

# Product-Service System Inventory Control for Malaysian Palm Oil Industry: A Case Study Utilizing IDEF0 Modelling

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**Abstract.** Over the last several years, the palm oil industry has grown rapidly in Malaysia as it is among the main contributors to the country's economic development. The government strongly emphasises palm oil productivity in Malaysia in terms of quality and safety. The current inventory context offers a more extensive set of uncertainties that the company needs to manage due to the enhanced scope and complexity of the product and service offering. The current method of determining inventory takes an annual physical inventory by comparing the actual inventory with record levels. This method is a costly and time-consuming effort. This paper investigates Product-Service System (PSS) Inventory Control for different types of the section in the palm oil industry. In this work, an integrated and systematic methodology is presented for the assessment of inventory control. The methodology is represented as an IDEF0 activity model that rigorously defines the interconnections of information and activities with incorporating product and service elements. This research will lead to the discovery of how PSS inventory control can integrate some of the elements involved in inventory control and consequently give a positive impact on all palm oil industry players.

**Keywords:** Product-Service System (PSS), Inventory Control, Palm Oil, IDEF0

## 1 INTRODUCTION

The palm oil industry in Malaysia has undergone changes beginning with ornamental plants to become the most valuable commodity crops as it is among the main contributors in the country's economic development. As the economic crisis hit Malaysia around 1997, the palm oil industry played a significant role in absorbing the effects of the economic downturn through its export [Vijaya, 2008]. The palm oil industry in Malaysia is based on yearly oil planted area. In 2017 it reached 5.81 million hectares, which are increased by 1.3 % compared to 5.74 million hectares from the previous year. The current method of determining inventory was done manually by takes an annual physical inventory and comparing the actual inventory with record levels. This kind of method is a costly and time-consuming effort. This research will carry out the investigation on

Product-Service System (PSS) Inventory Control for different types of the section in the palm oil industry. PSS is known as the integration between product and service and has its advantages, which will reduce the impact on the environment [Baines, 2007]. PSS will assist the company in terms of improving the value of products and services. In this work, an integrated and systematic methodology is presented for the assessment of inventory control. The methodology is represented as an IDEF0 activity model that rigorously defines the interconnections of information and activities with incorporating product and service elements.

Inventory control in agriculture controlling the budgets, raw materials, and finished products [Sani, 2014]. It will often cope with the issue of uncertainty elements, and the integration of these elements become importance in managerial decisions in order to gain efficiency and competitiveness to stay relevant in the market [Borodin, 2016]. The theory of inventory control, especially on agriculture products, need more consideration due to its unique characteristics such as unpredictable supply and price and inconsistent demand [Shi, 2015]. Inventory control plays a crucial role in managing inventory so that the inventory level of palm oil product should be low but enough to meet the order of the processing unit. Inventory control provides useful information for managers to make more accurate and timely decisions.

## **2 LITERATURE REVIEW**

In 2008 palm oil was one of the major commodities exports in Malaysia; the total production of 17.7 million tonnes, which contributes 41% of total world palm oil production [Umar, 2018]. The Malaysian palm oil industry plays an essential role as a significant producer and exporter of palm oil and palm oil products not only for local use but also for global demand for oil and fats [Alam, 2015]. Nowadays, palm oil production has brought countless economic benefits and is now a new emerging economic sector in Malaysia [Alam, 2015].

Many manufacturers feel that developing a Product-Service System (PSS) is very important because of the trend of servitization and creating social value [Meier, 2010]. PSS is as an interesting business theory by creating high value added through the integration of products and services [Muto, 2015]. PSS is a business model and integration concept of services and products to empower new capital business in order to increase value-added flow and meet customer demands [Papazoglou, 2018]. PSS also can be classified as a commercial service and product set that can satisfy customers' needs [Goedkoop, 1999]. Existing studies have shown that the concept of business model can be a reference to implementing PSS, but companies still need guidance in implementing it.

