in the projects table	
		Create a view for the projects detail page, and connect to the database for the display of data for each selected job name, and toggle tasks containing data table views of each task development	1. There is a detailed display of job name data according to what was previously selected in the projects table on the projects page	
			2. There is a task data display feature in the form of a toggle task in which there is a task table	
			3. Connecting all data views to the database according to the data needed	
		Create a view for the products page, search feature on the table, and connect to the database for the pie chart and products table	1. There is a feature to display project data in the form of pie charts	
			2. There is a products data display feature in the form of a table	
			3. Connecting all data views into the database according to the data needed	
			4. There is a search feature to display the contents of the table data according to the service name in the products table	
3	Sprint Planning III	Create a view for the list customers page, search feature in the table, and connect to the database for the list customers table view	1. There is a feature to display list customers data in the form of a table	May 6, 2024 - May 30, 2024
			2. Connect the list customers data display to the database according to the list customers data	
			3. There is a search feature to display the contents of the table data according to the name of the customers in the projects table	
		Create a view for the inbox notifications page, search feature in the table, and connect the notification to the API data that has been added or changed by the admin	1. There is a comprehensive notification data display feature of API data that has been added or changed by the admin	
			2. There is a search feature to search for data that was changed or added by the admin according to the project name	
4	Sprint Planning IV	Create a display for the profile page, connect to the database for user data	1. There is a user data display feature in the form of name, email, and role	
			2. There is a profile photo editing feature	
			3. There is a logout feature	

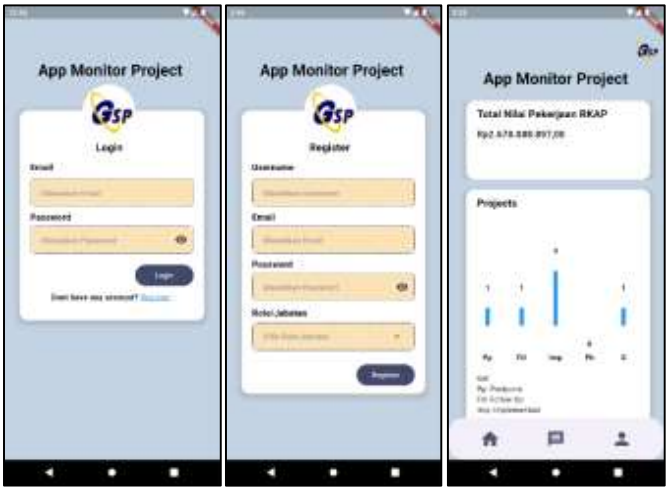
		display, and profile photo, as well as a logout feature		May 31, 2024 - June 24, 2024
		Build the .apk file for the application so that it can be shared	1. Checking all the tools and dependencies needed have been saved	
			2. Set the configuration on build.gradle to suit your needs, such as minSdkVersion, login, register, home, and so on	
			3. Generate signed apk in the build menu section of the Android Studio toolbar	
			4. Configure the keystore by entering the password, file name, and other information	
			5. Configure the apk to select the location of the file to be saved, and other information	

3) Sprint Review

In the sprint review stage, the sprint results are demonstrated to stakeholders for feedback. The revisions provided will become the new product backlog and be worked on in the next sprint [24]. In the testing phase, product functionality is tested according to requirements and analyzed with decision table testing in black-box testing. The development team creates test cases for various data conditions with successful or unsuccessful results to ensure the product functions properly [22].

a) Sprint I

In Sprint I, the application developer completed the login page, register page, and home page. Furthermore, the final result of this Sprint I is that application developers have completed all Sprint Planning I, as shown in Figure 6. In detail, Figure 6a displays the login view that requests email and password to authenticate registered users in the PT GSP Mobile Project Monitoring application database. Figure 6b displays the registration view for new users, which asks for a username, email, password, and job title to create a new account. Figure 6c displays the home view after successful login, displaying the total RKAP, actual, contract/year valuation of project data, project data bar charts, product pie charts, number of customers, as well as calendar and task features for user notes.

