

Development of Sales Modules for Agricultural E-Commerce Using Dynamic System Development Method

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Abstract—E-Commerce is a process model of selling and buying goods using information and communication technology. This business model offers a broad market for products owned by the seller. However this sales model is not yet common for agricultural products. Most of the process of buying and selling agricultural products is still done conventionally. The lack of agricultural e-commerce sites is the main reason for the research conducted. This research will develop an agricultural e-commerce system. This system has two main modules that are sales module and purchasing module. This article specifically develops sales modules for agricultural e-commerce. In the development of modules applied Dynamic System Development Method. The used of this model is based on characteristic of the project which have limited number of development team and short development time. The development stages consist of pre-project, feasibility study, business study, functional model iteration, and design and build iteration. In this study a prototype has been produced for the sales module on agricultural e-commerce that is being developed.

Index Terms— Agricultural E-commerce, Sales Module, Dynamic System Development Method, DSDM

I. INTRODUCTION

Agricultural business is a trade process related to the sale and purchase of agricultural commodities / products. Agricultural products can be in the form of agricultural crops, processed products of agricultural crops, tools and materials needed for agricultural processes. Nowadays, most of the trade in agricultural products is still carried out conventionally, that is, farmers sell their agricultural products directly through cooperatives, middlemen, or buyers who come directly to their place. The process of selling products that utilize information technology is still very minimal.

Marketing or selling products using information technology can be done through social media networks, blogs, and existing online sales sites. Any media used

for sales and excess. Social media publications and blogs have a vulnerable level. In addition, this media is only used to express and offer products needed for the process of direct communication between sellers and buyers.

Online sales of agricultural products can also be done through several existing commercial e-commerce sites. However, these sites generally sell a wide variety of non-specific items of agricultural products. Whereas agricultural products have specific characteristics such as short product age, unit or size of sales of diverse products and specific product delivery processes.

Therefore, ongoing research conducted the development of an e-commerce application for agricultural products. There are two main business processes in the system: modules for product sales and modules for product purchases. Application development is using Dynamic System Development Method (DSDM). This paper specifically discusses the sales module on E-commerce agriculture being developed. The developed seller module aims to bridge between the seller and the e-commerce system. Through this module sellers can promote and sell agricultural products that they have.

II. LITERATURE REVIEW

A. Dynamic System Development Method (DSDM)

Dynamic System Development Method (DSDM) is a framework that contains knowledge about project management of a system. Initially DSDM was a framework used for software development processes. But the latest version of DSDM has been equipped with software development process, system engineering process, and business development process on the project, so the DSDM framework is now more general and can be used on various engineering projects [1]. DSDM is a framework that can support the completion

of projects on time and cost in accordance with the planning. This framework is prepared based on the successful experience of the development team in carrying out engineering projects. This causes DSDM to become a practical approach to flexible and practical project management [2].

The DSDM method was created in 1995 by a non-profit group in the UK. This method is a development of the Rapid Application Development (RAD) method and is an evolutionary model of its predecessor and successor. The DSDM method appears through the DSDM consortium not the result of scientific literature [3]. Therefore this method is practical as a result of the experience of practitioners skilled in engineering projects. This method continues to evolve from 2001 with the term "Agile" Framework, 2008 with DSDM Atern 4.2. and the latest version of 2014 DSDM is more compatible with several frameworks and other system development methods [4].

System development process in DSDM method consists of 7 main stages: pre-project, feasibility study, business study, functional model iteration, system design and build iteration, implementation, and post-project. These seven stages are known as "the three pizzas and a cheese" as seen in figure 1.



Fig. 1. System Development Process in DSDM

Pre-project stages are done early before the project starts. This stage will ensure that resources and funding to run the project are available. Feasibility and business study stages are carried out sequentially. These two stages form the basis of the next development process. Therefore these two stages must be carried out before carrying out the next stage. The next three stages are functional model iteration, design and build iteration, and implementation can be implemented iteratively and incrementally. DSDM provides the freedom for the project team to take advantage of the flexibility of the method in running the next three stages. The most important thing in the DSDM is to understand the purpose of each stage and the resulting product at each stage [2].

