

Implementation of Extreme Programming Method in Developing Website of Agribusiness Harvest Transportation Order Data Management

Ginanjjar Wiro Sasmito^{1,*}, Slamet Wiyono¹, Edy Irwansyah², and Derwin Suhartono²

Abstract

Agribusiness is the largest and most significant sector in the national economy of Indonesia. In running and sustaining a business of agriculture, plantation, forestry, fishery, and animal husbandry fields, or called agribusiness, a lot of problems may arise. One of the obstacles occurring during the process of transporting agribusiness crops is the management of harvest transportation data. The mismanagement of processing data for the transportation of agricultural crops is one of the major factors that hinders the distribution of crops after harvesting. Inaccessibility of the place to rent transportation means, unstable cost of the transportation rent, and insufficient number of transportation to load all the crops made it difficult to fix the recording of the data. Therefore, the website application of renting transportation for crops, which includes: the number and identity of business owners of transportation, the type and number of transportation, transportation order data, as well as the transaction data of post-harvest transportation, is developed by the extreme programming (XP) method. This method has been chosen since it can speed up the website development process compared to the prototyping method. This method only takes 84 days to release with better design quality and function, and it can also reduce the cost and optimize productivity. This website application is developed using the PHP programming language with the Laravel and Bootstrap frameworks to produce a UI/UX-responsive web design. Meanwhile, MariaDB is used as a relational database management system.

Keywords

Agribusiness, Extreme Programming, Transportation

1. Introduction

Agribusiness is the largest and most significant sector in the national economy in Indonesia [1]. Agribusiness greatly influences future economic development [2]. Therefore, the key to success in running and developing agribusiness is proper, effective, and efficient management of the agribusiness system [3].

In running and sustaining a business in agriculture, plantation, forestry, fishery, and animal husbandry fields, or called agribusiness, a lot of problems may arise. One of them is post-harvest handling [4]. The complexity of these post-harvest issues is diverse, including the process of harvesting, sorting, transporting, packaging, and storage [5].

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In Indonesia, one of the obstacles occurring during the process of transporting agribusiness crops is the management of harvest transportation data. The management of harvest transportation data in Indonesia has not been integrated. The separated data included the number and identities of the transportation business owners, the type, and number of transportation, transportation order transaction, as well as transportation order transaction for crops. The less integrated harvest transportation data is one of the obstacles in handling the harvest transportation optimally, such as: Inaccessibility of the place to where to rent transportation means, unstable cost of the transportation rent, and insufficient number of transportation to load all the crops made them difficult to fix the recording of the data, while the way to minimize data redundancy and duplication is to carry out data integration [6]. Integrating the data aims to increase the effectiveness of data transactions, and guarantee data accuracy and validity [7], thereby the handling of the harvest transportation data can be more optimal.

Various types of transportation for carrying agribusiness crops include trucks (with different variants, such as ankles, diesel, containers, and trailer trucks), pickup trucks, and three-wheeled cargo motorcycles. These kinds of transportation are specifically designed based on the type and quantity of harvest that will be transported [8]. Based on these problems, the data management process for ordering harvest transportation needs a solution that can convert the data into more useful information [9]. The solution is to produce a website-based computer application used for managing data of agribusiness harvest transportation order that is accessible in real-time so that the resulting information can be optimized for agribusiness harvest transportation tenants and business owners in maximizing their business strategy and optimizing supply chain processes in agribusiness.

In this case, the method employed in developing website application software in this study was the extreme programming (XP) method, as one of the branches of agile software development methods used to adjust software development needs [10]. The XP method was selected in developing application software because this method is usable for system development with flexible requirements [11], thus providing an opportunity for developers to change processes while the system is being worked on [12]. This web application is expected to inform the transportation data management, tenants, and the rental business owner more optimally.

2. Relevant Studies

Munir et al. [13] have applied the XP method to their research to build a web-based application platform to recommend regional culinary tourism called wikuliner.com. The PHP programming language with the Yii framework and MySQL database was chosen to develop this application. This application was completed in two iterations. The first iteration completed five stories of users by 25 members of the team, meanwhile, the second iteration completed six stories of users by 29 members of the team. Several features, such as registration, authentication, culinary shop reviews, profile settings, and search based on user preferences, are implemented in this application.