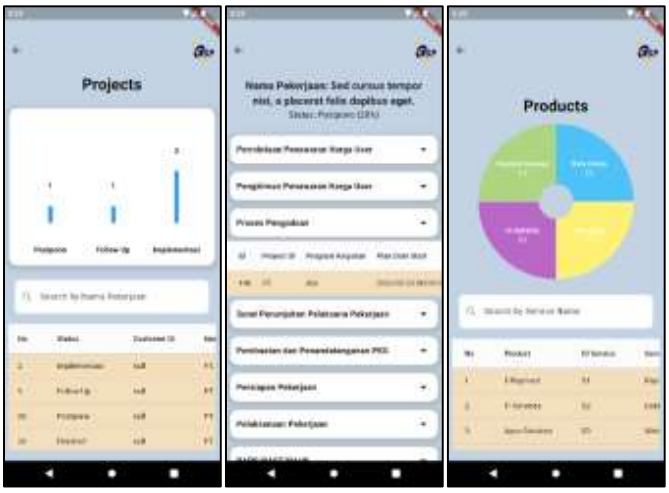


(a) (b) (c)

Figure 6. The Result of The Sprint I, Such As (a) Login Page, (b) Register Page, and (c) Home Page

b) Sprint II

In Sprint II, the application developer completed the projects page, detail projects page, and products page. Furthermore, the final result of this Sprint II is that the application developer has completed the entire Sprint Planning II, as shown in Figure 7. In detail, 7a displays the Projects page after the user clicks "view" on the project box on the home page. The page displays a bar chart and project data table based on job status. There is a search feature to search for jobs by name. 7b displays the Project Details page after the user selects a job name from the project table. The page displays a task toggle with a task progress data table for the selected job. 7c displays the Product page after the user clicks "view" on the product box on the home page. The page displays a pie chart and product data table by service name. There is a search feature to find service data from the product table.

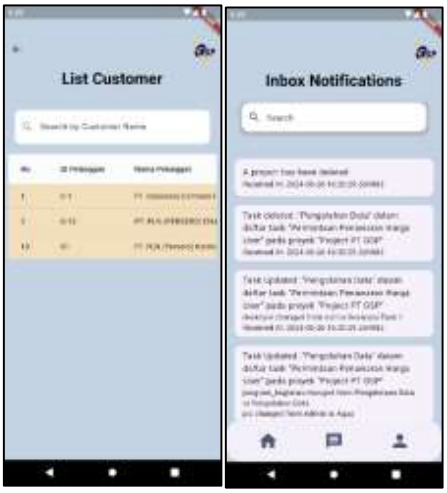


(a) (b) (c)

Figure 7. The Result of The Sprint II, Such As (a) Projects Page, (b) Detail Projects Page, and (c) Products Page

c) Sprint III

In Sprint III, the application developer completed the list customers page and inbox notifications page. Furthermore, the final result of this Sprint III is that the application developer has completed the entire Sprint Planning III, as shown in Figure 8. In detail, Figure 8a shows the customer list page displaying a customer data table with a search feature based on name. Figure 8b the inbox notification page displays notifications from the API by searching by project name.

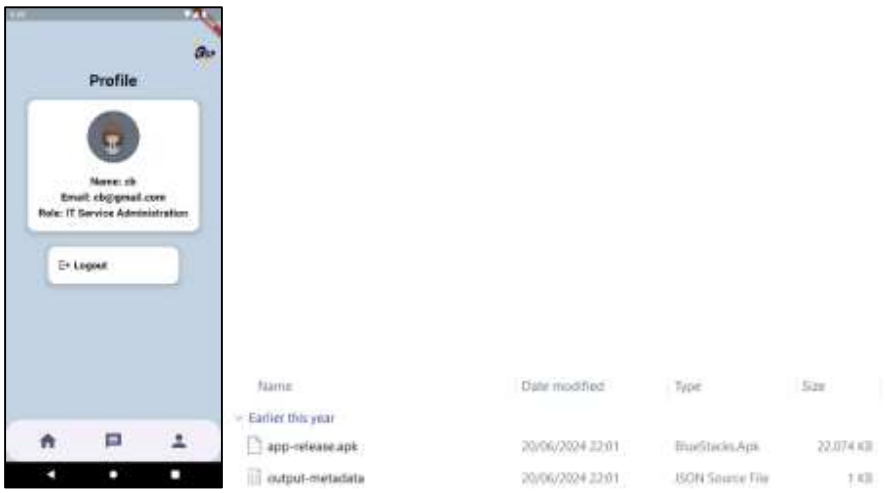


(a) (b)