B. E-Commerce

In today's global era promising new business E-commerce models. This business model utilizes the support of information and communication technology (ICT). According to Turban et al [5], Electronic commerce (electronic commerce, abbreviated EC, or E-

commerce) trading model that includes the buying, selling, transfer and exchange of products, services or information through computer networks, including the internet.

E-commerce business becomes one of the most important parts of the economy in Indonesia. According to Gentur [6]. Agus Tjandra in Berita Satu [7] as vice chairman & foreign relation of E-commerce Association of Indonesia (idEA) stated that the total value of Indonesia's E-commerce transactions in 2013 reached US \$ 8 billion or around Rp 94 trillion and predicted to increase up to US \$ 24 billion or around Rp 283 trillion in 2016. The number of people who shop online in the country recorded reached 4.6 million people during 2013 and is estimated to increase to 8.7 million people in 2016.

E-commerce also provides many benefits for both entrepreneurs and customers. Some benefits of e-commerce according to Khan [8] such as increasing the income of the entrepreneur, reducing the company's operational costs, saving time for shopping for consumers, and having a certain level of comfort in shopping.

With the rise of digital world-based economic activities or called E-commerce there are actors or users to make sales and purchase transactions. Most of the users involved in e-commerce business in Indonesia act as buyers, namely 78.5% (office workers (63.4%) and rough labor (15.1%). While only 21.5% do business people who acts as a seller [6]. Some E-commerce companies are currently developing through the digital world such as Lazada, Zalora, Tokopedia, Elevenia, Olx and many more. Quite a number of e-commerce users open new opportunities for business models in Indonesia. Some e-commerce related business opportunities by [9], is :

- Security Service, is a service to provide security to your computer or site, which aims to make your data and systems safer against attacks by irresponsible parties such as hackers and other cybercriminals.
- Data Storage. This type of data storage service primarily for which you need a lot of space to store their data, which is usually stored through cloud technology as well as servers owned by service providers.
- Web Hosting, is a type of business that acts as a hosting service provider from a website that allows people to have their own site.
- Shopping Cart is a transaction collection service that you will or have already done, so that the buyer will know how much the total purchase he/she has to spend.
- Web Design is web site design services that are useful to add an interesting impression for your site so that more visitors from websites that have been made.

- Merchant Processing is a form of business that serves relationship activities between sellers, buyers, and third parties, in this case financial services such as banks. Its role is as a mediator transaction between the seller and the buyer.
- Online Marketing is a product marketing activities conducted through the internet, such as video ads uploaded on the official website of a company and so on.

C. E-Agriculture

Agricultural websites have been widely developed in several countries including Indonesia. Agricultural Information System using web technology is often referred as e-Agriculture. There are several understandings about the definition of e-agriculture including e-agriculture understood as 1) information related to agriculture; 2) technology or tools for information and communication; 3) various types of agricultural information; 4) all stakeholders who will benefit from agriculture; and 5) the benefits that agriculture can gain from the application of ICT applications (E-Agriculture Working Group, 2007). In the application of e-agriculture can be a geographic information system, remote sensing, and various kinds of wireless equipment [10].

