# MOBILE DATA WAREHOUSE ARCHITECTURE FOR PORTABLE PADDY MANAGEMENT SYSTEM

**Muhamad Shahbani Abu Bakar[1], Azman Ta'a[2], and Muhamad Ashraf Muhamad Ridwan[3]**

[1]*Universiti Utara Malaysia, Malaysia, shahbani@uum.edu.my*
[2]*Universiti Utara Malaysia, Malaysia, azman@uum.edu.my*
[3]*Universiti Utara Malaysia, Malaysia, s809898@student.uum.edu.my*

**ABSTRACT**. Business intelligence has been adopted for increasing profit and sharing information, especially for large sectors. One of the sectors is agriculture, which paddy is one of the biggest plantations for staple food industries. In particular, the Malaysian Paddy Management System (PMS) that provides the information to the farmers, brokers, agencies and government still lack of reliable and accurate information for planning and supporting decision making. Therefore, the data warehouse is used to integrate various agency databases into one big database for PMS. Moreover, the PMS will be implemented in a mobile environment to ensure the paddy sector activity can be benefited from the information provided. The mobile data warehouse architecture is developed and uses the paddy farming in Kedah state as a case study. The portable PMS is developed based on mobile data warehouse architecture. The PMS is evaluated by using an expert review technique, which is focusing on the eight dimensions of the software quality model.

**Keywords**: Mobile Application, Data Warehouse, Business Intelligence, Agriculture, Paddy Management System

## INTRODUCTION

Mobile applications become very important and growing faster in the next few years. Nearly, all new mobile customers (e.g. farmers, fisherman) will come from the developing country (e.g. Malaysia, Thailand) to benefit the advantages of the mobile technologies. According to CTIA-The Wireless Association®'s[1], in year 2012, there are already 326 million cellular telephone subscriptions worldwide and the number of subscription and mobile connections is expected to exceed the global populations by 2015. In Malaysia, the majority use for seeking information is 94.4%, communication through text is 84.7% and education is 64.5% (MCMC, 2012). Doubtless, one of the big subscribers is farmers, which is very important to expose and educate them with the current and updated information about the paddy farming. It is a new approach to deliver the farmers with reliable data to make sure the increment in the growth of the agriculture activity. Each agency that related to agriculture must take action to consider the best channels or formula for them to distribute and share the information to the farmers and related parties. One of the major problems that need to consider is how to spread and share the information from the related agencies to the farmers and support the farmers with the right and accurate information for decision making.

[1]http://www.ctia.org/

## MOBILE DATA WAREHOUSE ARCHITECTURE

To implement the portable PMS requires an environment that supports the data warehouse in mobile application. The mobile data warehouse becomes key components in the architecture of the PMS implementation. The architecture for mobile DW implementation is comprised of relationships between eight main activities in mobile DW system development as shown in Figure 1 (Bakar & Ta'a, 2012).

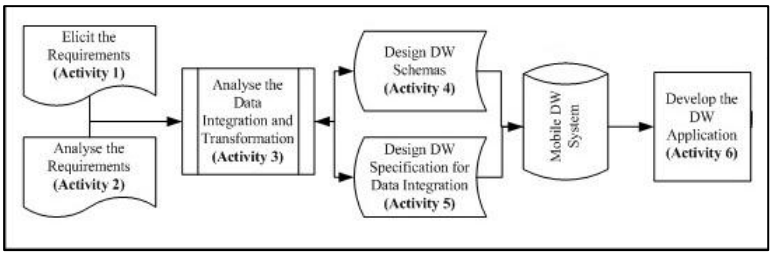


**Figure 1. Mobile DW System Development Architecture**

In Figure 1, the development process is represented by the sequence of activities, which started by identifying requirements (activity 1 and 2), defining ETL process specifications (activity 3), designing mobile DW schemas (activity 4 and 5), and producing the data for user's utilization (activity 6). Since the PMS is for mobile, the requirement elicitation and analysis are focused on the information that suited to the mobile characteristics such as data frequency and latency. In the mobile data warehouse, the design is based on dimension modeling (Rizzi, 2007), which has adapted several mobile elements in the modeling. The ETL process specifications defined the extract, transform and load data from the source to the mobile DW for PMS. The process link the data source to the mobile DW continuously for ensuring the PMS will produce the most recent and accurate data effectively.