The development of a web-based marketplace application called Tokocabai has used the XP method. This digital market application was developed to minimize the very fluctuating price of chilies in Indonesia. gRPC and GraphQL as API services are used for back-end development in this application, while front-end development in this application uses the Vue.js framework. The planning, design, coding, testing, and release stages were carried out as an implementation of the XP method in this application.

The iteration was successfully carried out twice from a total of 19 user stories. The number of user stories for each iteration in the first iteration was 8, and in the next iteration, there were 11. Among the feature categories that have been successfully implemented are auth, product catalog, profiles, transactions, and product reviews [14].

At a university based on Google Apps, to produce a helpdesk ticket system design, they used the XP method as the approach. This approach was chosen because it can make the development process more efficient, including all stages of iteration. In identifying needs, this is done using Value Chain analysis and SWOT analysis. Meanwhile, Google Apps services for the development of the Helpdesk Ticket System are used to minimize the investment in server hardware for processing and storage. In this case, Google Apps script is very reliable for completing processes in this system, which is very complex, and users are also very familiar with the interface [15].

A study conducted by Sari and Ayu [16] has produced a mobile-based application called the BuJel application (stands for *Buang Jelantah* in Indonesian, meaning “Throw the waste coconut oil away”). This application was built to help janitors in collecting WCO and maximize WCO data processing effectively and efficiently in the Pancoran Sub-district, South Jakarta. This application is equipped with the Google Maps API feature to determine the WCO speed. The BuJel application was developed using the XP method because of the relatively small number of teams, but it optimizes the existing members’ performance. Therefore, the team could accelerate the production of research products and immediately provide solutions to existing problems.

The XP method is also usable in developing mobile e-commerce application software for the sale of marketplace-based agricultural products. This application was created to accommodate farmers’ needs in selling agricultural products directly, thus enabling them to obtain higher profits. Moreover, this application is low-cost for agricultural product consumers. The XP method applied to the development of e-commerce applications does not have formal documentation used as a measuring tool for application completion. This application is considered complete if the user does not need additional requirements according to the planning submitted at the beginning (regarding user requirements). This application involves not only buyers and sellers but also marketplace managers as transaction supervisors by verifying purchase and sales transaction data [17].

3. Method

The XP software development method was chosen as a reference in this research. In the XP method, repeated iterations can be carried out as needed. This method offers stages in a short time and repeatedly for different parts according to the focus to be achieved [18]. In addition, XP can simplify every process in its stages. Hence, the XP method is more adaptive and flexible [11]. The stages of software development included: planning, design, coding, and testing [19]. Those steps are described in Fig. 1.

4. Result and Discussion

The development stages of this web application implementation about transportation order that uses the XP method can be seen in Fig. 1.

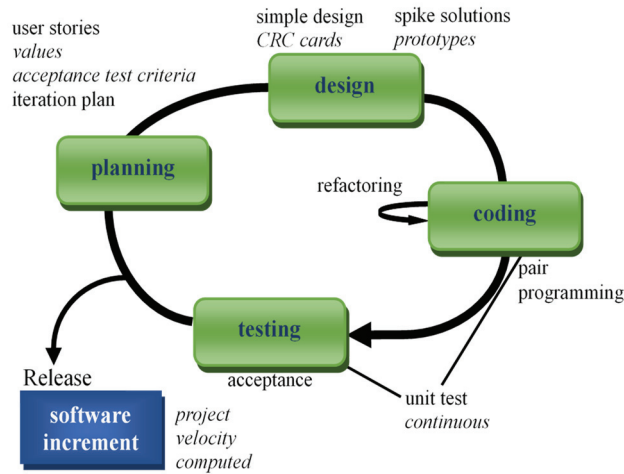


Fig. 1. Stages of extreme programming.