According to Cecilia [11], E-Agriculture is a field that appear at the intersection of agricultural informatics, agricultural development and entrepreneurship, refers to agricultural services, technology dissemination, and information delivered or enhanced through the Internet and related technologies. The use of the digital world in conducting business processes has a huge impact on the growth of the agricultural economy market. According to the Organization, Food and Agriculture [12] benefit of e-agriculture are:

- As part of a national ICT strategy, encouraging the development and implementation of national e-agriculture strategies that focus on providing reliable and affordable connectivity and integrating ICT in rural development to support food security and fight against hunger.
- Collaborating and sharing knowledge in agriculture via electronic practice communities, including the e-Agriculture Community, in sequence to exhibit and promote models, methodologies, good practices and adoption of Open Access standards and interoperability, effectiveness and fair use of ICT for sustainable agriculture and rural development.
- Promote the creation and adaptation of content including in local languages and contexts from trusted sources, including, to ensure equitable and timely access to agricultural knowledge by resources- Poor men and women farmers, foresters and fishermen in rural areas.
- Develop the digital literacy of rural and remote institutions and communities in the region to

consider local needs and constraints by providing appropriate learning opportunities for all that will enhance the individual and collective decision-making skills.

- Promote the use of ICT to strengthen the country's resilience capacity, Communities and individuals to reduce and adapt to nature and humanity - Create disasters, food chain challenges, socio-economic and other crises, Conflict and trans-boundary threats, diseases and environmental degradation.
- Promote public-private partnerships in collaboration with CSOs / NGOs, cooperatives, farmer organizations, academics, research institutions In the agricultural sector (which also includes forestry and fisheries) for Inclusive, efficient, affordable and sustainable ICT services and initiatives in Indonesia Agriculture and rural development which will promote the widespread use of ICT and encourage sustainable agribusiness business models.

Some e-agriculture applications have been developed including e-Choupal (India), Agricultural Market Information System (Bangladesh), and Infotrade (Uganda) [13].

III. RESEARCH METHODOLOGY

The method used in developing the system is the DSDM method. There are 6 main stages in the research are pre-project, feasibility study, business study, functional iteration model, design and build iteration, and implementation.

A. Pre-Project

At this stage, all resources for system development are available. For the development of agricultural e-commerce, it takes resources of energy for process analysis, designing and coding the program. The need of this resource has been fulfilled with the formation of a team of developers consisting of 2 college students and 4 lecturers from Information Systems and Informatics. Meanwhile for financing, this research activity was fully funded by the Institute of Research and Community Service Duta Wacana Christian University for the system development process and the Information Technology Faculty for publication funding from research. Besides the resource, initialization process and planning have been done when pre-project. Developed system is a part of process of development Integrated Agriculture Information System (IAIS). IAIS is the main project that has been built since 2015 and is scheduled to end in 2022. Agricultural e-commerce developers is a part of the IAIS project and become focus project in 2018. Therefore the development of an agricultural e-commerce system is based on the IAIS blueprint that developed in 2016 - 2017 [14] [15] [16]. With the availability of supporting resources for the development of agricultural e-commerce systems, the

system development process can proceed to the feasibility study stage.

B. Feasibility Study.

Problems that will be resolved at the feasibility study stage are problems related to the unavailability of online sales and purchase of agricultural products. Even though this system can help farmers in expanding the market for selling agricultural products they have. For this reason, this research developed an agricultural e-commerce system. Reviewed from the availability of resources and funds to support research that has been defined in the pre-project then the planned project is feasible to run.

C. Business Study

Business study for system development have been done when developing blueprints for IAIS. The development of e-commerce is an activity that matches the second goal of IAIS business motivation. This goal is a development of architecture and application for IAIS. This goal have an objective, that are 1) Blueprint strategy for system development; 2) Availability of IT Infrastructure; and 3) Development of Agriculture Information Systems and Knowledge Based Systems [16]. Specifically for module development, researchers conducted observation for sales and purchasing process in some farmer groups in Sleman, Special Region of Yogyakarta. Researchers also did literature review to article related with sales and purchasing business processes activities. In particular, researchers observed some business process in some online stores.

D. Functional Model Iteration

Functional Model Iteration is a stage to perform functional definitions of the system to be developed. Activities at this stage are done iteratively. There are several activities undertaken at this stage that are agree plan, create functional prototype, review prototype, and identify functional prototype. Based on the collected data from business study and observation for some well-known e-Commerce sites, sales module can be consists the following functionalities: 1) user management; 2) product management; 3) sales transaction management; and 4) reporting management.