Inventory interpreted as a raw material used to produce the product through several processes before it can be sold. Inventory can be classified into three component, namely raw materials, work in progress and finished goods. Inventory control described as the process of checking the supply, inventory and storage company so that it all meets the current demands and needs and avoid over-stock and other problems involving stocks. Agricultural inventory literature has not been exploring well because of its

unique elements, including supply characteristics, uncertain demand, unstable prices, and selling price decision [Shi, 2015]. Agricultural sector faces new challenges, including managing agricultural supply chains efficiency that has become an attractive topic for researchers and practitioners.

### 3 IDEF0

This paper used Integration Definition for Function Modelling (IDEF0) to represent all activities and interconnections, including products and service. IDEF0 is a functional model methodology for describing processing and manufacturing. It is increasingly popular among industry and academic practitioners due to its function, which offers good and effective communication between researchers and customers by showing a simplified diagram [Waissi, 2015]. By using IDEF0, functions are depicted via boxes, which means represent such as activities, actions, processes, and operations. Interfaces are displayed by arrows which indicate data or activity. Input arrow consists of data which entering the functions box from the left side. Output arrow exiting the box on the right side. Control-arrow entering from the top of the box and mechanism entering from the bottom of the box. Control is a constraint and direct activity in the process which fixed and seldom changed. The mechanisms are resources and tools that are needed to perform and complete the process. Figure 1 below shown IDEF0 representative

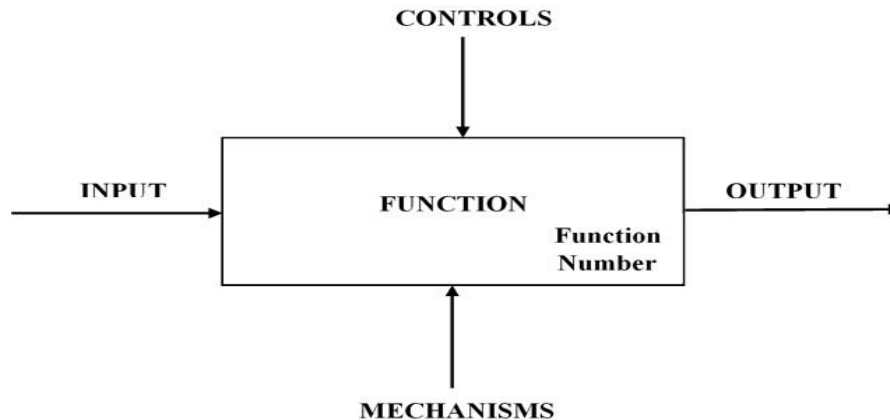
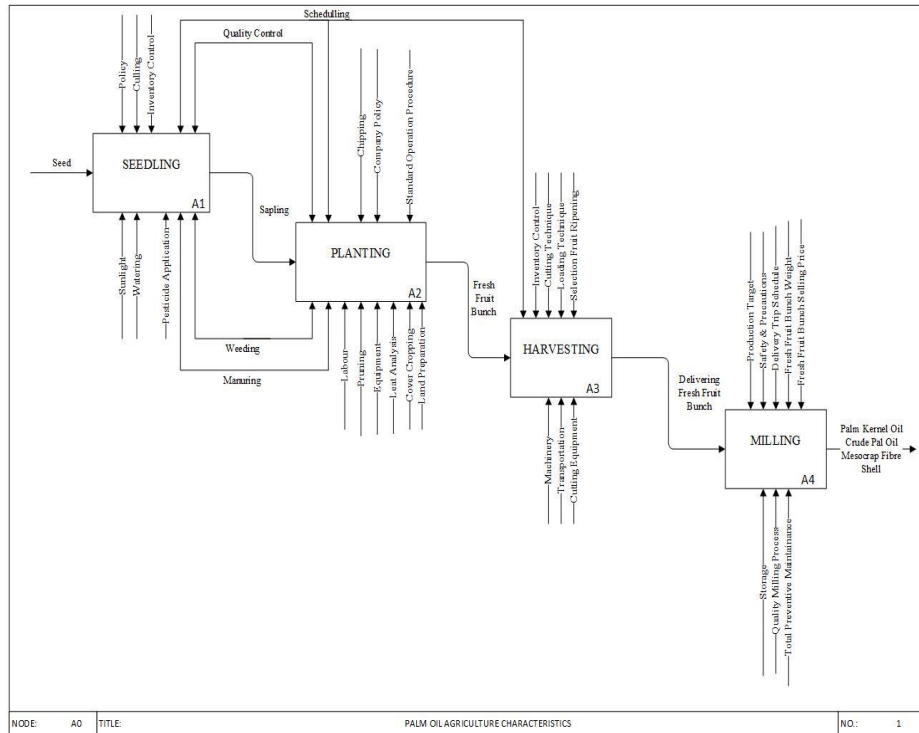


