# AN INVESTIGATION USING RFID IN SMALL MEDIUM INDUSTRIES (SMI) IN SARAWAK (KEK LAPIS)

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# CHAPTER 1

# INTRODUCTION

## 1.1 Introducing RFID into Kek Lapis industry

Kek Lapis ( layered cake) Sarawak is a layered cake, traditionally served in Sarawak, Malaysia on special occasions. Sarawak layered cake is a signature product as a souvenir to visitors who come to Sarawak. Its unique taste and its colourful layered design feature have made purchasers willing to pay as high as RM120 for a 1kg piece.Various types of kek lapis are shown in Figure 1.1. The demand of Sarawak layered cake is high especially during the festive Hari Raya season, with sale revenues reaching RM40, 000 per producer.

This industry contributes almost RM3 million a year to entrepreneurs. The producers have exported their products to the Peninsular Malaysia, Singapore and Brunei as the demand is very encouraging in those places. The layered cake industry in Sarawak is centered almost entirely in Kuching in response to the One District One Industry Program. A total of 90 Sarawak layered cake entrepreneurs are recorded under the Bumiputera Entrepreneur Development Unit, Department of Sarawak Chief Minister in 2009.

Figure 1.1 : Various types of kek lapis

The Deputy Minister in the Department of Agriculture, Sarawak, has claimed that with the growth of the industry from a festive seasonal product to become a successful cottage industry, it thus has potentials as a tourism product for Sarawak.

Therefore, RFID is introduced to further improve the production of the entrepreneur.Radio Frequency Identification (RFID) is an auto-ID technology. One of the key differentiation of RFID is each RFID tag's identity is unique, and do not require a line of sight.

As compared to other auto-ID technologies like bar codes, optical character readers and some biometric technologies, such as retinal scans, often requires a person to manually scan a label or thumbprint in the case of biometric to capture the data. RFID is designed to enable reader to capture the data on tags and transmit it to a computer system without needing a person to be involved. This is good to reduce human error, and negligent.

RFID is also used to capture multiple tagged items or boxes at once. This is done by having an antenna to read the tags on boxes stacked on a pallet. In this scenario, a passive RFID tag will be used. A passive RFID tag does not has a battery, and obtain it power via induction from the radio waves send by the antenna. A passive RFID tag consists of a microchip that is attached to a radio antenna mounted on a substrate. The chip can store as much as 2 kilobytes of data.

Apart from a passive RFID tag, there are another two types of RFID tag, namely, an active RFID tag, and a semi-passive RFID tag. An active RFID tag has a battery, while a semi-passive RFID tag has a battery but when the battery is depleted, the semi-passive RFID tag become a passive RFID tag.

To retrieve the data stored on an RFID tag, a reader is required. A typical reader is a device that has one or more antennas that emit radio waves and receive signals back from the tag. The reader then passes the information in digital form to a computer system. The basic RFID system are shown in Figure1. 2.

Now, RFID technology has been used by thousands of companies for more than a decade. Smartag is specialized in providing versatile and robust RFID solutions in a variety of sectors from supply chain to healthcare.


Figure 1.2 Basic RFID system

## 1.2 Problem Statement

The development of the Sarawak Layered Cake Industry is affected by several factors, especially by the increasing trend of prices of its basic ingredients, the traditional non-productive method of production and the imperfect competition in the market structure. To ensure the growth of this industry there is a need for innovation.

According to the survey conducted by the Department of Sarawak Agriculture, the problem of inflation is increasingly affecting the price of basic ingredients of the cake such as flour, sugar, butter, margarine and eggs. A limited number of suppliers of the ingredients in the market have given the suppliers opportunities to administer higher prices.

However at the retail level, intense competition among sellers is forcing sellers to lower prices and thus affecting the profit margin. As compared to the last few years, the price of layered cake was relatively high as there were less competition in the retail level, but at present, each layered cakes could only be sold at RM 10 to RM 25 per piece. According to a producer who was interviewed informally, the profit margin for the layered cake was 70 to 100%, but now it has decreased to 35% due to the greater competition at the retail level but at increased production cost.

The Indonesian varieties of kek lapis are actually mass-produced using moulds, whereas Sarawak kek lapis are crafted painstakingly by hand, with tried-and-tested recipes. The industry has been hampered by the problem of use of inefficient ovens and inappropriate packaging. Some producers even reject the use of large capacity oven as they believed it was impractical and

expensive. Figure1.3 shows the general process of making kek lapis.

The survey conducted by the Department of Agriculture has found that only 2 producers are using large capacity oven equipped with temperature control and timers. Each oven is priced at RM 9,000 with the capacity of baking 27 cakes at a time and can be operated by 2 workers only. In comparison to the typical oven that is widely used at present that has a price range of RM250-RM600 per unit which bakes 6 cakes only at a time. Besides, each small oven requires a worker to operate and as the majority of the active producers in Kuching use 20 to 23 ovens each, thus each producer has to employ 20 to 23 workers. The oven also does not have timers and temperature control, thus causing high temperatures in the production area and putting the workers in discomfort.

