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Analysis of Ancol Application Development Using Reuse-Based Software Engineering

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Abstract— *Ancol has a website that supports visitor activities to purchase tickets, online payments, and obtaining other information about Ancol area. Apart from having a website-based system as a ticket sales technology solution, Ancol has also released Android and iOS-based applications. Ancol application purpose is to make it easy for potential visitors to create transactions by a smartphone and provide a better user experience as well. In terms of data management and operations, website and applications are managed by different organizational groups. This causes several differences between website and application, both in terms of process flow, operations, and system functions. Therefore, Ancol wants to carry out further development of Ancol application by aligning features and rewriting program code. This study analyzes Ancol application development using reuse-based software engineering method, with the purpose of knowing reusable assets in further ancol application development. Through reuse-based software engineering may speed up time and reduce development costs. The results showed that estimated development time was 12% faster and estimated development costs were 23% more efficient compared to initial calculations by experts from IT Policy & Business Solution Department of PT Taman Impian Jaya Ancol.*

Keywords— *Ancol, Application, BPMN, Software Engineering, Software Reuse.*

I. INTRODUCTION

At present, both Ancol's website and application have been operating publicly, used by many users to make ticket purchase transactions online. Tickets sold on website and application were released from marketing team of PT Taman Impian Jaya Ancol.

Although two systems sell tickets from Ancol marketing team, they are managed and operated by two different organizations. Ancol website is managed by PT Taman Impian Jaya Ancol, while application is managed by Bank DKI. These causes Ancol to have two dashboards, website dashboard and application dashboard.

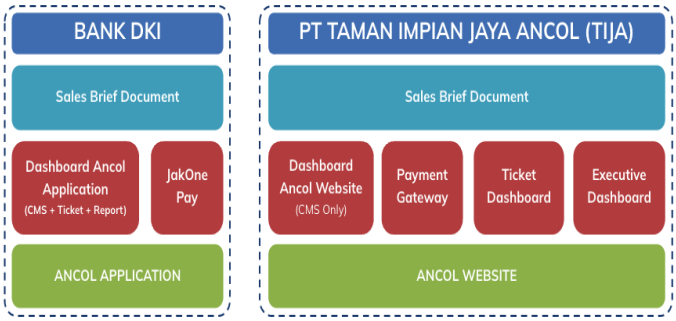

Fig. 1. Differences between Website and Application Operations

These two dashboards create several problems arise, such as redundancy of user accounts, data storage and reports that are not centralized, transaction data is out of sync, differences in payment methods, inefficient operations, and high bounce rates.

Due to the problem occur PT Taman Impian Jaya Ancol hoping to develop more about Ancol application through reuse-based software engineering analysis. The purpose of reuse-based software engineering is to find out and identify a list of assets from previous devices and will be reused in the next software development process. By reuse-based software engineering, development team might produce a new software according to needs of end users.

In this research process, reuse-based software engineering method is applied, means an analyzes series to know and produce components that can be reused in the next development process. An important goal of using reuse-based software engineering methods is to speed up development time and reduce development costs.

II. LITERATURE REVIEW

Several research references, Bharti Bisht and Parul Gandhi in 2021 conducting research "Metric Approach to Anticipate Reusability of Object-Oriented (O-O) Software Systems", stating that a collection of reusable assets shows different results based on the use of object-oriented features, and more influenced by multilevel-inheritance [1]. Diego Castro and Claudia Werner in 2020 conducted research "Reusing and Deriving Games for Teaching Software Reuse" stating that one of the most widely used ways to teach programming is through the reuse of "code blocks" [2]. Soundarya Veni and Shanthi Palaniappan in 2018 conducted research "Software Reuse, Agile Software development" obtained results of agile-based software reuse with the same role in different projects shorten project time, produce reduce costs and increase project productivity [3].

Even though they have similarities in terms of themes, the previous studies did not carry out the stages of software reuse from start to finish, such as analysis of business process modelling, analysis of changes in requirements and designing system designs. In this research, the object is Ancol application and application dashboard.

