

# PRODUCT – SERVICE SYSTEM INVENTORY CONTROL FOR MALAYSIAN PALM OIL AGRIBUSINESS

Nina Iwani A Zailaini\*<sup>1</sup>, Siti Zubaidah Ismail<sup>1</sup>

\*Correspondence

zubaidahismail@ump.edu.my

<sup>1</sup> Faculty of Mechanical and Manufacturing Engineering, Universiti Malaysia Pahang, 26600, Pekan, Pahang, Malaysia

Articles Info:

Received **6 August 2019**

Received in revised form

**10 September 2019**

Accepted **29 September 2019**

Available Online **30**

**September 2019**

Keywords:

**Product-service system;  
Inventory Control;  
Palm Oil Plantation;  
Inventory Application  
System.**

## ABSTRACT

This research deals with the study of Product – Service System (PSS) and inventory control for Malaysian palm oil plantation company. PSS is a managing system that combining product and service in one system. PSS is essential to provide better environmental impact, improve competitiveness and to help the company satisfy the demand from customer. The current PSS in the palm oil plantation and palm oil processing in this research could not be running smoothly when the inventory of product and service are managed in separate interface systems. Also, using manual inventory control like Microsoft Excel and handwriting documentation as a medium to store, analyse the data and cost estimation. In order to make PSS inventory control more accessible and systematic, an inventory application system is developed. This research is focusing on developing a PSS inventory control tool which could help in decision and calculation making for product and service of palm oil plantation.

## INTRODUCTION

The palm oil industry is one of the regulated industry in Malaysia. Based on the Malaysia Palm Oil Council (MPOC), Malaysia has been one of the biggest producers and exporters of palm oil and palm oils products which 39% of world palm oil production and 44% of world exports. In order to promote and develop the nation's goals, policies and priorities for well-being of the Malaysia Palm oil industry, an agency was established known as Malaysia Palm Oil Board (MPOB). This agency was responsible for developing, promoting and commercialising research findings such as provide the technical support, advisory and consultancy services to the palm oil industry all around Malaysia, which is a part of PSS.

A product-service system (PSS) can be defined as one of the systems that helps to satisfy the specification of the customer needs and to provide better environmental impact compared with the traditional business models [1]. PSS also is an excellent tool to improve competitiveness and to promote sustainability at the same time. PSS business models enable companies to form new sources of added value and competitiveness, as long as they meet the customer needs in an integrated and suitable way. PSS

consists of combine and design for a tangible product, and an intangible service depends on the customer specification demands [2].

The definition of inventory is the stock of any solid object that kept or any services provided, which can contribute to any organisation's output [3]. Besides, inventory can also be defined as a store or stock of object which provides specific value to an organisation. Inventory management is essential to balance the organisational objective mainly for raw material, and production output. Inventory management decisions can determine the future of the company [4]. Any wrong decision might cause the company faced more significant losses in the future. Moreover, inventory control will function as a monitor to monitor the stock at any given point in time. In additions, there are several popular methods can be used in inventory control such as Minimum Stock Level, Stock Review, Just in Time, Economic Order Quantity (EOQ), Example, Solution, Re-order Lead Time, Batch Control and First in First out (FIFO) [5].

Nowadays, several problems happened in the oil palm industry, which related to the high inventory problem. The first problem is the high inventory of the palm oil trees. This problem happens because the palm oil trees have been replanted in different years. If more than that 7 to 14 years, the number of fruit produced will decrease years by years. Though the trees still produce fruits, the process to harvest might take longer time to compare to harvest fruit from prime palm oil trees. Second problems is a high inventory of sapling of palm oil tree also happened in the nursery of the palm oil plantation. The most significant factor of this problem happened is when the replanting program had been postponed. The longer the time of replanting program postpones, the higher the amount of sapling and the lower the spacing in the nursery. Next is a high inventory of the fresh fruit bunches (FFB). This problem usually happened when delivering the process of the FFB to the factory was disrupted due to technical problems. In order to maintain the freshness of the fruit, the fresh fruit bunches must be delivered to the factory within 24 hours; the faster the fruit is crushed, the less FFA is formed, the better the yield and quality of CPO [6].