4.1 Planning

The planning stage begins with an understanding of the business process, and it includes defining outputs, features, and application functions [20]. The initial step at this stage was identifying problems regarding the need for developing a platform used to manage agribusiness harvest transportation order data. After the problem identification stage, a problem analysis was carried out and resulted in the details and substance of the problems occurring. Then, the next stage is to describe the solution based on the problem analysis results. The description of this solution was related to the business process agreed upon between the product owner and the development team. In this case, the output, features, and functions of the application are also defined. After completing these stages, the results of the agreement are compiled in the form of a functional requirement analysis. Functional requirement is needed to find out the processes that can be carried out by the application, as well as the appropriate users of the application being built [21]. The following is an explanation of the functional requirements for website applications:

1) Admin

- Being able to manage the type of bank for the payment process
- Being able to manage order data
- Being able to manage company data
- Being able to manage users' data
- Being able to manage suggestion and critique
- Being able to manage an admin account

2) Transportation company

- Being able to manage vehicle data
- Being able to manage driver data
- Being able to manage a company account

4.2 Design

In the XP method, the application design is developed using the class-responsibility-collaborator

(CRC). CRC is an index card utilized to map classes in a specified design scenario. The classification aims to facilitate the design process by ensuring the active participation of the designers involved, especially in building the classes that will be used [22]. The CRC design developed is described as follows:

- 1) Application function: describing the application usage to users. Table 1 presents the function of the website for agribusiness harvest transportation data order.
- 2) Determining time: In this step, the developer estimated the time spent developing the application (Table 2).

Table 1. Application function of CRC

Document	User application function	Description of application created
Name of application	Agrocar	Development of the application for managing
Name of client	Admin and transportation company	transportation order data functions to: (1) facilitate the
Activity	Managing data application function	admin in managing transportation orders and company
Time	May 4, 2021 to July 26, 2021	data and (2) assist the transportation company in managing vehicle and driver data.

Table 2. Schedule of activities

Document	User application function	Description of application created
Name of application	Agrocar	2021 May 1st week: Iteration
Name of client	Admin and transportation company	2021 May 2nd week: Iteration
Activity	Managing data application function	2021 May 3rd week: Iteration
Time	May 4, 2021 to July 26, 2021	2021 May 4th week: Iteration
		2021 June 1st week: Iteration
		2021 June 2nd week: Iteration
		2021 June 3rd week: Iteration
		2021 June 4th week: Iteration
		2021 July 1st week: Iteration
		2021 July 2nd week: Iteration
		2021 July 3rd week: Iteration
		2021 July 4th week: Iteration

After designing the CRC, the next stage was designing the application using a unified modeling language (UML) as the standard in designing object-oriented system applications with high complexity [23]. In developing application systems using specific programming languages, UML is employed to define, visualize, design, and document [23]. In this study, UML diagrams were described using use case, activity, sequence, and class diagrams.

4.3 Coding

Coding is an advanced stage after the design stage, where the results of the CRC and UML designs are implemented in a programming language to build a website application. In this case, the PHP programming language version 7.4.6 [24] with the Laravel framework version 8.4.0 and Bootstrap version 4.3.1 were used to create a UI/UX-responsive web design. Meanwhile, MariaDB version 10.2.4.4

was used as a relational database management system (RDBMS) as a result of MySQL development, which is an open-source [25]. The appearance of the application is shown in Fig. 2.

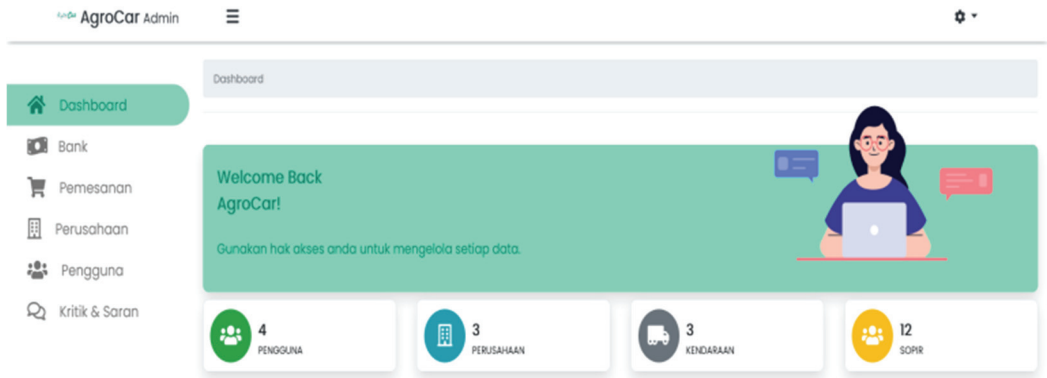


Fig. 2. Admin dashboard page.