III. METHODOLOGY

The data obtained by interview and observations through online and offline with Department IT Policy Business Solution and Strategic Partnership Digital Engagement from

Sahid Triambudhi and Hustinawaty, "Analysis of Ancol Application Development Using Reuse-Based Software Engineering" *International Research Journal of Advanced Engineering and Science*, Volume 8, Issue 2, pp. 47-52, 2023.

International Research Journal of Advanced Engineering and Science
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PT Taman Impian Jaya Ancol. The result is related to the information needed in the research.

A. Observation

The purpose of observation is to obtain data needed in research. The data becomes an analysis basis in preparing Ancol application development plan applying reuse software engineering. Observations are made by looking directly at development process and other activities that support requirements of the current Ancol application. Through observation, the accuracy of interview technique will raise and become a complement.

B. Interview

The goal of an interview is obtaining datas and informations directly related to the object under research, in this case Ancol application. Before starting, several things must be prepared such as a list of questions to be asked, media used (face to face, online meet, telephone, etc.), and the resource persons.

C. Research Stages

Figure 2 explains the stages applied during research writing. Process-wise, this research was divided into two stages, data collection process and reuse-based software engineering process. Data collection process stage, authors conducted a field study, observation activities on the current system and interviews with Ancol team to determine needs for research writing.

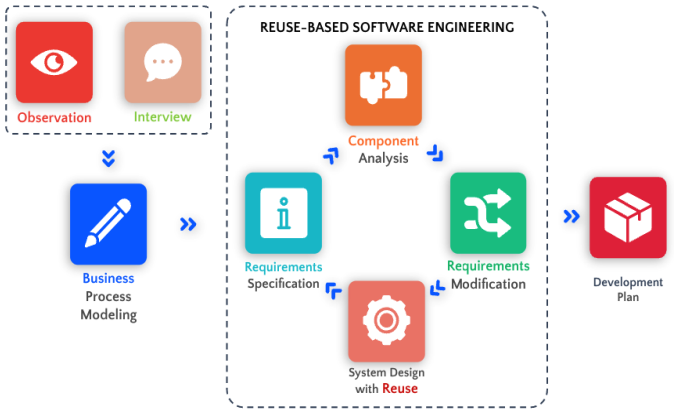

Fig. 2. Research Stages

The next step is Business Process Modeling. This step defines business processes and models flow of activities and ongoing procedures. Business process modeling is used as a basic reference for defining user requirements as the main part of system development, it is necessary to do business modeling, so users several flows and series of activities can be generated in the form of business process diagrams.

D. Reuse-Based Software Engineering

Reuse-based software engineering is a software engineering strategy that focuses on reusing existing software to develop new software according to user needs. By using concept of reuse, the process of developing and maintaining software becomes cheaper and the quality of device is better. The concept of reuse takes a development approach by maximizing pre-existing software [4].

First step of reuse-based software engineering is requirements analysis. Requirements analysis is a stage of process for specifying and obtaining functions required in general. Requirements analysis stage is expected to be able to understand the needs of Ancol application developed. Requirements analysis is the initial process in determining what kind of system will be developed.

Second step is component analysis. This step is carried out by purpose of finding components that meet specification requirements [5]. Some of the components through analysis is not completely precise and or used directly, this happens because of several different conditions (e.g., number of parameters used), so that a process of modifying requirements is needed to conform the new requirements of developed system.

The results from component analysis will be used as a component library. In addition, based on these components, changes can be made to conform to the needs of existing components. However, if this is not possible, component analysis can be re-analyzed or modified. In addition, this step is not required when all the components resulting from analysis filled up by the requirements of system to be developed.

Last step is a continuation of component analysis and requirements modification. This step also includes a reuse-oriented modeling process because it leads to system design with the concept of reuse. The result of this step is a design based on reuse of components to be implemented in system to be developed.