E. Design and Build Iteration

At this stage the module design process for sales on agricultural e-commerce is carried out. The design process is based on module functionality that has been defined in the previous stage. Based on the 4 functionality of the seller module, 8 functions are generated in the seller module. Mapping functionality and function in the module can be seen in table 1.

Table I. Modul Functionality Mapping.

Functional Model	Function Module
User Management	Registration
	Login

Functional Model	Function Module
Product Management	Product data management
Sales Transaction Management	Check product prices
	Sales transaction management
Reporting Management	Function of user reporting
	Function of admin reporting
	Function of non login user reporting

The design of sales modules includes designing data flow diagram (DFD), designing of database, flowchart, use case diagram, activity diagram, sequence diagram, and user interface. The DFD design is intended to describe the Entities, processes, and data flows that flow in the sales module. DFD seller module level 0 can be seen in figure 2.

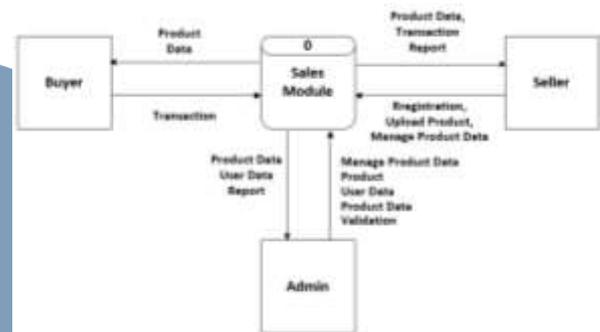


Fig. 2. Data Flow Diagram of Sales Module.

Database design of purchasing module is designed using Entity Relationship Diagram. This process uses Logical Data Modelling. There are 8 steps in the modelling: 1) identify main entities; 2) depiction of entity relationship; 3) defining primary and secondary key; 4) defining foreign key; 5) business rules definition; 6) non-key attribute addition; 7) validating normalization rules; 8) data dictionary creation. There are 16 entities in e-commerce database. The followings are relation scheme:

- Master_detail_user (ID_User, nama, jenis_kelamin, tanggal_lahir, alamat, provinsi, kabupaten, kecamatan, kelurahan_desa, no_telpon, email, foto),
- Master_kategori(ID_Kategori, Nama_Kategori, Deskripsi, aktif),
- Master_Kategori_Topik(Id_Kategori_Topik, Nama_Kategori_Topik)
- Master_user_kat(ID_kategori, ID_user),
- Master_user(ID_User, Password, PIN, Tingkat_Priv),
- Master_Produk_Tani(ID_Produk, ID_Spesies, ID_Kategori, Nama_Produk, Deskripsi_Produk, Satuan),
- Master_Spesies_tanaman(ID_Spesies, Id_Morfologi, Jenis_Tanaman,

- Nama_Tanaman, Nama_Latin, Habitat, Masa_Tanam, Akar, Batang, Daun, Buah, Biji, Perkembangbiakan, Foto1, Foto2, Iklim, Jenis_Tanah, Kelembaban),
- Master_Kategori_Produk(ID_Kategori, Jenis_Kategori, Nama_kategori),
 - Master_alat_tani(Id_Alalat, ID_Kategori, Nama_Alalat, Deskripsi_Alalat, Spesifikasi, Harga_terendah, Harga_Tertinggi, Fungsi),
 - Master_bahan_pertanian(ID_Bahan, ID_Kategori, Nama_Bahan, Deskripsi_Bahan, Spesifikasi_Bahan, Harga_Terendah, Harga_tertinggi, Fungsi_Bahan, Jenis_Bahan),
 - Master_Hasil_Tani(ID_Hasil, ID_Kategori, ID_Spesies, Nama_hasil, Deskripsi_Hasil, Harga_Terendah, Harga_Tertinggi, Satuan),
 - Trans_Topik_Diskusi(ID_Topik, Id_Kategori_Topik, ID_User, Judul_Topik, Tanggal, Waktu, Isi_Diskusi),
 - Trans_Komentar_Diskusi(ID_Topik, ID_User, Komentar, Tanggal, Waktu),
 - Trans_Pembayaran(ID_Pembayaran, ID_Permintaan, ID_User, No_Rekening, Nama_rekening, Jumlah_Rekening, Bukti_Rekening),
 - Trans_permintaan(ID_Permintaan, ID_User, ID_Penawaran, Qty, Harga, Tgl_Kebutuhan, Tgl_Permintaan, Status_Bayar, Status Kirim), and
 - Trans_penawaran_prod_tani(ID_Penawaran, ID_User, Tanggal_Penawaran, Spesifikasi_Barang, Id_Barang, Kondisi_Barang, Merk, Harga, Tahun_Produksi, Gambar1, Gambar2, Status, Satuan_Barang, Validasi Admin).