In addition, as this industry is largely a home-operation industry (83% of the operators), producers are finding difficulties in getting recognition by the Hazard Analysis Critical Control Point or HACCP and HALAL standardizing authorities.

The industry needs to be innovative in order to grow. As every business faces global market competition with changing marketing strategies, quality assurance requirement, changes in franchising structure, consistency in production and guaranteed hygiene practices must be adhered to. Innovation in the industry requires that producers have certain criteria as inducers. The criteria may be related to behavioral and social as well as marketing elements.

As the industry is facing increasing production cost and changes in the market structure, without innovative changes, not only the market demand but also the supply of Sarawak layered cakes will be affected. The industry may not be able to move into the global market if it could not meet consumers' tastes and international standards.

Hence, stated below are the problems encountered by the company :-

- Limited type of kek lapis to be export due to product shelf life. To ensure the food safety, kek lapis need to be monitor in a specific temperature processing, storage and transport.
- Obstacle for HALAL Certification. Thus, a management system will be introduced to overcome the issue.

- Identify market demand and reduce waste. RFID tag system will be introduced to ensure accurate market demand and the source reduction product.

Figure 1.3 : General process of kek lapis

### 1.3 Objective of Study

The objectives of the study are:

- To have variety types of cake lapis available for export
- To comply and maintain Halal certification
- To quickly determine market demand and the source reduction product

Outcome of the case study, is crucially important to ensure the company competitiveness in the market. Perhaps, it will highlights ways to enhance the company needs to growth and survive. The RFID technology which is exactly for value improvement and also a helpful management tools can provide consumers with comfort by its highly- value added products or services, and it can also contribute to the society for making good use of industrial resources.

Through multiple case summaries, Angeles (2005) also illustrates the potential benefits derived from RFID technology adoption in a supply chain context, such as the reliability of the information on the movements of the physical goods, the better tracking of products in manufacturing processes, the automation of manual processes and the reduction in human-based errors, etc.

### 1.4 Research Scope

The research (case study) was done at DiWannie Kek Lapis Sdn Bhd; a company in Sarawak which is listed under Small and Medium Industries Development Corporation (SMIDEC, 2011).

a) The research is carried out to identify ways to improve the manufacturing practices covering the following aspects namely product technology and innovation, production process, management, quality and customer focus by using RFID tracking system.
b) The current study does not cover interface software development.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

Malaysia adopted a common definition of SMEs to facilitate identification of SMEs in the various sectors and subsectors. This has facilitated the Government to formulate effective development policies, support programs as well as provision of technical and financial assistance.

An enterprise is considered an SME in each of the respective sectors based on the Annual Sales Turnover or Number of Full-Time Employees. Small enterprises is classified by the annual sales turnover ranging from RM250,000 (USD83,300) to less than RM10 mil (USD3.3 mil) or having full time employees from 5 to less than 50. For the medium enterprises, the annual sales turnover ranging from RM10 mil (USD3.3 mil) to less than RM25 mil (USD8.3 mil) or having full time employees between 51 and 150.

## 2.2 Background of DiWannie Kek Lapis Sdn Bhd

Interview has been conducted with the owner of DiWannie Kek Lapis Sdn Bhd. The owner, Zoraidah Leen had started the business since 1985, with RM50’000 as her initial capital. Currently, they are hiring 7 permanent staff and from time to time taking up partime workers to accommodate the demands.The main branch of DeWannie is located at No.345 Lorong Satok 9, Jalan Satok and another kiosk located at Waterfront Kuching.

They have all together 60 types of kek lapis to be offered to the customer. During the festive season, for example Hari

Raya Aidilfitri , Chinese New Year, Gawai Dayak and Christmas ;the income of DeWannie can achieve up to RM200’000 per month.

## 2.3 LITERATURE REVIEW

RFID has been identified as one of the ten greatest contributory technologies of the 21st century. RFID technology features remote distance reading ability, larger memory capacities and reading range, and faster processing than bar codes, and identification of objects or human beings.

An RFID tag consists of a microchip and an antenna. The RFID reader/writer requests the identifying information contained in the microchip by sending an RF signal to the tag, which then wirelessly transmits the information to a reader/ writer. The reader then digitizes the information and sends it to the application software with the help of middleware. The encoder, often the RFID reader/writer itself, encodes the data for storage in the tag once or many times, depending upon whether the RFID tag is a read-only tag or a read-write tag.

Due to its many advantages, RFID has been applied in many areas, such as supply chain management, telemedicine, manufacturing, inventory control, construction industry, warehouse management, and digital learning. E.W.T. Ngai (2008) Developed an RFID-based sushi management system. The case of a conveyor-belt sushi restaurant to enhance operational efficiency and designed to help a conveyor-belt sushi restaurant to achieve better inventory control, responsive replenishment, and food safety control, as well as to improve its quality of service.

From this study, the benefit of RFID are ;-

- Keeping the stock records of the raw materials for making sushi electronically,
- Tracking the real-time consumption and availability of sushi on the belt,
- Enabling responsive replenishment,
- Removing the expired sushi from the belt automatically to strengthen food safety control,
- Simplifying the billing procedure and improving its accuracy, and also;
- Providing more transparent sushi information to diners like prices, availability, and calorie content.