After all the analysis steps for reuse process completed, the next step is to develop the Ancol application development plan by using reusability component in accordance with the requirements and needs of Ancol application. One form of development arrangement is the feature comparison matrix table between the Ancol website and, the Ancol application and the estimated development time.

IV. Result and Discussion

A. Business Process Modelling Notation

BPMN is a standard for modeling business processes that provides a graphical notation for describing a business process. BPMN describes a business process diagram based on flowchart, structured to create graphical models of business operations in activities and flow controls that define work sequences [6].

Business process modeling analysis of the current Ancol application produce a requirements model process that has to be re-analyzed, both from Ancol application and the application dashboard. The results of the process modeling analysis that require re-analysis are described in table below.

Figure 3 describes current Ancol application flow process of registration and login which required phone number as primary ID. These will also be used as JakOne Pay account data. Meanwhile Ancol website, uses email as the primary ID to register and login.

Sahid Triambudhi and Hustinawaty, “Analysis of Ancol Application Development Using Reuse-Based Software Engineering” *International Research Journal of Advanced Engineering and Science*, Volume 8, Issue 2, pp. 47-52, 2023.

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TABLE 1. Requirements Needs to Re-Analyze

No.	Requirements		
	Module	System	Notes
1	Register - Login	App	Re-Analyze
2	Buy - Paid Ticket	App	Re-Analyze
3	Activation & Claim E-card	App	Re-Analyze
4	Reservation	App	Re-Analyze
5	Ancol Partner Information	App	Re-Analyze
6	Selling Report	Dashboard	Re-Analyze
7	Ticket Configuration	Dashboard	Re-Analyze
8	Order List	Dashboard	Re-Analyze
9	Reservation List	Dashboard	Re-Analyze
10	Payment Configuration	Dashboard	Re-Analyze

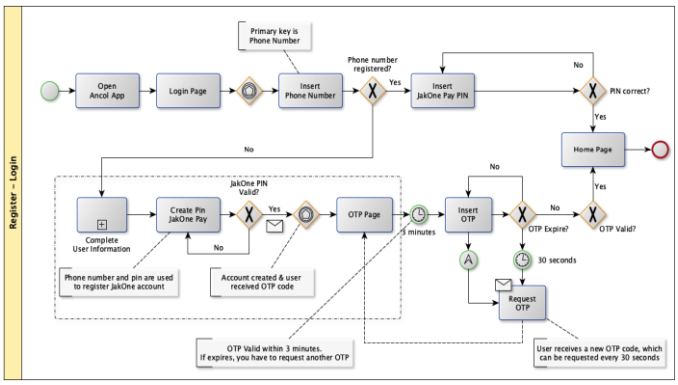

Fig. 3. Existing Flow Process Register – Login

JakOne Pay is the only payment method in Ancol application. This is a point that has to be corrected according to the user requirements. Meanwhile, Ancol website displays a choice of various payment methods (debit, credit, various types of banks or e-wallets). See figure 4 for detail flow process.

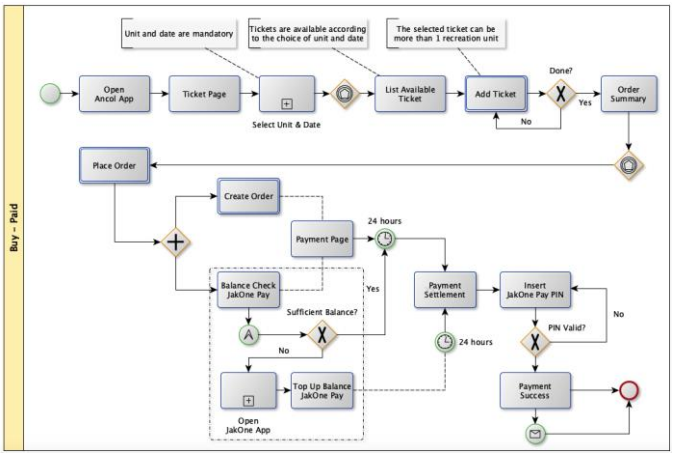

Fig. 4. Existing Flow Process Buy – Paid

Figure 5 explains user's flow process who buy annual pass tickets, they need to activate their e-card first before making a reservation. That is required to ensure that the e-card of owner's data is valid according to the data filled in as they create order and activation the e-card. The e-card claim process is a feature that allows a user to transfer ownership of another user's e-card by validating e-card code and e-card expiration date.