Complete figure of Database design can be seen in Figure 3.

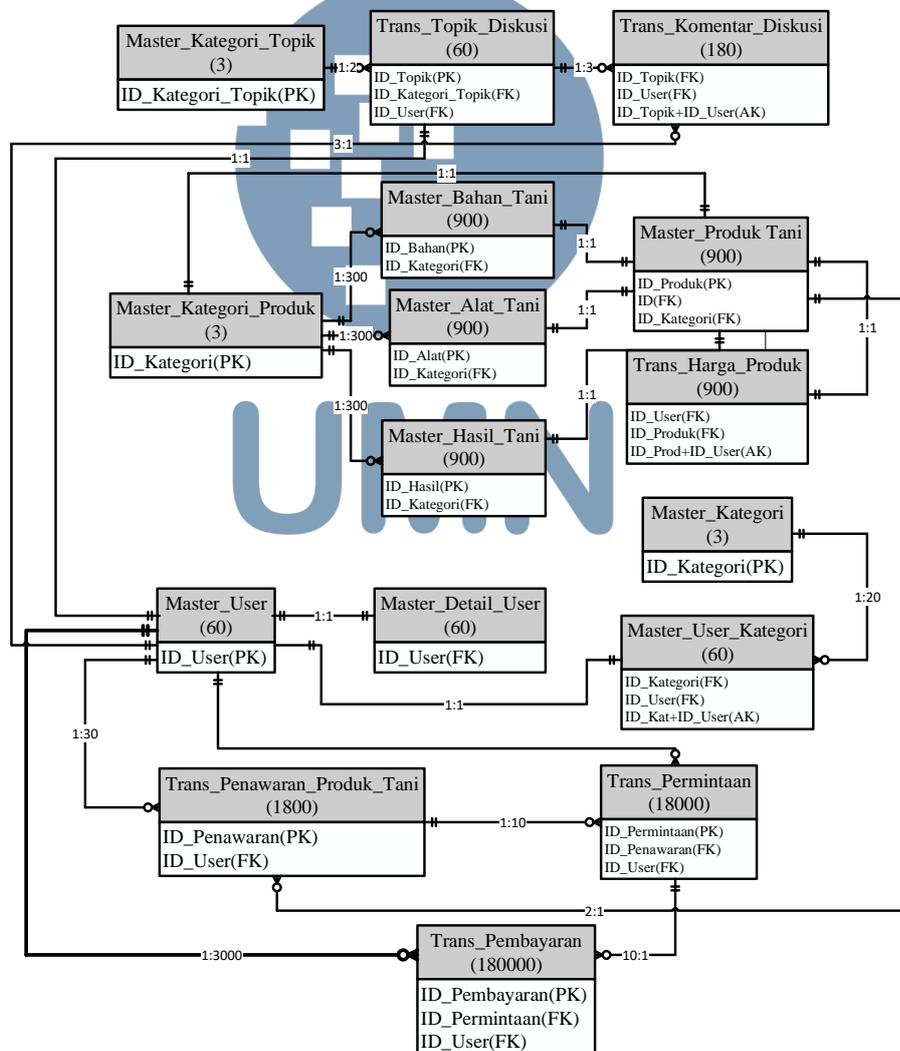


Fig. 3. Entity Relationship Diagram System.