T.-H. Tan, C.-S. Chang (2010) developed and evaluated an RFID-based e-restaurant system for customer-centric service. From their study, they found the benefits of RFID in three aspects; namely

- technological perspective, -proven technology adopted in food industry and responsive multiple tag real-time read/write capabilities
- managerial perspective – enabling responsive replenishment and improving efficiency and accuracy of billing process
- application perspective – providing inventory level report to manager , providing replenishment order information for suppliers and providing real-time ordering information to cooks.

These proofs that execution of RFID based e-restaurant replacing the traditional restaurant service is a success. For that reason, RFID based management system will be introduce to identify market demand and reduce waste. Kumar and Budin (2006) indicated that the US Food and Drug Administration

reported a total of 1307 processed food product recalls between 1999 and 2003. In Japan, a massive recall was also reported from two Japanese food makers in 2002(Jiji Press, 2003). Demand for higher food hygiene and safety is becoming a growing concern (Kerryet al., 2006).It is verified that RFID technology has already been adopted for use in the food supply chain and to improve the traceability of food (Hutter, 2004). In food supply chain management, a food operator can use RFID technology to record and provide information on all stages from supplier, transportation, and production, to storage and distribution of an individual food item. Food traceability refers to the ability to trace and follow a food, feed, food-producing animal, or ingredients, throughout the production and distribution process (Regattieri et al., 2007).

(A. Sarac et al., 2010) analysed that, the main advantages of RFID technologies in supply chains are:

- Improvement of traceability and visibility of products and processes,
- Increase of efficiency and speed of processes,
- Improvement on information accuracy,
- Reduction of inventory losses, and
- Facilitation of management through real-time information.

In 2003, Wal-Mart, a leading US retailer, implemented an RFID system for tracking supplies (Tajima, 2007). Wal-Mart and other companies anticipate significant benefits in their own supply chains and believe that, in long term, RFID can also benefit their suppliers. The potential benefits of utilizing RFID technology for suppliers include reduction of operations

costs, optimization of inventory management and increased information accuracy (Chuang & Shaw, 2007), and improvement of customer relationship (Lin, Lo, & Chiang, 2006). Xiao, Shen, Sun, and Cai (2006) proposed two RFID applications in telemedicine to investigate supply and demand of doctors, nurses and patients in hospitals and healthcare and to develop mobile telemedicine services. They also performed a comprehensive survey of security and privacy issues in RFID systems and suggested their solutions. (S.I. Lao et al., 2012)

A real-time food safety management system for receiving operations in distribution centers are identify for major improvement :-

- Improvement in operation management,
- Improvement in timeframe for resource assignment, and
- Improvement in customer satisfaction and quality.

Bal (2007) deployed an RFID system on a college campus to guide visually impaired pedestrians. In this implementation, all campus walkways were embedded with electronic tags connected to a Path Finder application Server. Current user location could be identified by RFID tags, and the RFID tag reader actively provided voice information of the location to guide the user.

Liu (2007) applied RFID technology to resolve two manufacturing logistics problems arising in IC packaging houses: manual operational errors in the wafer receiving process and incapability electronic transaction process for inventory control. Also, this study developed an electronic material flow control system by employing RFID technology, a RosettaNet network and ERP system. Then the electronic material flow control system was implemented in a local IC packaging company. The experimental results revealed substantial benefits, including reduced operator workload,

increased productivity and increased accuracy and speed of information processing.

Domdouzis, Kumar, and Anumba (2007) briefly introduced applications of RFID technology for the uninitiated reader without going into the technical and mathematical details. In their study, RFID is used successfully for the tracking of pipe spools, structural steel members and as an on-site support system. Chow, Choy, Lee, and Lau (2006) proposed an RFID based resource management system (RFID-RMS) that integrated the RFID, case based reasoning and the programming model technologies to help users to select the most suitable resource usage packages for dealing with warehouse operation orders. The practical application of RFID-RMS in a company revealed that the utilization of warehouse resources is expected to be maximized while working efficiency will be significantly improved.

Furthermore, RFID technology was recently adopted in *Poon et al.* (2009) to facilitate the collection and sharing of data in a warehouse. In this study, comprehensive tests were performed to evaluate the reading performance of both the active and passive RFID modules. The efficient radio frequency cover ranges of the readers are then examined based on the testing results for formulating a radio frequency identification case-based logistics resource management system (R-LRMS). A successful case example achieved in a company demonstrated the feasibility of R-LRMS in real working practice. Tan, Liu, and Chang (2007) developed a ubiquitous learning environment with educational resources (EULER) based on RFID, the Internet, ubiquitous computing, embedded systems and database technologies to enhance teaching in outdoor environments and to cultivate student ability to use information technologies for assisting learning.

The experimental results showed that RFID sensor technology was effective in providing context- aware and ubiquitous learning experiences.