In order to make inventory management more manageable, it is good to have an inventory tool. Other than making the inventory process faster, it also helps to make the inventory process more efficient and productive.

## METHODOLOGY

This part will explain the methodological choice and the impact of this on the processes. The method is divided into several stages. All data that had been collected from the interview session and observation will be summarized in the diagrams known as IDEF. For IDEF, the application developed to store and show the inventory control of palm oil in the plantation. Besides, it also helps produce a consultation service and give suggestion or advice for the improvement of the inventory control of the palm oil.

### Integrated Definition Methods (IDEF0)

IDEF0 has released by an organisation known as Computer Systems Laboratory of the National Institute of Standards and Technology (NIST) as one of the standards for Function Modelling. The main objective of IDEF0 is to guide the decision, actions and activities of an organisation or system. Other than be used as a functional modelling, IDEF0 also can be used as a communication tool and an analysis tool. IDEF0 is a functional modelling method which consists of three levels. The main level is the most general that provides the most general description of the modelling object. Next level is known as parent/child diagram. This parent/child diagram would describe more detail of the modelling object from A-0 diagram. Last but not least is the last level known as a node tree. This node tree is the most detail diagram compared with the other two diagrams.

There are four different directions of arrows for this IDEF0 such as Input arrow, Output arrow, Control arrow and Mechanism arrow. All these four arrow types are collectively called as ICOM. Input arrow will transform input into output meanwhile output arrow is exiting the right side of the activity box. Mechanism arrow is representing for the physical aspects of the activities such as skilled workers, machinery, computer equipment and tools. However, Control arrow is representing for the condition, directives and guideline that can be controlled.