The implementation of the XP method for this application development was completed in just 12 weeks or more precisely for 84 days, with some activities explained in Table 3, this is 2 weeks faster compared to the prototyping method used [26]. Since the product owner is directly involved in website application development and provides an overview of the application needs from the initial to the final stages of the XP method, it made cost and productivity more efficient.

Table 3. Duration of application development

Stages	Duration (day)	Number of teams
Problem identification and analysis	3	1
Solutions description (business process)	4	1
Needs (both functional and resource) identification	7	1
Design the application (CRC, UML, UI/UX)	12	1
Design and create database with MariaDB	15	2
Coding to create website application with PHP programming language	20	2
System integration (integrating the application with the database and integrating between administrator menus)	5	1
Testing (software testing using Blackbox)	3	1
Testing (usability testing)	7	1
Revision and refinement after testing stages	5	2
Release (after integrating, testing, revising, and refining the application based on the testing results and product owner needs, the website application was then released)	2	2

4.4 Testing

Blackbox testing is used to test website applications that have been produced. The aim is to check application functionality, observe software fundamentals, and test its suitability to user needs [27]. In this test, the input and output ranges were determined using the equivalence partition method. The Blackbox

Testing was to test the input data sample, with instructions stating that if the input condition specified a range, then it was defined for a value of 1, then the condition was valid, and a value of 2, meaning the condition was invalid in its equivalence.

The success or failure of the test can be seen in the website application, which is presented in Table 4. The test results are true with an effective rate of 100% found in test IDs 1, 2, 4, 5, 6, 7, 9, 10, while in Test ID 3, the value was 1 false, thereby resulting in an effectiveness value of 3:4, which was 75%. For Test ID 8, there were 2 false values, meaning the test produced an effectiveness value of 2:4, which was 50%. Consequently, the value of effectiveness for all Test ID results was 92.5% (Fig. 3).

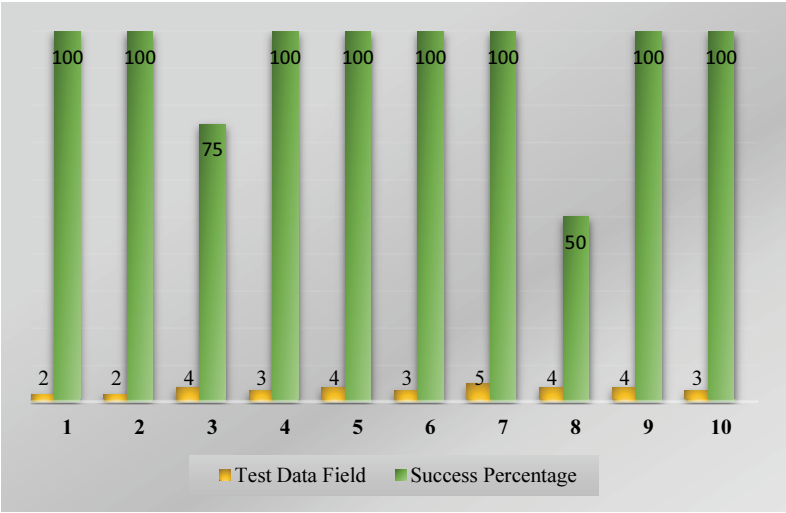


Fig. 3. Graph of Blackbox test result.