## CASE STUDY: PADDY MANAGEMENT SYSTEM IN KEDAH STATE

Currently, the only effective mechanism for informing farmers about agriculture activities is through television. However, only few farmers, managers and agents were receiving the updated information about the paddy farming activity schedule, paddy crop information, manual procedures and guidelines, government policies and more (Samah, 2009). The limited distribution of information to the farmers has been studied by researchers and finding that *"The information sharing using the television is effective, but with the limited air time frame for agriculture segments, the user can't have enough information for the agriculture activities"*.

Mobile technology is the technology that can be used anywhere and anytime. Therefore, the development of the PMS must suite with the concept of the portable PMS, which can be accessed from anywhere and anytime. The PMS delivers the information to the users in order to guide farmers to increase the productivity and income by using the right information for planning, farming, and harvesting the paddy plantation. The case study for PMS will be based on the paddy management system in Kedah state.

### Requirement elicitation and analysis

The information about paddy management is handled by the related agencies such as Muda Agriculture Development Authority (MADA), Padi Beras Nasional Berhad (BERNAS), Department of Irrigation and Drainage Malaysia (JPS), Malaysian Agricultural Research and Development Institute (MARDI) and several more was not integrated to be one

"database" that can be shared by the farmers, managers and agents, especially in helping farmers for farming their paddy plantation.

Mobile data warehouse in PMS consists of data that develop from several databases that supply the information to the system as shown in Figure 2. Each of the databases comes from a different location and combined as the data warehouse system for integration and data analysis. The gathered requirements will be used to design the DW according the mobile elements. Each data is analyzed to specific user level and location. The data provided to the DW system will display the information for the PMS users including the important information or announcement from the information provider. Indeed, the information can be shared among farmers by using mobile devices and can be accessed anywhere and anytime with the availability of the internet connection.

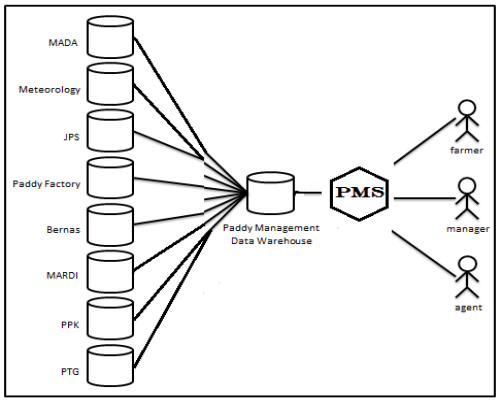


**Figure 2. The User Domain for PMS**

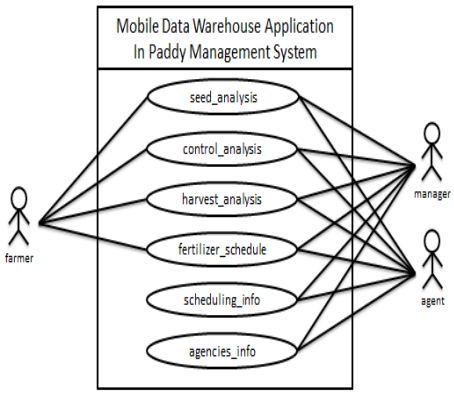


**Figure 3. The Use Case of the PMS**

Based on the Figure 2, the various data sources are collected from several related agencies in different locations. Each of the agencies supplied the data to the data warehouse and performs the analysis and integration to load the required data into the DW. Then, the information produced from the analysis is ready to be accessed by the farmers, managers and agents as shown in use case model in Figure 3. The functions shown in Figure 3 are used to design the mobile DW structure for portable PMS. The main information provided by the DW is comprised of seed analysis, fertilizer analysis, farming scheduling analysis, and control analysis. The evaluation will determine the correctness of the DW model through expert review. The proposed DW model is used to develop the prototype for PMS.