Analysis result shows that there are differences in activation process on website and application. Ancol website, e-cards that will be used by other user, procedurally can be done by making a request to the CS team then attaching the new e-card owner's identification card. Whereas in Ancol application, this process can be carried out independently via the claiming e-card feature.

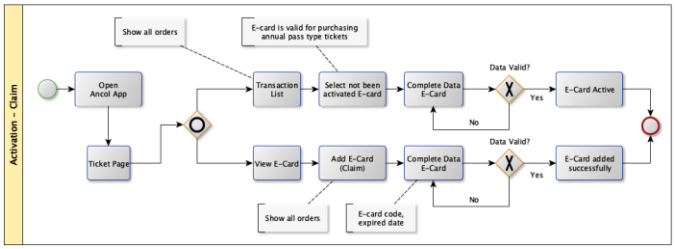

Fig. 5. Existing Flow Process Activation and Claim E-card

Currently, ticket purchased would be processed on Ancol application and will automatically reserve a visit according to the date selected. When the user of Ancol application has an annual pass type ticket, for the first visit it will be according to the date selected at the time of purchase, while subsequent visits must reservation via reservation.ancol.com.

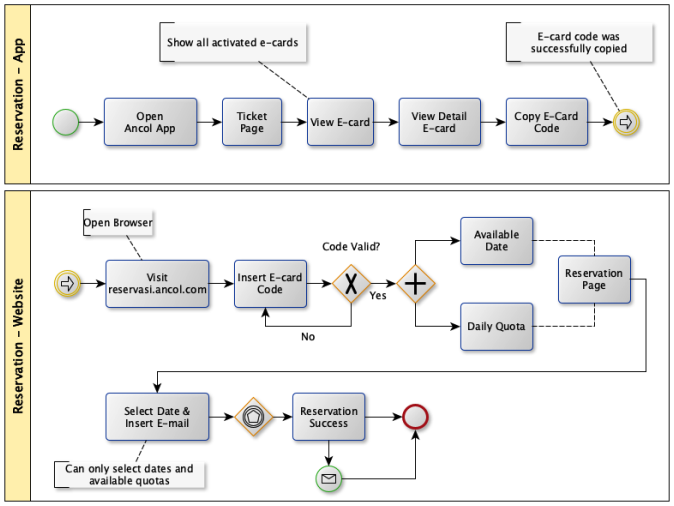

Fig. 6. Existing Flow Process Reservation

B. *Requirements Analysis*

Requirements analysis step is carried out to identify current system requirements and determine requirements for system to be developed further. The next process is analysis of the requirements that will be re-analyzed as shown in table 2 before.

TABLE 2. Requirements Analysis

No.	Requirements	
	Module	Notes
1	Register - Login	Email, full name, phone number.
2	Buy - Paid Ticket	Recreation unit, ticket type and payment method
3	Activation & Claim E-card	User data, e-card code, and expiration date
4	Reservation	E-card code, reservation date, email
5	Ancol Partner Information	Ancol partner detail information

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International Research Journal of Advanced Engineering and Science
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6	Selling Report	Transaction data, unit data, ticket types and payment methods
7	Ticket Configuration	Data recreation unit and ticket type
8	Order List	Transaction data, unit data, ticket types and payment methods
9	Reservation List	Reservation data
10	Payment Configuration	Credential payment production

C. Component Analysis

This section describes the results of component analysis performed on Ancol application and Ancol website dashboard, to identify which components can be reused in further Ancol application development.