Figure 8. The Result of The Sprint III, Such As (a) List Customers Page, and (b) Inbox Notifications Page

d) Sprint IV

In Sprint IV, the application developer completed the profile page and created a .apk file so that it can be shared with stakeholders. Furthermore, the final result of this Sprint IV is that the application developer has completed the entire Sprint Planning IV, as shown in Figure 9. In detail, Figure 9a displays the profile page showing the user's name, email, and role data. Users can change their profile picture and log out. Figure 9b displays the results of building the .apk through Android Studio, which involves checking tools and dependencies, configuring the "build .gradle" file, creating the signed APK, and configuring the Keystore.



(a) (b)

Figure 9. The Result of The Sprint IV, Such As (a Profile Page, and (b) Build .apk

The monitoring application that has been created will then be tested as shown in Table V. Table V contains a summary of black box testing from sprint 1 to sprint 4. The results of black-box

testing in Table V for nine modules and 21 scenarios will be calculated using the following formula.

$$Percentage\ of\ success = \frac{Number\ of\ successful\ scenarios}{Sum\ of\ all\ scenarios} \quad (1)$$

$$Percentage\ of\ success = \frac{21}{21} x100\% = 100\% \quad (2)$$

The results obtained in the black-box testing calculation show 100%. Therefore, all features tested in the black-box testing table for sprints I, II, III, and IV have been successful and functionally meet user needs.

TABLE V
BLACKBOX TESTING SPRINT 1-4

No	Sprint	Testing Class	Test Action	Expected Result	Result
1	Sprint I	Login page (S1)	1. Fill in the username, email, password, and role correctly, then press the "register" button to register the data to the database	Data is successfully registered, register is successful, and enter the login page	Success
			2. Did not fill in the data correctly, then pressed the "register" button	The data cannot be registered, the register fails, and the notification "Please fill in all data before continuing" appears	Success
		Register page (S2)	1. Fill in the username and password correctly, then press the "login" button	Data registered, successful login, enter the home page	Success
			2. Fill in the username and password correctly, but the data is not registered, then press the "login" button	Data is not registered, login failed, notification "Login was unsuccessful. Your email or password is not registered"	Success
			3. Did not fill in the username and password correctly, then pressed the "login" button	Login failed, notification "Login was not successful. Please fill in your email and password correctly"	Success
		Home page (S3)	1. Pressing the "home" icon, stay on the home page	Pressing the "home" icon successfully, stay on the home page	Success

			2. On the home page, pressing the "view" button in the second box of the projects section goes to the projects page	Pressing the "view" button succeeds, going to the projects page	Success
			3. On the home page, pressing the "view" button in the second box of the products section goes to the products page	Pressing the "view" button succeeds, leading to the products page	Success
			4. On the home page, pressing the "view" button in the second box of the list customers section goes to the list customers page	Pressing the "view" button succeeds, leading to the list customers page	Success
2	Sprint II	Projects page (S4)	1. Pressing the "search" button to find the project name according to the table data	The "search" button succeeds, displaying the table data according to the project name search	Success
			2. Pressing the "search" button to search for project names that do not match the table data	The "search" button succeeds, but no data appears in the table	Success
			3. Pressing the job name column in the project table to enter the project details page	The job name column button succeeds, and opens the project details page	Success
		Detail projects page (S5)	1. Pressing the task button to display the task table data	Toggle task successfully displays the task table data	Success
		Products page (S6)	1. Pressing the "search" button to search for the service name according to the product table data	The "search" button succeeds, displaying table data according to the service name search	Success
			2. Pressing the "search" button to search for a service name that does not match the product table data	The "search" button succeeds, but no data appears in the table	Success
3	Sprint III	List customers page (S7)	1. Pressing the "search" button to search for customer names according to the data in the customer list table	The "search" button succeeds, displaying the table data according to the customer's name search	Success