## Mobile Data Warehouse Model

The mobile DW is designed based on the dimensional modeling that contains fact, dimension and measure components in the table schema. Based on the requirement analysis presented in Figure 3, the components of DW model are listed in Table 1.

**Table 1. Components of DW Model for PMS**

| DW Components | Description |
|---|---|
| Fact | Paddy Farming |
| Dimensions | Season, Farmer, Seed, Crop, Lot |
| Measures | Size Area, Yield, Farming Cost, Profit Cost, Seed Cost, Plough Cost, Fertilizer Cost, Poison Cost, Harvest Cost, Subsidies Cost, Other Cost, Percent Profit. |

The measures defined the information required by the users, which is comprised of total cost of farming such as seeds, plough, fertilizer, and poison. Other information is size area, yield, profit cost, subsidies cost, harvest cost, and percent profit. All these components are presented in DW modeling as shown in Figure 4.

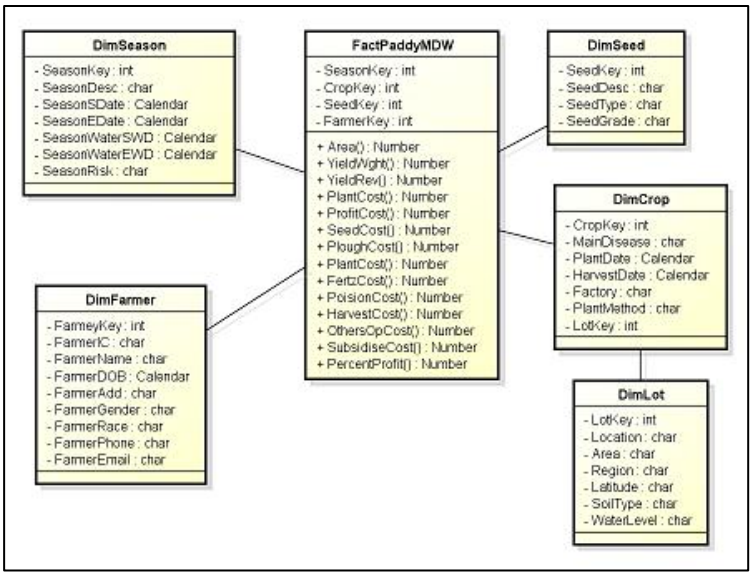


**Figure 4. Mobile DW Model for PMS**

**Mobile Server Architecture**

In mobile DW Application for PMS, the Microsoft .NET Framework is used as the server architecture of the development platform. The development of the PMS is using the Microsoft Visual Studio 2010 as the integrated development environment (IDE) for utilizing the advantages of the tools and the security offered by the Microsoft. Current .NET Framework 4.5 provides several new features to improve the environment of application development. One of the features used for PMS is the Microsoft ASP.NET MVC tools that support the development of mobile web application and mobile application. This feature is helping the development and implementation of the portable PMS. Three components of the MVC framework (i.e., Model, View and Controller) support the logic code for the application domain.

**Prototype for PMS**

The PMS prototype consists of six functions that are seed analysis, control analysis, harvest analysis, fertilizer schedule, scheduling info, and agency info stated in the use case. All of these functions developed based on the data stored in the DW for PMS. The prototype is developed using the Microsoft Visual Studio 2010 based on the Microsoft ASP.NET MVC framework and Microsoft .NET 4.5 Framework that connected to the DW system of Microsoft SQL Server 2008. This combination of software is the best combination from Microsoft for the best experience in developing portable PMS.

The interfaces are designed for mobile characteristics and all of the functions can be accessed by mobile devices and personal computer. It is important to make sure the user of the mobile devices can access, read and use the system smoothly. The system also can be accessed from the computer with the web browser interface. Examples of the interfaces designed for PMS is shown in Figure 5 and Figure 6. Figure 5 shows the main menu of the PMS, and Figure 6 shows one of the analysis functions provided by the prototype system that

is the seed analysis system. This function is for determining the suitability seed for the planting process of the paddy field. The attributes such as field size, water level, type of soil and decease are shown in the area. The entire attribute insert to the system or by collecting the information for the personal user information, the system will determine the suitable seed for the planting process.