As a result, two components are obtained consisting of reusable system components and reusable requirements components. The reusable system component consists of libraries and tools used in developing the current Ancol application system.

Meanwhile, the reusable requirements component consists of all requirements that can be reused for further Ancol application development.

Reusable requirements are divided into four components: requirements, flow, UI/UX and code. Each component has one value, RM (reuse modification) or RC (reuse component).

TABLE 3. Reuse Component Requirements

No.	Reuse Components				
	Module	Req	Flow	UI/UX	Code
1	Register - Login	RM	RM	RM	RM
2	Buy - Paid Ticket	RM	RM	RM	RM
3	Activation & Claim	RM	RC	RC	RC
4	Reservation	RM	RM	RM	RM
5	Ancol Partner	RM	RM	RM	RM
6	Selling Report	RM	RC	RM	RM
7	Ticket Configuration	RM	RC	RM	RM
8	Order List	RM	RC	RM	RM
9	Reservation List	RM	RC	RM	RC
10	Payment Configuration	RM	RC	RM	RM

D. Requirements Modification

Requirements modification step aims to analyze the changes that is required to reach the changing requirements/new requirements. Although reusable components reach most of the requirements, they need some minor modifications to adapt changes. Following are some of the proposed Ancol application process flows.

Figure 7 is a proposed registration process flow - login to the Ancol application through a single sign-on. Then users who may register or login simply enter their email or choose to login using Google Mail or Facebook services. After registration or login, if the user data has not been completed, they will be directed to the user information form first.

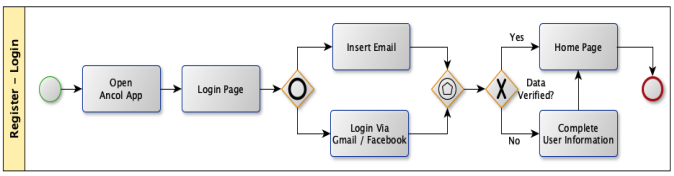

Fig. 7. Propose Flow Process Register – Login

Figure 8 is a continuation of buy and paid process flow that need to be implemented and display a various payment methods as listed on current ancol website is the implementation priority.

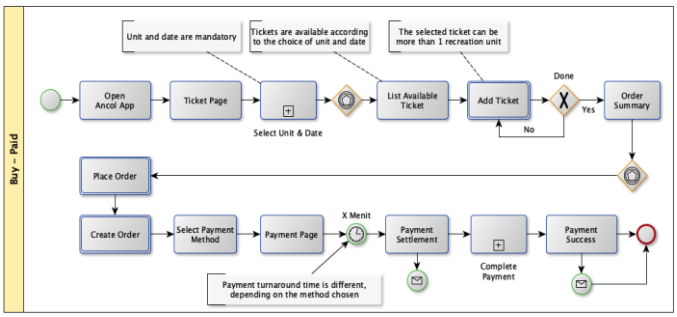

Fig. 8. Propose Flow Process Buy – Paid

Proposed reservation process flow in Ancol application is to add an independent reservation feature. Thus, it will be easier for users to make reservation process, without accessing the reservation.ancol.com website first.

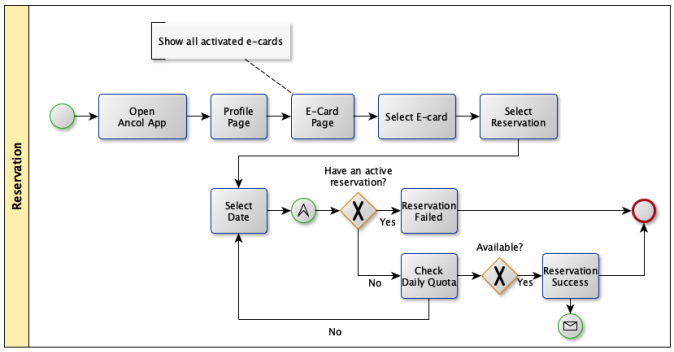

Fig. 9. Propose Flow Process Reservation

E. System Design with Reuse

Reuse system design step will produce a general system framework/architecture that is designed by components that can be reused. This process considers every reusable asset so that it can fill up the needs of system to be developed.