Table 4. Blackbox testing

Test Id	Description	Test data field	Test results	Conclusion
1	Sign in menu	Username, Password	True, True	Successful
2	Types of bank menu	Id of Types of Bank, Name of Bank	True, True	Successful
3	Order data management	Ordering Id, Types of Ordering, Destination, Charge	True, True, True, False	Failed
4	Transportation company data management	Company Id, Name of Company, Types of Services	True, True, True	Successful
5	User data management	User Id, User Name, Email, Whatsapp Number	True, True, True, True	Successful
6	Suggestion and critique management	Id of Suggestions, Category, Content	True, True, True	Successful
7	Admin account profile	Admin Id, Types of Admin, Name of Admin, Username, Password	True, True, True, True, True	Successful
8	Vehicle data management	Transportation Id, Police Number, Types of Transportation, Maximum Load	True, True, False, False	Failed
9	Driver data management	Driver Id, Driver Id, Types of Driver's License, Address	True, True, True, True	Successful
10	Company account profile	Profile Id, Address, SIUP Number	True, True, True	Successful

Next, the application is tested based on the user’s point of view using the usability testing method. This is done after getting the Blackbox test results. Questionnaires were distributed randomly to 10 respondents to carry out the usability testing method. These respondents included: admins, transportation companies, communities, academics, and programmers. The questionnaire included 10 questions regarding efficiency, effectiveness, usability, accessibility, and satisfaction [28].

Furthermore, all respondents, according to their level, are given access to operate this website’s application, except for programmers and academics, who are given access to operate at all user levels. This is done before filling out the questionnaire or providing an assessment of the questions on the questionnaire sheet, according to the score description provided in Table 5.

Table 5. Description of score

Score 1	Score 2	Score 3	Score 4	Score 5
Awful	Poor	Okay	Good	Excellent

Fig. 4 shows the method used to calculate the total score using the system usability scale (SUS) method. The formula used is as follows:

$$Y = \frac{Q}{S} \times 100\%, \tag{1}$$

where *Q* is respondent’ score of each question, *S* is respondent’ maximum total scores, and *Y* is grade in percentage.

Hence, the usability testing using SUS resulted in:

$$Y = \frac{450}{500} \times 100\% = 90\%. \tag{2}$$

And Table 6 shows the adjective rating based on the SUS scale. The testing using usability testing and SUS scale calculation showed that this website application obtained excellent results.

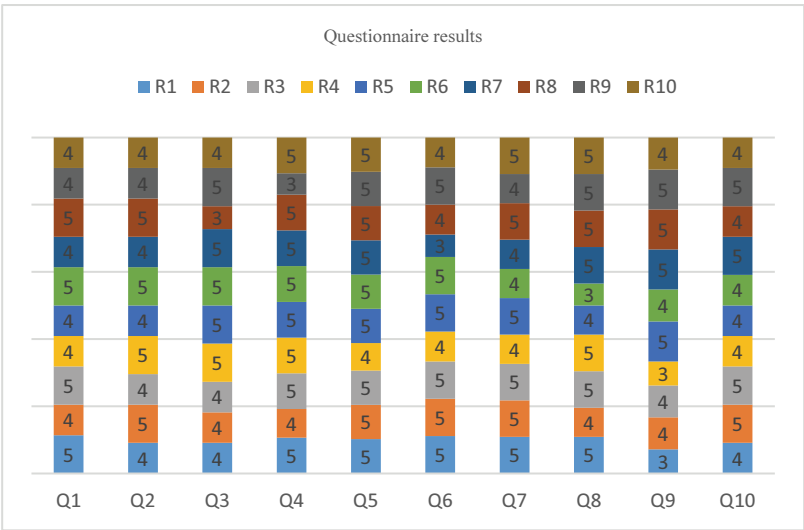


Fig. 4. Questionnaire result.

Table 6. Adjective rating

Score	Grade	Adjective rating
>80.3	A	Excellent
68–80.2	B	Good
67	C	Okay
51–66	D	Poor
<51	E	Awful

5. Conclusion

The results of this research concluded that the agribusiness harvest transportation order data management website could properly manage the data of transportation companies, vehicles, drivers, users, types of banks, and orders. This website application was completed quickly in only 84 days or 12 weeks, since the product owner was directly involved in this application development from the initial to the final stages. The result is that the XP method is faster than prototyping methods for developing this application. Moreover, it produces better quality with more efficient budget and resource productivity.

Conflict of Interest

The authors declare that they have no competing interests.

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