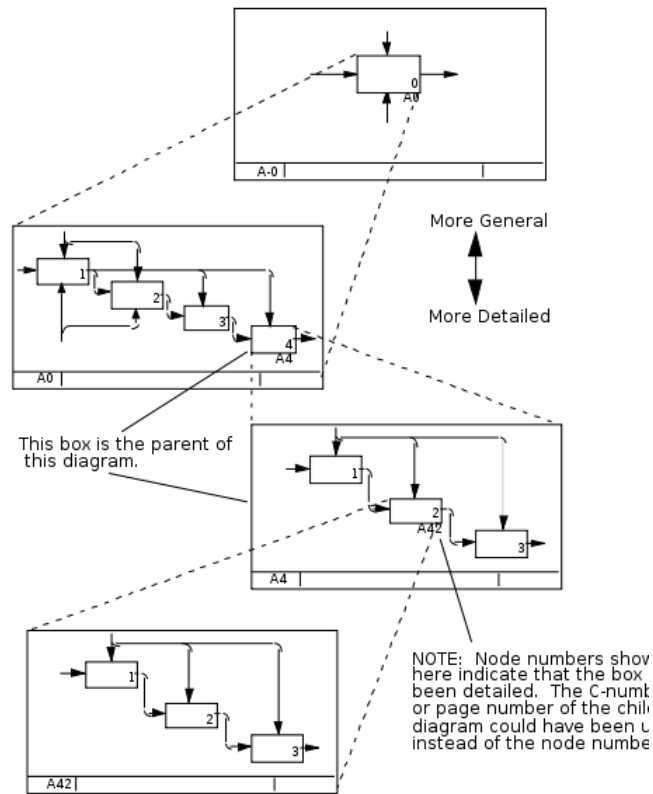


Figure 1: Hierarchy of diagrams in IDEF0

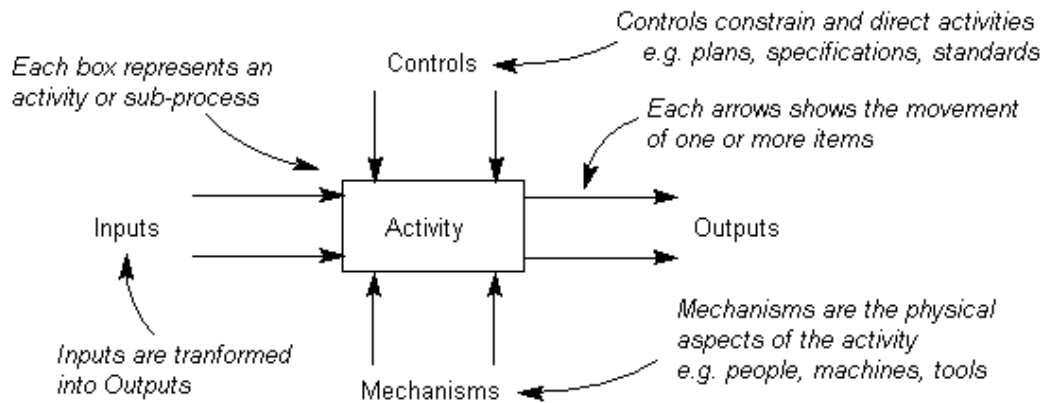


Figure 2: Activity box and ICOM arrow

### Development of Inventory Tools

There are several main steps in order to develop the inventory application system. The first step is listing and selecting the most suitable software that might be used for the inventory tool. Before selecting the most suitable software for the development of the inventory tool, all the listed software should undergo a comparative analysis. The software that would be used for this application system must be able to stand alone or independently, be able to store a large amount of data, be able to make some prediction to help in decision making and have good security. Therefore, after analysing the most optimum software that would be used in this application system are Java servlet as the user interface and MySQL server as database.

Next is creating the online database by using MySQL and phpMyAdmin server which supported in XAMPP. Then continuous the step with designing and developing the user interface of the inventory tool by using Java servlet. Programming and writing the coding to connect the MySQL server with the Java servlet. Lastly, troubleshooting the inventory tool until it completely running as expected.

Connection command used to link both software and to recall the database from the MySQL. Thus, data that inspected from Java can be imported into the MySQL database easily by using phpMyAdmin. Figure 3 shows the command that would send data from Java program to MySQL database which supported by phpMyAdmin.

### RESULT AND DISCUSSION

Based on the result from the analysing of data collected by using IDEF0, the development of the inventory application system is implemented.

#### Development of IDEF0

A0 diagram is the main layers of the IDEF0, which contains several major sub-level for one complete process such as Palm Oil Plantation Process. There are six major sub-level in Palm Oil Plantation