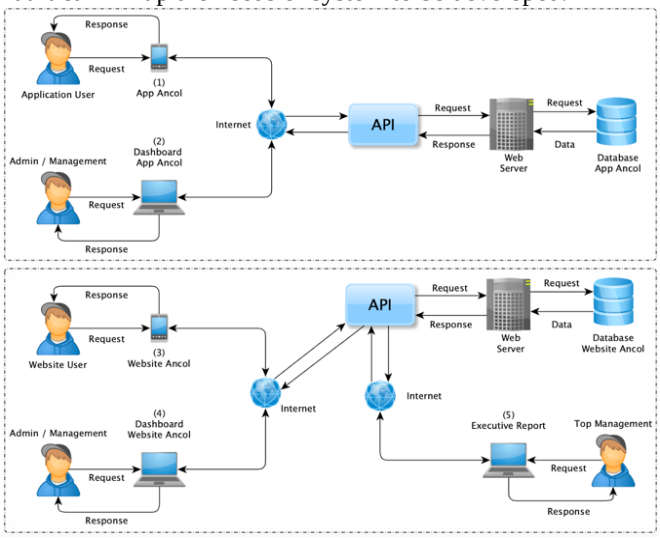

Fig. 10. Existing General Architecture

Sahid Triambudhi and Hustinawaty, "Analysis of Ancol Application Development Using Reuse-Based Software Engineering" *International Research Journal of Advanced Engineering and Science*, Volume 8, Issue 2, pp. 47-52, 2023.

International Research Journal of Advanced Engineering and Science
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PT Taman Impian Jaya Ancol's goal is to combine Ancol application dashboard and website dashboard, so that Ancol has only one managed dashboard plus the database becomes centralized. Even if later there are two systems managing organizations, configuring the roles and user access sections of each of these organizations could be done to resolve.

Figure 10 describes current condition of website system architecture and Ancol applications. The transaction process and activity record are collected from Ancol website and Ancol application, they are stored in different databases, and on different web servers.

Furthermore, figure 11 explained about general architectural proposals for centralized Ancol applications and websites. In general architectural proposal picture, the database and records transactions is centralized on the Ancol website and application. Likewise with application programming interface (API), which becomes 1 (one) collection, it will make it easier for development team to adjust if in the future there are changes in needs or requirements.

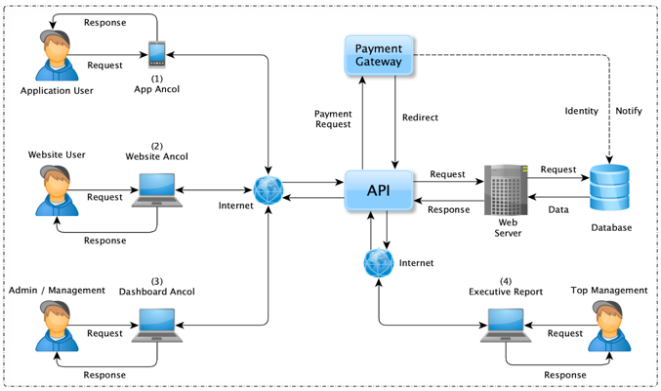

Fig. 11. Propose General Architecture

F. *Preparation of Development Plan*

This process describes the plans of Ancol applications development in the future, by utilizing reusable assets that have been identified using reuse-based software engineering method. Also, several other development activities such as rewriting program code (rewriting), migrating databases, calculating development costs, and planning ancol application development timeline.

First step of development plan is rewriting program code. Rewrite is a system development process that utilizes several reusable components, such as interfaces, process flows, modules, and features, as well as several API service collections. Therefore, the plan to rewrite previous Ancol application, use flutter as mobile framework. Flutter allows developers to write mobile-based program code for multiple platforms, and it only needs to be done on 1 (one) codebase. This will increase the level of development productivity and faster.