			2. Pressing the "search" button to search for customer names that do not match the data in the list customers table	The "search" button succeeds, but no data appears in the table	Success
		Inbox notifications page (S8)	1. On the home page, tap the inbox notification icon to open the inbox notification page	The inbox notification icon succeeds, and opens the inbox notification page	Success
			2. Press the "search" button to search for the desired notification data	The "search" button succeeds, displaying the desired notification data	Success
4	Sprint IV	Profile page (S9)	1. On the home page, press the profile icon to go to the profile page	The profile icon succeeds, leading to the profile page	Success
			2. Pressing the Logout button/icon to the Login page	Logout button/icon successful, go to Login page	Success
Result			21		100%

After black-box testing, a User Acceptance Test (UAT) was conducted to ensure the application met the needs of the users. Four stakeholders from the Business Development and Marketing division of PT GSP evaluated the functionality, performance, and ease of use of the application. The UAT used a questionnaire consisting of five answer categories with five Likert scales, namely strongly agree (5), agree (4), moderately (3), disagree (2), and strongly disagree (1). The results show the application meets user needs [17][18]. The questionnaire statements are based on the use of the application and are filled in by relevant stakeholders [17][27]. The following is a table qualifying the results of the statements in the UAT.

TABLE VI
Statement Result Qualification in UAT

Answer Category	Rating Scale	Percentage of Positive Statements	Percentage of Negative Statements
Strongly agree (SA)	5	80 - 100%	0 - 19%
Agree (A)	4	60 - 79%	20 - 39%
Disagree (D)	3	40 - 59%	40 - 59%
Moderately (M)	2	20 - 39%	60 - 79%
Strongly disagree (SD)	1	0 - 19%	80 - 100%

Table VI distinguishes between positive statements (P) to ensure features meet user needs and negative statements (N) to ensure user convenience. From the UAT results obtained, Table VII shows positive statements with a percentage of 74%, including a good category that shows the application meets the needs and expectations of users. In comparison, Table VIII shows negative statements with a percentage of 46%, including a fairly good category that shows the application is quite comfortable to use. The percentage results of each statement are in the following table.

TABLE VII

POSITIVE STATEMENT (P) RESULTS IN UAT

No	Answer Category	Answer					Percentage Result
		SA	A	D	M	SD	
1	I find the app easy to use	-	-	1	1	2	85%
2	I feel the features in this app work well	-	-	1	3	-	75%
3	I feel others will quickly understand how to use this app	-	-	2	2	-	70%
4	I feel there are no barriers to using this app	-	-	1	3	-	75%
5	I feel the app can be used smoothly in a variety of conditions, including in the field or when working from home	-	1	-	3	-	70%
Total Average Percentage		-	2	15	48	10	74%

TABLE VIII
NEGATIVE STATEMENT (N) RESULTS IN UAT

No	Answer Category	Answer					Percentage Result
		SA	A	D	M	SD	
1	I need technical assistance to use the app	1	1	1	1	-	50%
2	I feel there are many inconsistencies in the app	-	2	1	1	-	55%
3	I feel the app confusing	-	2	1	1	-	55%
4	I need to familiarize myself before using this app	-	-	2	2	-	70%
5	I feel the app is less reliable when used in the field or in a work-from-home situation	-	2	-	2	-	60%
Total Average Percentage		1	10	15	20	-	46%

4. Retrospective Review
   Sprint Planning went smoothly during Sprints I through IV, and the backlog schedule was met on time. Challenges included displaying chart data and toggle tasks at mobile sizes, connecting notification data from APIs, and integrating photo profile data. Improvements include simplifying data visualization, better communication with backend developers, thorough testing and review during the .apk build, and better team communication.