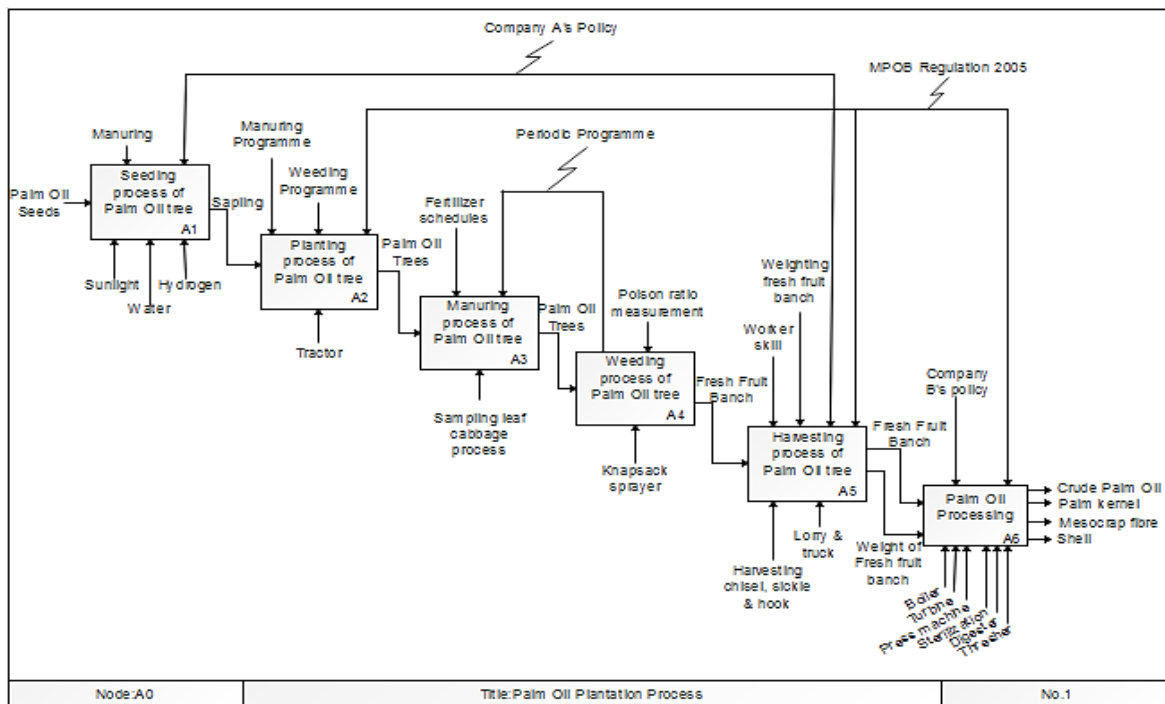


Figure 3: IDEF0 A0 diagram

Process. All the inputs and the output are illustrated in the A0 diagrams, as in Figure 4. For this A0 diagram, the sub-level was identifying with several node numbers:

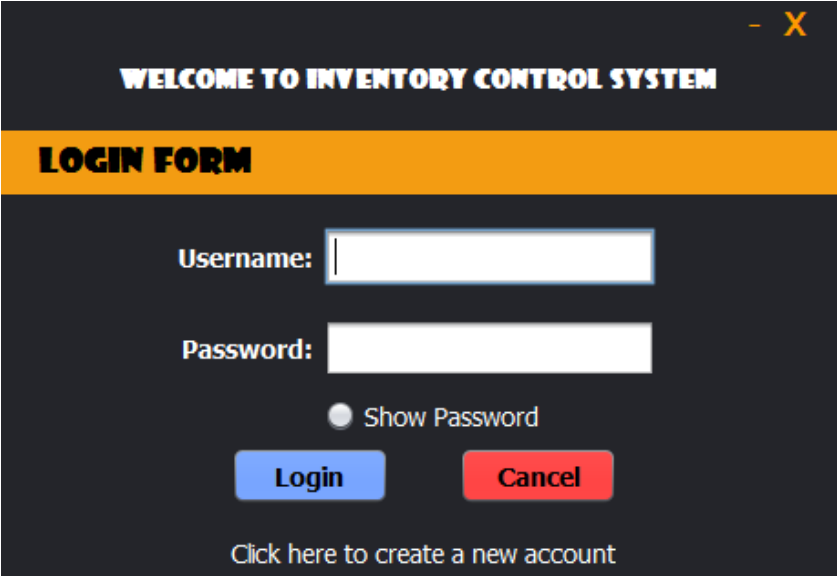
- A1: The Seedling process of Palm Oil trees
- A2: Planting process of Palm Oil trees
- A3: Manuring process of Palm Oil trees
- A4: Weeding process of Palm Oil trees
- A5: Harvesting process of Palm Oil trees
- A6: Palm oil Processing

### Development of Inventory Tools

There are several main steps in order to develop the inventory application system. The first step is listing and selecting the most suitable software that might be used for the inventory tool. Before selecting the most suitable software for the development of the inventory tool, all the listed software should undergo a comparative analysis. The software that would be used for this application system must be able to stand alone or independently, be able to store a large amount of data, be able to make some prediction to help in decision making and have good security. Therefore, after analysing the most optimum software that would be used in this application system are Java servlet as the user interface and MySQL server as database.

#### *Login & Registration Form*

This login form created in order to improve the security of the inventory application system, which is only certain people like staff or person in charge can access into the application system. However, the user must register themselves first in the registration form before login into the system.