Next step, to reduce data redundancy in several databases, it requires migration from Ancol application database to Ancol website database. Then website and application data storage will be in one place. The benefits are the maintenance process is more centralized, usage costs are relatively cheaper, and so on.

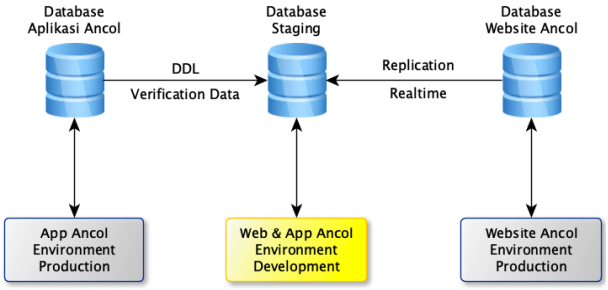

Fig. 12. Proposed Migration Database Scheme

The most important process in system development is calculating estimation of time and cost. PT Taman Impian Jaya Ancol informed that development time for rewrite Ancol application by using waterfall software engineering method had been calculated by an Expert from the IT Policy & Business Solution Department within 6 months, or 132 working days. Timeline details are shown in figure 12.

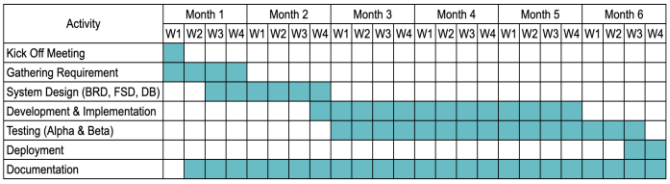

Fig. 13. Estimated Development Time - Waterfall

Table 4 shows the value of estimated development time (days) for each reusable component and reuse category (RC/RM) from the IT Policy & Business Solution Department Head, whereas the estimate is formulated by the IT Policy & Business Solution Department as a development reference for each partner/vendor in the field of information technology in collaboration with PT Taman Impian Ancol.

TABLE 4. Estimated Development Time for Each Component

No.	Component Requirements		
	Component	**Reuse Component (RC)**	**Reuse Modification (RM)**
1	Requirement	0.5 day	1 day
2	Flow	0.5 day	1 day
3	UI/UX	0.5 day	1 day
4	Code	1 day	3 days

The adjustments to these values are made for reuse components (RC/RM) for all requirements after the estimated development time values for each component collected. The result shows that developing Ancol applications by reusing required components is within 53 days.

There're Ancol application dashboard modules might be reused without changing the requirements. This is certainly a profitable factor for developer in time efficiency. Furthermore, by using the same method for calculating the Ancol application development estimation, author find out the estimated time for developing the Ancol application dashboard

is within 63 days.

TABLE 5. Estimation of Ancol Application Development Time

No.	Reuse Components					
	Module	Req	Flow	UI/UX	Code	Total
1	Register - Login	1	1	0.5	3	6
2	Buy - Paid Ticket	1	1	0.5	3	6
3	Activation & Claim	1	0.5	0.5	1	3
4	Reservation	1	1	1	3	6
5	Ancol Partner	1	1	1	3	6
6	Home Page	1	0.5	1	1	3.5
7	User Profile	0.5	0.5	0.5	1	2.5
8	Recreation Page	0.5	0.5	0.5	1	2.5
9	Rides Page	0.5	0.5	0.5	1	2.5
10	Facility Page	0.5	0.5	0.5	1	2.5
11	Promotion Page	0.5	0.5	0.5	1	2.5
12	Restaurant Page	0.5	0.5	0.5	1	2.5
13	Hotel Page	0.5	0.5	0.5	1	2.5
14	Event Page	0.5	0.5	0.5	1	2.5
15	Direction	0.5	0.5	0.5	1	2.5
Total (Days)		**10.5**	**9.5**	**10**	**23**	**53**