V. CONCLUSION

The conclusion from the creation of PT GSP's company monitoring application shows that using the open-source Flutter framework effectively produces applications with optimal performance and appearance on various platforms. The Scrum pattern was chosen to improve team communication and enable incremental product development according to user needs. Testing using black-box testing achieved 100% results in 9 modules tested, the test was conducted to ensure features function properly, while the User Acceptance Test (UAT) showed 74% positive statements and 46% negative statements, indicating the application generally meets users' needs. To ensure the application's future performance, it is recommended that the development team continue to improve the quality of the product and conduct performance testing. This will not only reassure our stakeholders but also ensure the application's use is comfortable.

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References

[1] Sabila Fitri Afsari, Heri Supomo. "Analysis of The Usage of The Android-Based Scantling Calculation Application for Wooden Ship Construction for Survey Activity Based On BKI Vol VII 2013 Rules." *IOP Conference Series: Materials Science and Engineering*, Jan. 2021. DOI: 10.1088/1757-899X/1052/1/012044
[2] S M Romero, L F Bohorquez, M P Rojas Puentes. "Application of Project Management Tools in Engineering Services Companies: Four Case Studies." *IOP Publishing*, 2018. DOI: 10.1088/1742-6596/1126/1/012058
[3] Dwi Puspita Sari, Syopiansyah Jaya Putra, Eri Rustamaji. "The Development of Project Monitoring Information System (Case Study: PT Tetapundi Prima Kelola)." *International Conference on Cyber and IT ServiceManagement (CITSM)*, Nov. 2014. DOI: 10.1109/CITSM.2014.7042172
[4] Kopishynska O, Utkin Y, Kalinichenko A, Jelonek D. "Efficacy Of The Cloud Computing Technology in The Management of Communication And Business Processes of The Companies." *Polish Journal of Management Studies*, Vol. 2, No. 2. 2016. DOI: 10.17512/pjms.2016.14.2.10
[5] Yiyang Fang. "The Theory and Application in Agile Project Management (APM) with Scrum." *Atlantis Press*, Vol. 582, Oct. 2021. DOI: 10.2991/assehr.k.211011.117
[6] Amna Abdullah, Asma Ismael, Aisha Rashid, Ali Abou-ElNour, Mohammed Tarique. "Real Time Wireless Health Monitoring Application Using Mobile Device." *International Journal of Computer Networks & Communications (IJCNC)*, Vol.7, No.3, May. 2015. DOI: 10.5121/ijcnc.2015.7302
[7] Elvin Meiwati Nazara, Dewi Nasien. "Employee Attendance System Using Rapid Application Development Method Based on Location Based Service." *Journal of Applied Business and Technology*, May. 2024. DOI: https://doi.org/10.35145/jabt.v5i2.148
[8] Li Ma, Lei Gu, Jin Wang. "Research and Development of Mobile Application for Android Platform." *International Journal of Multimedia and Ubiquitous Engineering*, Vol. 9, No. 4. 2014. DOI: http://dx.doi.org/10.14257/ijmue.2014.9.4.20
[9] Yans Fithratul I, Erlangga Lesmana Putra, Fitri Dwi Fadilah, Megawati Putri Martinez, Kevin Igor Ibnu Listanto, Mochammad Rifki Ulil Albaab. "Quality Control Management System Design: Framework-Based of Siprima Mobile Application." *International Journal of Computer Science and Information Technology*, Vol. 1, No. 1, Mar. 2024.
[10] Aakanksha Tashildar, Nisha Shah, Rushabh Gala, Trishul Giri, Pranali Chavhan. "Application Development Using Flutter." *International Research Journal of Modernization in Engineering*, Technology and Science (IRJETS), Vol. 2, Aug. 2020.
[11] Christelle Scharff, Ravi Verma. "Scrum to Support Mobile Application Development Projects in a Just-in-time Learning Context." *Association for Computing Machinery*, pp. 25-31, May. 2010. DOI: https://doi.org/10.1145/1833310.1833315