**Figure 5. System Main Menu** **Figure 6. Seed Analysis Page**

## EVALUATION OF THE MOBILE DATA WAREHOUSE MODEL

The mobile DW model evaluation was done by using expert review technique. Two focus group sessions were conducted. The purposed of the session is to get feedback from the experts (nine experts) on the data warehouse mobile model and developed prototype. The sessions involved two rounds; the first was open discussion where they were asked eight of quality model dimensions that are visibility, complexity, compatibility, flexibility, clarity, effectiveness, manageability, and evolutionary of the model. The second round required the respondents to go through the model and the prototype of PMS. The respondents were asked to complete an instrument measuring eight dimensions indicates in the research. The result shows the proposed model generally has moderate strength of five dimensions and high strength in three dimensions that are visibility, clarity, and effectiveness. The strength of the model can be illustrated in Figure 7.

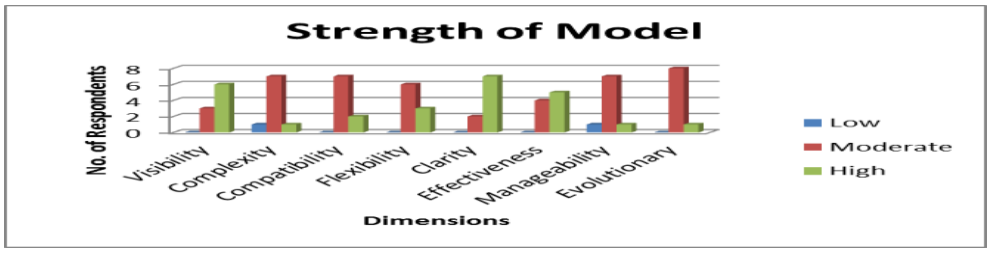


**Figure 7. Strength of Model**

## RELATED WORKS

Several methods and approaches have been suggested to develop and implement the mobile DW due to the emergence of mobile-based application. Most of the researchers were interested in the method to implement the DW system in mobile environments. However, few methods are proposed to model and design a portable-based application of DW system because the success of DW system is always depends on the success of the DW design process (Inmon, 1992; Kimball, 1996; Lujan-Mora, 2005; Rizzi, 2007). Existing methods were not focused on the design process, and neglected the important roles of mobile functionalities. Generally, the various methods and approaches used in the design and

implement mobile DW system focuses on the distribution and dissemination of information to the mobile users.

Oueslati and Akaichi (2010) has studied on mobile information collectors' trajectory DW to analyze complex phenomena. Gaspar et al. (2011) has designed and implement a client warehouse application over an enterprise resource planning system for mobile devices. They have proposed a client warehouse application over Microsoft Dynamics Navision for Enterprise Resource Planning system. Motskin et al. (2011) has proposed a strategy to distribute a set of well-placed nodes (warehouses) to act as intermediaries between the information sources and clusters of users Network Warehouses. This method was known as efficient information distribution to mobile users. As far as this research is concerned, none of the propose approach or model was merely suitable to be used for modeling and designing the portable PMS. Therefore, this research aims to ensure the propose DW model and architecture can be used to implement the portability PMS successfully.

## CONCLUSION

This research aims to cater the problem of the information sharing in Paddy Management by using portable PMS. The PMS was developed by using mobile and DW technology to facilitate the information sharing to the farmers. The farmers, managers and agencies of MADA, MARDI, JPS and other related agencies available using the mobile technology that can use the system anywhere and anytime. The system is planned to share the valuable information of the agriculture information specific to paddy management to be useful for the user to make their agricultural activity easy, direct and successful, regardless location and time. By using the system, it is encouraging the farmers, managers and agents in paddy agricultural activity and management to keep information sharing from the respectful agencies that provide information for the agriculture activity anywhere and anytime.

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