*J.-P. Qian et al.* (2012) analyzed the wheat flour supply chain flow in China, including grading, purifying, grinding, packaging and logistics. Labels with a QR Code were used to identify small wheat flour packages, and RFID tags were used to identify wheat flour bins and record logistics information automatically. J. Song et al. (2006) Automating the task of tracking the delivery and receipt of fabricated pipe spools in industrial projects. Potential benefits from the use of RFID technology in automated pipe spool tracking may include:-

- reduced time in identifying and locating pipe spools upon receipt and prior to shipping,
- more accurate and timely information on shipping, receiving, and inventory,
- reduced misplaced pipes and search time, and increased reliability of pipefitting schedule.

Karkkainen (2003) indicated that adopting RFID technology can improve replenishment productivity as well as reduce stock loss in the supply chain of short-shelf-life products. Jones, Clarke-Hill, and Hillier (2005) reported that RFID technology can be used throughout the supply chain for the UK retail foods industry, including tighter management and control of the supply chain, reduced shrinkage, reduced labour costs, improved customer service and improved compliance with traceability protocols and food safety regulations.

Chen, Yeh, and Kuo (2008) proposed an integrated traceability system for the entire food supply chain by RFID technology. In their study, the food production can be traced so that consumers can get the complete food production

information to choose and buy the most safety food. Kumar and Budin (2006) also concluded that RFID plays a crucial role in the prevention of food product recalls. Recently, Chao, Yang, and Jen (2007) analyzed the contributions of the RFID industry and forecasted technological trends via a historical review and bibliometric analysis.

Their review indicated that the major emerging issues of RFID are supply chain management, health industry applications and privacy issues. This study also demonstrated that the contribution of various enterprises to the adoption of RFID can be divided into four categories according to managerial perspective and enterprise opportunities:

- identifying objects and persons,
- tracking process flow,
- authentication, authorization and security and
- financial record keeping.

Most importantly, Chao et al. (2007) predicted the global diffusion and integration of RFID into daily life in the near future. Many organizations devote considerable resources and knowledge to reconfigure and create innovative new structures in order to conquer the issues in mobile commerce such as user security and privacy, low-quality wireless connectivity and limited screen size of hand-held device (Li, 2005), improve the cost-effective of operations (Edwards, Delbridge, & Munday, 2005) and gain economic benefits (Szántó, 2005).

While RFID has successfully been employed in many areas, further exploration of its innovative applications is needed to enhance competitive advantage of enterprises and quality of life. For example, innovative applications of RFID are still rare in the restaurant industry. Recently, Ngai, Suk, and Lo (2008) developed an RFID-based sushi management

system in a conveyor-belt sushi restaurant to enhance competitive advantage.

Their case study showed that RFID technology can help improve food safety, inventory control, service quality, operational efficiency and data visibility in sushi restaurants. As competition between restaurants intensifies, restaurants must integrate innovative technologies with business management processes to enhance customer service and improve competitiveness (Kumar,Karunamoorthy, Roth, & Mirnalinee, 2005). This situation motivated the development of this RFID-based e-restaurant system with customer-centric service to enhance customer satisfaction and perceived value (Lee, Fiedler, & Smith, 2008). Consequently, application of RFID is significantly fit to solve the problems encountered by the kek lapis company.

# CHAPTER 3

# RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter explains and illustrates the steps and procedures used in this research to generate the case study results and achieve the research objectives. This steps and procedures conducted are called as research methodology.

## 3.2 Research structure

The main objective of this research is to do case study in the manufacturing company in order to get continuously cost reduction . The company by the name of , DiWannie Kek Lapis Sdn Bhd is the sample of the research . This research can assists to suggest to the company the approach to achieve their objective of cost reduction for their product . Also, to understand the problems faced to further improve the manufacturing product quality. The overall research structure of this research consists of five main areas namely :-

1. Identify the research topic and research scope;
2. Preliminary study and literature review of journal and conference papers;
3. Case study
4. Analyze results: Target result against the actual result
5. Conclusion and suggestions for improvements.

## 3.3 Research Methodology

In the research methodology, identifying research topic is done, preliminary study and
literature review and the most important to be learned is the operation and management theory that can be adapted by the company.

### 3.3.1 Identify Research Topic

The challenges of the globalisation had increased the pressure on industries to
improve their products for commercialisation, in terms of quality, cost and delivery.
An organised process control could be used to maintain and improve the products and services to customers. Effective approaches which will contribute to cost reduction for the company is the main concern without affecting the quality of the product. The selected manufacturing company is listed in SMIDEC and located in the state of Sarawak.

### 3.3.2 Preliminary study and literature review

In early stage of the research, the author had explored and gained knowledge about the research topic which is related to the company profile , product of the company ,the process and factors affecting extrusion and etc.

A brief literature review had explain about RFID, the construction and the factors related to the process . Then, the author had reviewed the acceptance sampling application in the manufacturing industry, implementation process and its effectiveness. As a result, benefits and the difficulties during investigation and implementation process will be presented. In this research, DiWannie Kek Lapis Sdn Bhd is selected.