TABLE 6. Estimation of Application Dashboard Development Time

No.	Reuse Components					
	Module	Req	Flow	UI/UX	Code	Total
1	Selling Report	1	0.5	1	3	5.5
2	Ticket Configuration	1	0.5	1	3	5.5
3	Order List	1	0.5	1	3	3.5
4	Reservation List	1	0.5	1	1	5.5
5	Payment Method	1	0.5	1	3	2.5
6	Dashboard User	0.5	0.5	0.5	1	2.5
7	Application User	0.5	0.5	0.5	1	2.5
8	Roles – Permission	0.5	0.5	0.5	1	2.5
9	Audit Report	0.5	0.5	0.5	1	2.5
10	App User Report	0.5	0.5	0.5	1	2.5
11	App Version Config	0.5	0.5	0.5	1	2.5
12	App Service Config	0.5	0.5	0.5	1	2.5
13	E-Card List	0.5	0.5	0.5	1	2.5
14	CMS Recreation List	0.5	0.5	0.5	1	2.5
15	CMS Rides	0.5	0.5	0.5	1	2.5
16	CMS Facility	0.5	0.5	0.5	1	2.5
17	CMS Promotion	0.5	0.5	0.5	1	2.5
18	CMS Restaurant	0.5	0.5	0.5	1	2.5
19	CMS Hotel	0.5	0.5	0.5	1	2.5
20	CMS Event	0.5	0.5	0.5	1	2.5
Total (Days)		**12.5**	**10**	**12.5**	**28**	**63**

Estimated time of Ancol application development within (53 days) and estimated time of Ancol website dashboard development within (63 days) then it would be 116 working days for work. Compared to the Experts from IT Policy & Business Solution Department, which is 132 days, then total reusable assets are 16 days faster or around 12%.

TABLE 7. Development Cost Estimation from Ancol

No.	Estimation Cost (IDR)				
	Roles	Team	Month	Rate	Subtotal
1	Analyst	2	4	27,650,000	221,200,000
2	UI/UX	1	4	27,650,000	110,600,000
3	Mobile Dev	2	6	30,700,000	368,400,000
4	Web Dev	2	6	30,700,000	368,400,000
Grand Total					**1,068,600,000**

The last one is development cost estimation. PT Taman Impian Jaya Ancol also provided information that the Expert from IT Policy & Business Solutions Department had calculated the initial estimated cost of developing ancol application and website dashboard, IDR 1,068,600,000 and the total of required personnel to complete Ancol application, as shown in table 7.

Table 8 shows the required personnel and time are less, it based on the results of reuse components analysis that have been identified before Ancol application development process. There is a decrease in the estimated development costs of IDR 245,600,000 or 23% of the former estimated cost.

TABLE 8. Propose Cost Estimation

No.	Estimation Cost (IDR)				
	Roles	Team	Month	Rate	Subtotal
1	Analyst	2	3	27,650,000	165,900,000
2	UI/UX	2	3	27,650,000	165,900,000
3	Mobile Dev	2	4	30,700,000	245,600,000
4	Web Dev	2	4	30,700,000	245,600,000
Grand Total					**823,000,000**

V. CONCLUSION

The conclusions based on the results of analysis steps reuse-based software engineering process in this research, business process modeling, requirements analysis, component analysis, requirements modification, to reuse system design.

1. Reuse-based software engineering might be applied as an analytical method for developing Ancol applications.
2. Business Process Model Notation (BPMN) might be used as a tool design for the current system process model, it is able to describe the design, propose business flow of Ancol application requirements in needs of requirements changing.
3. Determine a catalog of reusable-assets that might be reused in future Ancol application development, reusable system components, reusable requirements component and reusable systems.
4. Reuse-based software engineering methods is 12% faster, and the cost is 23% more efficient than the former by experts from IT Policy & Business Solution Department of PT Taman Impian Jaya Ancol.

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