Use case diagram system consists of 2 user categories that are user that act as end user who is a

farmer, seller, and common user. The second user category is an admin of the system. Use case diagram can be seen in figure 4.



Fig. 4. Use Case Diagram of Sales Module.

Activity and sequence diagram developed base on the function of the module. Activity diagram describe a business process that happen in the system. There are 9 activity diagrams in the sales module that are activity diagram for process of login, registration, uploading a product, product management, user management, reporting, product validation, check product price, and

check delivery status. Meanwhile sequence diagrams describe or display interactions between objects in the system arranged in a sequence or time series. There are 7 sequence diagrams in the system that are sequence diagrams login, registration, product validation, user validation, product price checks, delivery status checks, and sales transactions. Sequence and activity diagrams for each sales transaction can be seen in figures 5 and 6.

After the design process, proceed with the module coding process. The modules using PHP and HTML 5 as a language programming for website, MySQL for the database, Sublime tools as program code editor, and XAMPP Control Panel software. The design and implementation process will be done in an iterative manner with each function in the module.

F. Implementation

The implementation stage is the stage of delivering products to users. This stage will be done through user approval and user guidelines, user train, implement, and business reviews. Ongoing research has not reached the implementation stage. This research is currently on design and build sales module on agricultural e-commerce.

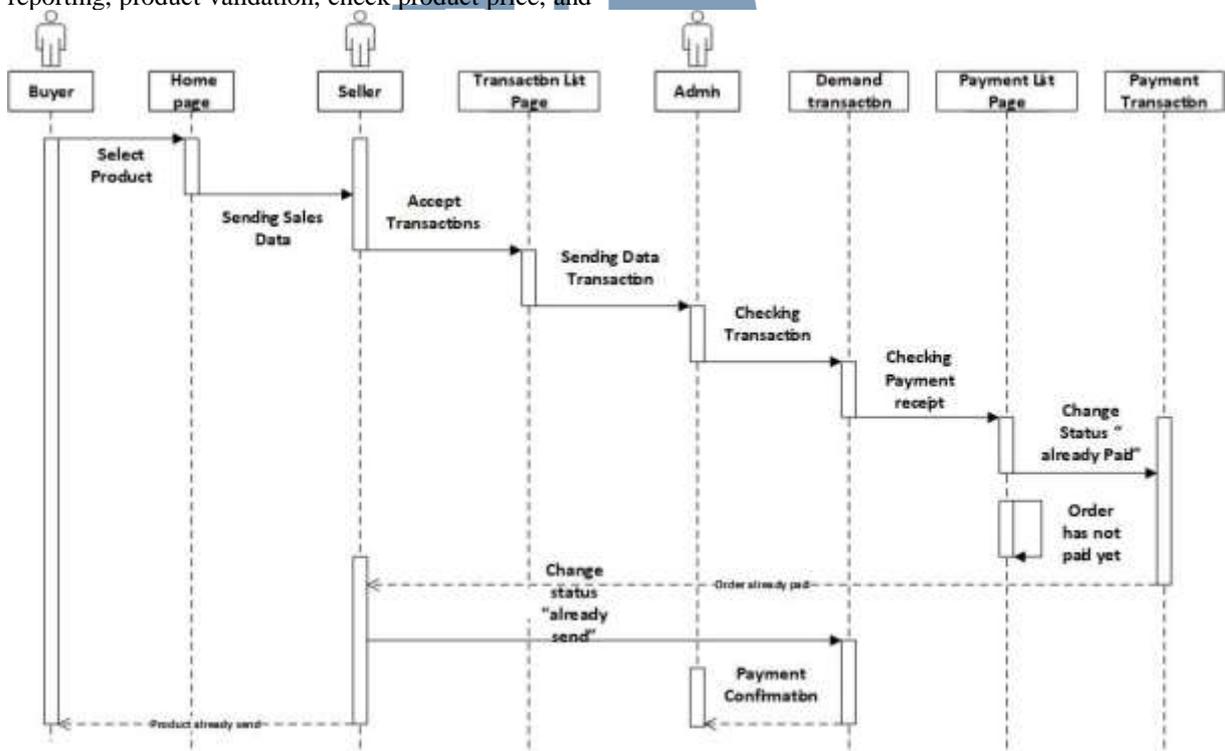


Fig. 5. Sequence Diagram Sales Transaction Process.



Fig. 10. Sales Transaction List page



Fig. 11. Product Discussion Page



Fig. 12. Sales Report page.

B. Testing System

Module testing is using the black box method. This black box testing focuses on the functional specifications of the software. Application testers can find out the errors by checking whether the input can be received properly, and the output is in accordance with what is expected. Table II is a table of the number of tests and the results of the sales module trial.

Table II. Modul Functionality Mapping.

No	Type of testing	Number of button/function	Number of tests	Success rate
1.	System User Interface	23 button	143	100
2.	Basic System Functions	3 function	81	100
3.	System Form Handle	6 Form Entry	40	100
4..	System security	2 cases	6	100

Based on the data in table II, it was found that the results of black box testing is 100% success in all test cases. Thus it can be said that the sales module prototype can be used for sales transactions on agricultural e-commerce.

C. Discussion