With this literature review, the author will be able to emphasize the importance of innovation awareness in the manufacturing industry. Thus, it could help to better understand the importance of quality and improves the manufacturing process as competitive advantage for the companies.

## 3.4 RFID-based *Kek Lapis* Management System (RFKM)

### 3.4.1 RFKM to quickly determine market demand and the source reduction product

How can we quickly know the customer's favorites and timely deliver it? Also, can we be more efficient by reducing the materials that goes to waste? The application of RFID-based *Kek Lapis* Management System (RFKM) could overcome this problem.

For DiWannie shop, it is difficult to always prepare the right number of order according to the customers' tastes, the season, the weekday and special orders. It requires years of analysis on the side of the head chef.

In the system invented, RFKM tags are placed on each package of cakes, which allows it to track each individual cakes. Data is collected by a terminal unit in each chain store and sent to a shared server in the data center. The supply manager in the headquarters can download and browse the data.

The connection between the data center, headquarters and each chain store is done over a VPN, and a VPN software is to be selected.

With the system, the no of sales per cakes in each store can be checked from the headquarters. Headquaters can also direct store managers, and remotely administer the PC systems.

By attaching an RFID tag to the packages of the cakes, each one can be tracked individually. The system can notice changing customers and their tastes, and adjust which items make their way on the shelf line. This improves customer satisfaction and reduces the amount that is thrown away. The investment for the system is balanced by an increase in customer satisfaction, which in turn boosts sales.

**RFKM Process Flow Chart**

- Step 1: Item to be equipped with RFID Tag
- Step 2: Chef prepare the food and send to shop floor
- Step 3: RFID Reader would detect the product and set a new timer for the item
- Step 4: The item timing would be monitored by the RFID readers
- Step 5: Once the item has reached its expiry time, it would alert the chef and automatically be removed from the shop floor .