[12] Harleen K. Flora, Dr. Swati V. Chande. "A Review and Analysis on Mobile Application Development Processes Using Agile Methodologies." *International Journal of Research in Computer Science*, Vol. 3, pp. 9-18. 2013. DOI: 10.7815/ ijorcs.34.2013.068
[13] Krunal Bhavsar, Vrutik Shah, Samir Gopalan. "Scrum: An Agile Process Reengineering In Software Engineering." *International Journal of Innovative Technology and Exploring Engineering (IJITEE)*, Vol. 9, No. 3, Jan. 2020.
[14] Sapti Wahyuningsih, Abd. Qohar, Darmawan Satyananda. "The Effect of Online Project-Based Learning Application on Mathematics Students' Visual Thinking Continuum in Covid-19 Pandemic." *International Journal: Interactive Mobile Technologies*, Vol. 15, No. 15. 2021.
[15] Mohammed Akour, Ahmad A. Al-Zyoud, Bouchaib Falah, Salwa Bouriat, Khalid Alemerien. "Mobile Software Testing: Thoughts, Strategies, Challenges, and Experimental Study." *(IJACSA) International Journal of Advanced Computer Science and Applications*, Vol. 7, No. 6. 2016.
[16] J Joosten, A E Permanasari, T B Adji. "The Use of Decision Table for Reducing Complex Rules In Software Testing." *IOP Conference Series: Materials Science and Engineering*. 2022. DOI: 10.1088/1757-899X/732/1/012086
[17] Rima Tamara Aldisa. "Application of the System Development Life Cycle Method for the South Jakarta Area Search System with User Acceptance Test." *International Journal of Information System & Technology*, Vol. 6, No. 1. 2022.
[18] Sherolwendy Anak Sualim, Noraniah Mohd Yassin, Radziah Mohamad. "Comparative Evaluation of Automated User Acceptance Testing Tool for Web Based Application." *International Journal of Software Engineering and Technology (IJSET)*, Vol. 2, No. 2. Dec. 2016.
[19] Manish Kumar, Santosh Kumar Singh, Dr. R. K. Dwivedi. "A Comparative Study of Black Box Testing and White Box Testing Techniques." *International Journal of Advance Research in Computer Science and Management Studies*, Vol. 3. Pp. 32-44, Oct. 2015.
[20] Elta Sonalitha, Bambang Nurdewanto, Anis Zubair, Salnan Ratih Asriningtias, Kukuh Yudhistiro, Irfan Mujahidin. "Blackbox Testing Model Boundary Value Of Mapping Taxonomy Applications and Data Analysis of Art and Artworks." *IEEE*, pp. 7-11. 2020. DOI: 10.1109/ISRITI51436.2020.9315406
[21] Kavitha Marimuthu, Arunkumar Panneerselvam, Senthilkumar Selvaraj, Lakshmi Praba Venkatesan, Vetriselvi Sivaganesan. "Android Based College App Using Flutter Dart." *Green Intelligent Systems and Applications*, Vol. 3. 2023.
[22] Mohit Singh, Shobha G. "Comparative Analysis of Hybrid Mobile App Development Frameworks." *International Journal of Soft Computing and Engineering (IJSCE)*, Vol.10, Jul. 2021. DOI: 10.35940/ijsce.F3518.0710621
[23] Jim Conallen. "Modeling Web Application Architectures with UML." *Communications of The ACM*, Vol. 42, No. 10. Oct 1999.
[24] Putu Adi Guna Permana. "Scrum Method Implementation in a Software Development Project Management." *International Journal of Advanced Computer Science and Applications (IJACSA)*, Vol. 6, No. 9. 2015.
[25] Ahmed Al-alshuhai, François Siewe. "An Extension of the Use Case Diagram to Model Context-aware Applications." *SAI Intelligent Systems Conference 2015*, Nop 2015.
[26] Ginanjar Wiro Sasmito, Achmad Fauzan. "The Implementation of Scrum Framework for Developing Fundraising Mobile Applications." *International Journal of Advanced Science and Technology*, Vol. 29, No. 1, pp. 1654 – 1663. 2020.

[27] Simon Fong, Zhuang Yan, Henry Ho. “User Acceptance Testing of Mobile Payment In Various Scenarios” 2008 IEEE International Conference on e-Business Engineering, pp. 341-348. Jan. 2008. DOI: 10.1109/ICEBE.2008.70