Dynamic System Development Method is an agile method that applies the iterative and incremental principles in development process. The utilization of this model is based on the limited number of project team and short development time. The project consist

of 6 members and 6 months (180 days) project time. This module is developed with 9 iterations. Time for each iteration is around 20 days. Activities and function developed in each iteration can be seen in Table III.

Table III. Iteration Activities.

Iteration	Activities/ Function Increment	Time
1	User Registration User Login	20 days
2	Product Data Management (CRUD Product Data)	20 days
3	Testing and Module Improvement	20 days
4	Sales Transaction Management (Sales Data CRUD)	20 days
5	Product Discussion Feature	20 days
6	Testing and Module Improvement	20 days
7	Reporting Module for user and admin	20 days
8	Testing and Module Improvement	20 days
9	Testing and Module Improvement	20 days

D. The Analysis of Strength and Disadvantage Module

Based on the trial testing and observations it is known that the system has several advantages that are 1) web-based system so that it can be used extensively; 2) the system has a recommended price feature to make a sale; 3) all reports on the system can be saved in pdf format; and 4) the system is able to send statements via email. But the system also has two main disadvantages that are 1) there is no limit on sending image files and image file forms are still limited to jpg, jpeg, png, and gif; and 2) system not yet full feature and network related product payment.

This module is in development phase and needs to be tested and evaluated. Some evaluations and testings should be conducted, such as usability testing and acceptance testing for application. By using the result for the test, it will be used to improve the system functionalities and modules. After conducting the test and acceptance test, the system will be ready to be implemented.

V. CONCLUSION AND FUTURE WORK

A. Conclusion

Some conclusions that can be formulated in this research include: 1) prototype of sales module in agricultural e-commerce system developed using dynamic system development method consisting of pre-project stage, feasibility study, business study, functional model iteration, and design and build iteration; 2) Prototype module has 4 definition of functionality that are user management, product management, sales transaction management, and reporting management; and 3) based on the results of the system testing turn out that all functions and pages in the system can run properly and correctly. Nevertheless, to have sufficient knowledge and understanding system quality and performance, usability and acceptance test will be conducted.

B. Future Work

The next work that must be done includes the development of purchase modules, integration of sales and purchase modules, agricultural e-commerce usability testing, and preparation for the implementation stages of the system.

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