Fig. 1. IDEF0 representative

## 4 RESULT AND DISCUSSION



**Fig. 2.** Palm Oil Agriculture Characteristics

Figure 2 shows the palm oil agriculture characteristics with all connection parent function together with their child function in one single diagram. At the Seedling (A1), the seed is the input for the beginning of the entire process chain. Sapling is the output for A1 and also an input for A2. Controls in this stage are policy, culling process and inventory control, scheduling and quality control. Culling is a procedure to be done in order to get the best and uniform seedlings that produce high yields and is monitored by quality control. Inventory control is ensuring that there is no stock dumping that will cause loss to the company. Mechanisms in this stage are sunlight, watering, weeding, manuring and pesticide application. Watering is to ensure the seedling get optimum water to reach optimum growth and avoid stagnantly. Manuring provides the growth of seedlings as additional nutrients based on the types of soil used at the nursery level. Weeding program takes place after the manuring to prevent the seedling from fungal attacks.

In planting (A2), the sapling to be input and the output has recognised as Fresh Fruit Bunch. Chipping process where trunks of the palm oil trees together with its fronds will be cut and chopped. For mechanisms are like weeding, manuring, labour, pruning, equipment, leaf analysis, cover cropping, and land preparation. Leaf analysis will come out with a program, and it is essential to determine the correct fertiliser to use.

For harvesting (A3), the fresh fruit bunch has been identified as input, and the output is delivering FFB to the milling stage. Controls in this stage are like scheduling, inventory control, cutting technique, loading technique, and selection fruit ripening. Inventory control plays a role in order to secure the company's operations run smoothly and does not experience a stock surplus. Cutting technique has to be done by the specialist hired labour. Mechanisms in this stage are machinery, transportation, and cutting equipment — machinery used in reception counters like backhoe and loading ramp. Transportation is an example or service in this study because outsiders provide it.

Delivering Fresh Fruit Bunch will be input in milling (A4) and will produce output such as crude palm oil, palm kernel oil, mesocarp fibre, and shell. To get such results, it needs to go through controls and mechanisms. Controls are like production target, safety & precautions, delivery trip schedule, FFB weight, and FFB selling price. For delivery trip schedule, it has to be inline with mill capacity in order to prevent from FFB dump at the grading area. In the case of FFB selling price, it may be slight differences from one company to another, but the government has set ceiling prices that these industry players have to follow. Grading FFB should be independent parties to perform their duties and may not be affected by any party. Every mill has to ensure that its storage well enough to stored its outputs so that the quality still in good condition. To ensure every machine works correctly and in the right conditions, the company had its maintenance schedule.

## 5 Summary and conclusion

This paper has provided a useful understanding of overall of the overall characteristics through the generic model in the palm oil industry using the IDEF0. The current research has shown that inventory control for palm oil is a complex process. This paper is a preliminary discussion for future work which will be used to develop software for efficient inventory control at the palm oil plantation and factory.

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