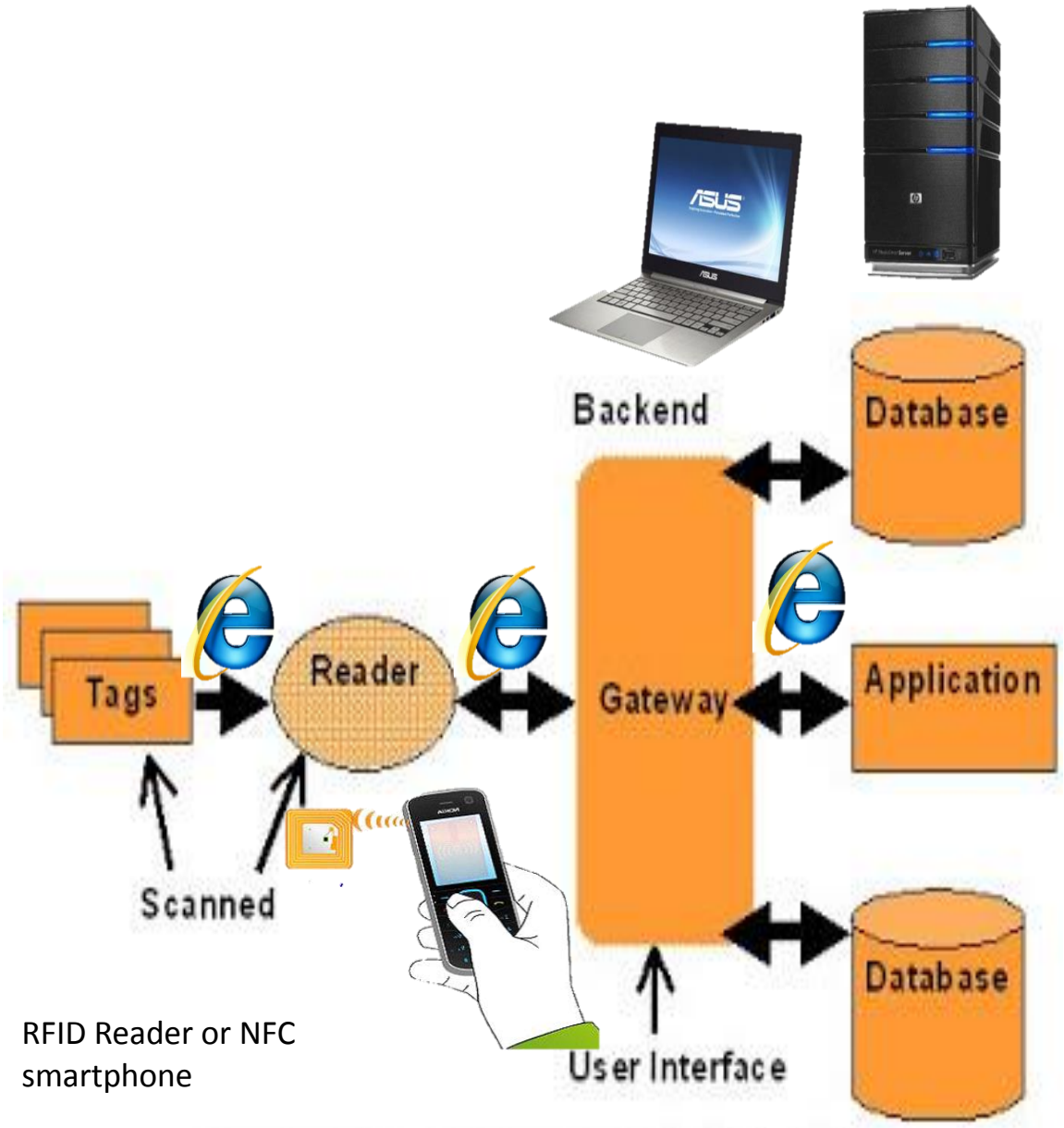


Figure 3.2 : General overview of RFID Architecture

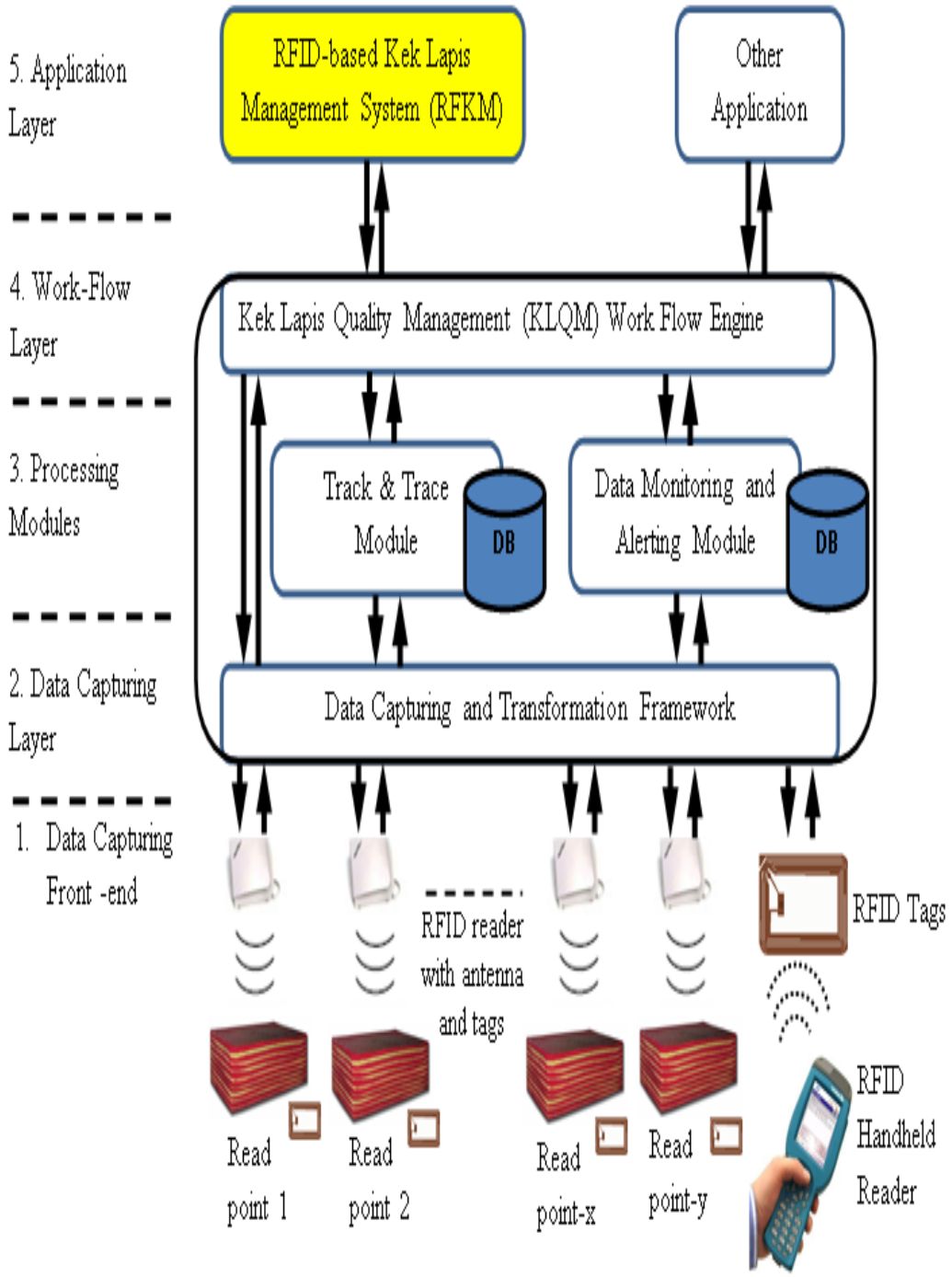


Figure 3.3 : Architecture of the RFKM system

### 3.5 RFKM to comply and maintain Halal certification