WELCOME TO INVENTORY CONTROL SYSTEM

**LOGIN FORM**

Username:

Password:

Show Password

[Click here to create a new account](#)

Figure 4: Login Form

The image shows a registration form titled "REGISTER NEW ACCOUNT". The form is set against a dark grey background with white text. It contains the following fields from top to bottom: "First name:" with a white input box, "Last name:" with a white input box, "Username:" with a white input box, "Password:" with a white input box, "Retype pass:" with a white input box, and "Email:" with a white input box. Below the fields are two buttons: a blue "Register" button and a red "Cancel" button. At the bottom of the form, there is a link that says "Click here to login". The form is enclosed in a window with a yellow header and a yellow footer, with a close button (X) in the top right corner.

Figure 5: Register Form

### *Inventory Manager*

This inventory manager could help the company to store all the inventory data into the MySQL database. Besides, this inventory manager page also helps to plot the vertical bar graph for the quantity of the inventory against the date of the store, which could help the management in decision making.

### *Analytical & Intelligence*

For this analytical & intelligence, it is also developed to help the management in decision making by showing some prediction of factors of the problem happened in a certain session. Then, it also would give some advice and suggestion on how to solve the problem. It might not show a very accurate factor or advice, but it still will help the user to the minimum the scope of the factor to be solved.

### *Calculator Manager*

Next is calculator manager. This calculator developed to help the user calculating in short of time. Based on the observation, the company A still uses manual calculator for making the calculation. Therefore this calculator manager will help the user in calculating by finding in the blank column and click calculate. For example, in figure 9, the amount of bags and the number of the ton as the output of the calculator is shown. In order to reset the calculator, the user needs to click on the reset button for starting a new calculation. Calculator manager is functioning as a smart calculator that very useful to calculate several amounts of inventory object such as the amount of fertiliser to order for manuring program. Besides, this calculator developed based on a real calculation that is collected during the interview session. In the company, this calculating process was done manually and one by one. Therefore, this calculator manager can reduce the time taken of the worker for doing the calculation.

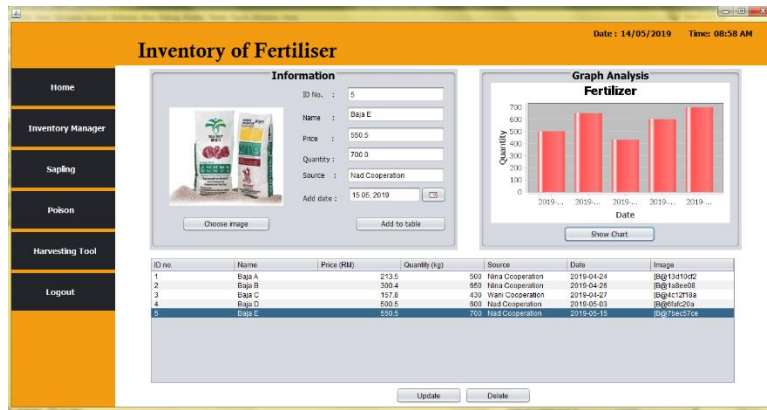


Figure 6: Inventory manager page

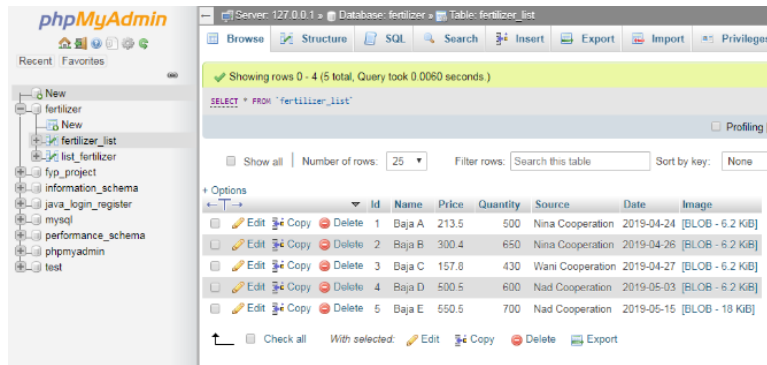


Figure 7: phpMyAdmin server (localhost)

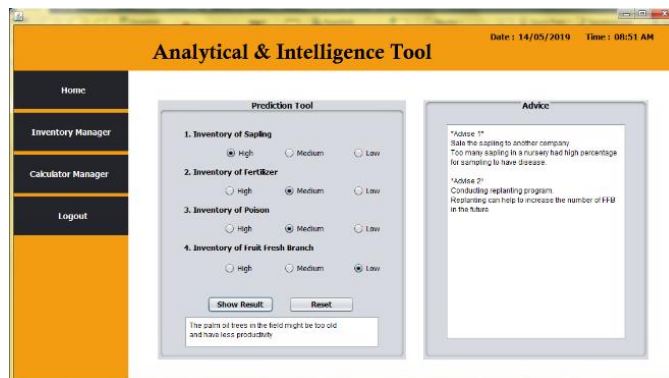


Figure 8: Example of Analytical & Intelligence result

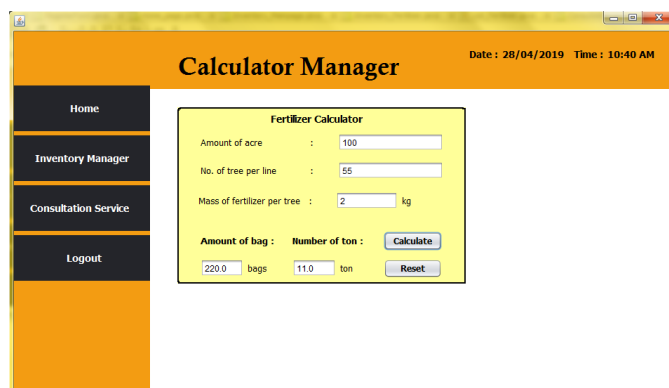


Figure 9: Calculator Manager result

## CONCLUSION

As the conclusion of this project, based on the interview session and observation with the top management in the palm oil plantation company, all the characteristic operations and inventory information of the palm oil plantation were successfully collected. Besides, in order to simplify and summarise all the collected information, generating model by using Integrated Definition Method (IDEF0) is very useful and practical. Integrated Definition Method (IDEF0) is a functional modelling as a communication tool and analysis tool which could help to improve the involvement of domain experts and consensus decision making by simplifying information into the graphical diagram. Moreover, a computerised PSS inventory control system is a beneficial, essential and better replacement for a manual management system. The primary purpose of development of this inventory application system is to help and to improve the management of inventory control system for palm oil plantation company. All the tools required for the PSS inventory control had combined in one application, which consists of inventory manager, analyse & intelligence manager and calculator manager. With the use of the online database, the data storage of the inventory objects would be enlarged, together with the better-enhanced security and quicker handling. Other than that, this inventory application system also would help the management in decision and calculation making. Thus, much time can reduce by using this inventory application system.

## REFERENCES

- [1] Manzini, E., & Vezzoli, C. (2003). *A Strategic Design Approach to Develop Sustainable Product Service Systems: Examples taken from the 'Environmentally Friendly Innovation'*.
- [2] Tukker, A. (2004). Eight Types Of Product –Service System: *Eighth Ways To Sustainability? Experiences From Suspronet.*, 260, 246–260.
- [3] Anderson & Lievan. (1986). *Quantitative management: An Introduction*.
- [4] Zhou, Q., Xia, B., Xue, W., Zeng, C., Han, R., & Li, T. (2017). An advanced inventory data mining system for business intelligence. *Proceedings - 3rd IEEE International Conference on Big Data Computing Service and Applications, Big Data Service 2017*, 210–217
- [5] Muhammad Barwa, T. (2015). Inventory Control as an Effective Decision-Making Model and Implementations for Company's Growth. *International Journal of Economics, Finance and Management Sciences*.
- [6] Alimalbari, A., Hanifarianty, S., Kumar, A., & Khomphet, T. (2019). *Effects of Pressed Palm Conditions on Acceleration of Palm Drying Rate and CPO Quality*. 1(1), 12–19.