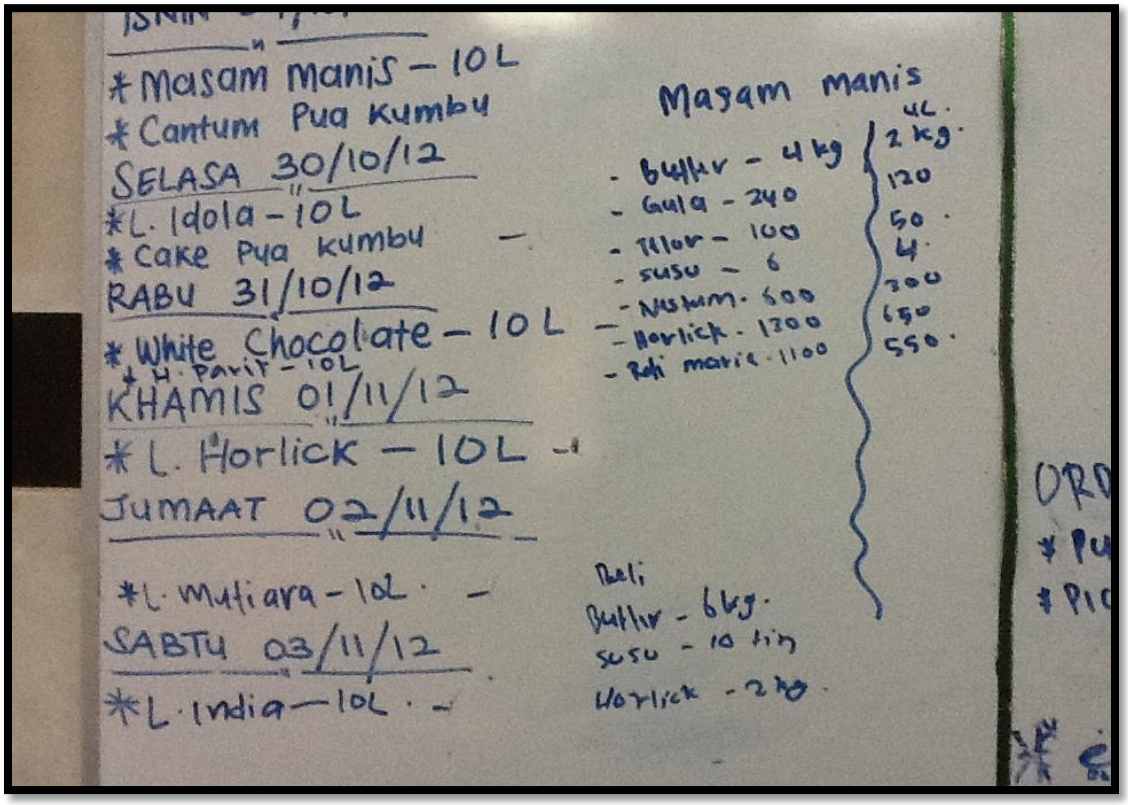


Figure 3.4: Current stock keeping system used in DiWannie Kek Lapis Sdn.Bhd

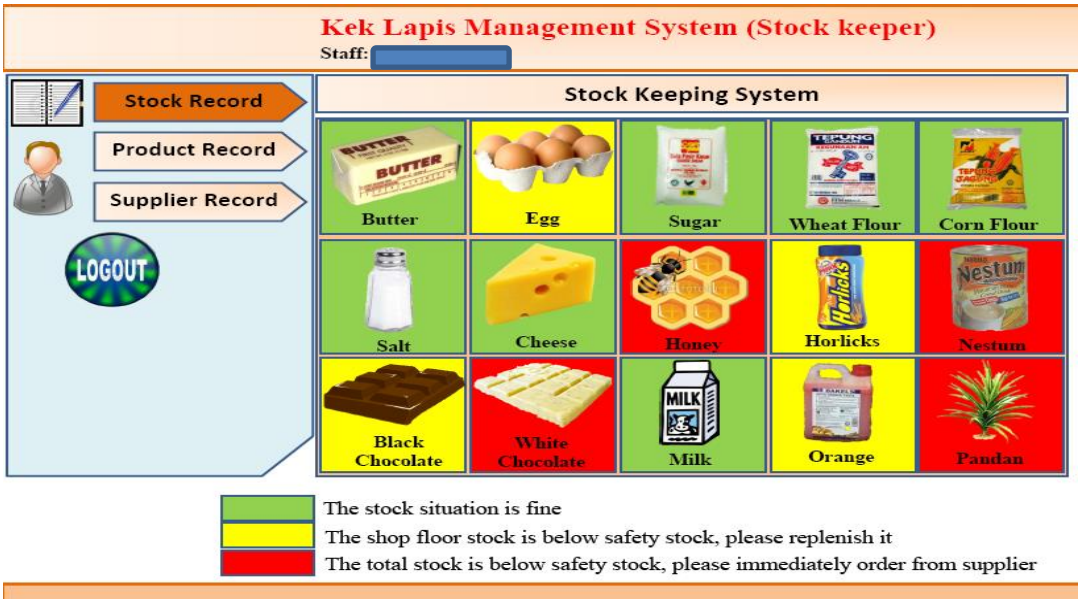


Figure 3.5 : Stock record using Kek Lapis Management System

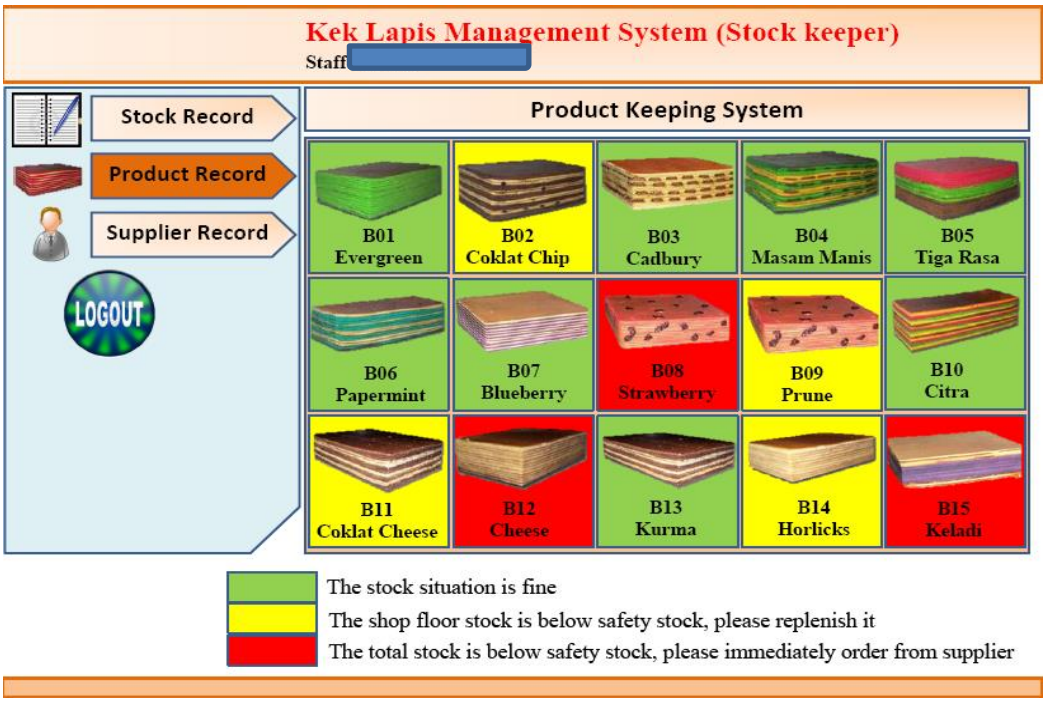


Figure 3.6 : Product record using Kek Lapis Management System

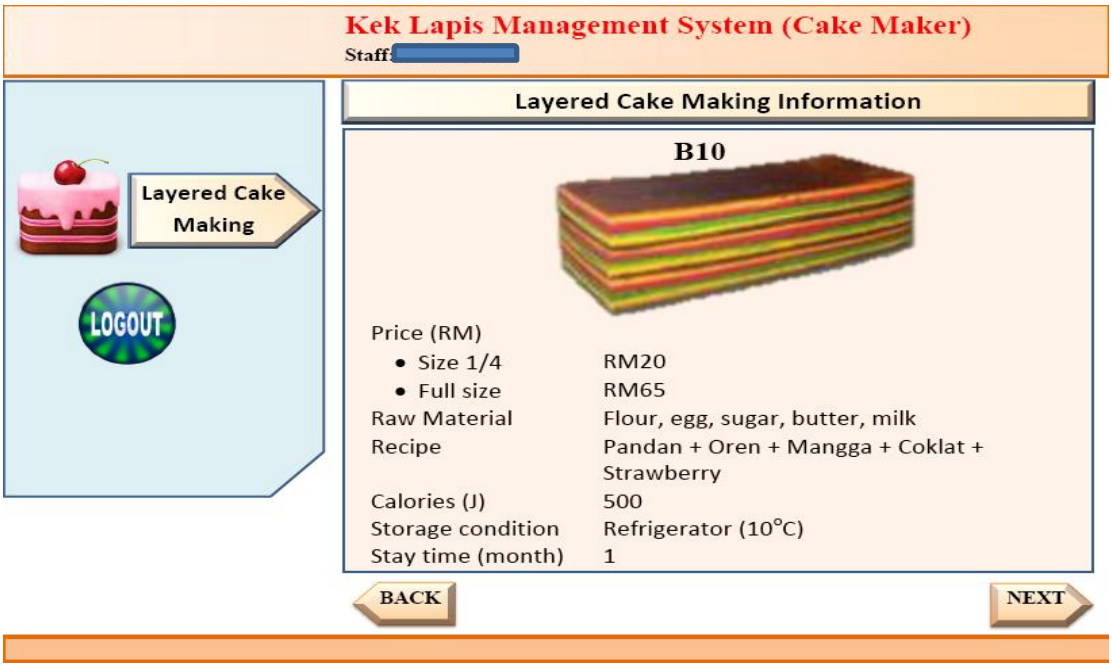


Figure 3.7 : Product information using Kek Lapis Management System

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