

The Challenges and Opportunities for Statisticians in RFID-Sensed Big Data

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Abstract

The use of RFID (Radio Frequency Identification) has increased dramatically in most areas in South Korea. As a statistician and an industrial engineer in the data-related field, we need to play a main role for analyzing the RFID data-driven marketing strategies. In this study, we present how RFID is adapted in Korean Supply Chain Management (SCM) industries, especially pharmaceutical companies and how the statisticians can contribute to the big data society by illustrating the difficulties and the future of statistical analytics in Korean pharmaceutical industry.

Key Words: Big Data, RFID, Supply Chain Management

1. RFID and Barcode

A barcode is an optical machine-readable representation of data relating to the object to which it is attached (Wikipedia, 2013). It represents data by varying the width and spacing of lines in one or two dimensional barcode. The very first barcode was introduced on a pack of Wrigley's chewing gum in 1974 (Fox, 2011). In spite of its convenience and utilities in the industry, a barcode system has many drawbacks: (1) barcode scanners should be used in a proper direction and distance. (2) barcodes are easily damaged by dirt or paints. (3) barcodes cannot have an item-level information due to the limited memory capacity.

Recently, Radio Frequency Identification (RFID) has become a good alternative to a barcode system. It contains at most 65Kb while a barcode has at most 100 bytes. Also, multiple RFID's can be read simultaneously without direct contact, while a barcode is read one at a time. More interestingly, RFID can be updated, which is impossible for a barcode system. The detailed comparison is illustrated on table 1.

Table 1: RFID vs. Barcode

Features	RFID	Barcode
Recognition Method	Not direct scanning	Direct scanning
Recognition Distance	Up to 27m	Less than 50 cm
Recognition Speed	0.01-0.1sec.	2-4 sec.
Data Storage	Up to 65 KB	Up to 100B
When dirty	Can be read	Cannot be read
Item-level tagging	Possible	Impossible
Tab Price	Expensive	Cheap
Scanning Quantity	Multiple	One

In South Korea, RFID has been widely used to verify its authenticity of meat products in groceries, liquors, apparels or pharmaceutical products. Also, auto industry has adopted RFID and RFID transportation cards are being used almost everywhere in South Korea. In

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the last decade, RFID sale increased rapidly, about 30 percents annually. It is noteworthy that Korean Ministry of Knowledge Economy has an important role not only to promote and evangelize RFID system but also to fund the related researches and development projects. In 2012, Korean Food and Drug Administration legislate to attach 2D barcode or RFID for appointed medicine and medical supply.

2. RFID in Supply Chain Management and Big Data

The use of RFID in Supply Chain Management (SCM) is well known for its benefits and advantages over other system such as a barcode system from manufacturers to wholesalers and retailers. Due to its efficiency and capabilities as shown on table 1, RFID is expected to provide its competitiveness to outbound process, inventory process and inbound process.

Especially RFID could contribute to E-pedigree area. E-pedigree is an electronic document which provides data on the history of a particular product (Wikipedia, 2013). As RFID can be updated, the relevant storage information or conditions are stored in RFID, so anybody can guard against the potential danger due to its improper treatment or handing.

Big data is not just a large size data. It not only means the variety of data type such as text, web-log, video streaming, or sensed data such as RFID, but also high velocity because it requires a real time analysis upon gathering data collection and monitoring.

RIFD/Ubiquitous Sensor Network (USN) data consists of header, filter, item reference, and serial number in compliance with Electronic Product Code (EPC) regulations, which could include tracking and shipping unit, brand name, product information and item-level serial number. All these informations are stored in hexadecimal code, and decoded in binary and URI (Uniform Resource Identifier) code if needed. In Korea, every drug should have item-level serial number from year 2015, so RFID sensed data is going to be saved in every minute, which would inevitably produce the enormous amount of data by RFID sensing. In pharmaceutical industry, RFID tag is sensed each process (inbound, inventory, or outbound), and the data need to be monitored for the proper management. For example, the drug or medical supplies should be kept in appropriate conditions and its expiration data control should be properly managed. With a help of RFID, we can do First-Expired-First-Out (FEFO) process. It is also noted that RFID is a sensed data, which is a kind of unstructured data, not to mention text information such as customer complaints or E-pedigree informations.

3. Opportunities in RFID Sensed Data

One of the promising areas for pharmaceutical industry that RFID sensed data could contribute in future is the expiration date management system. The expiration date of pharmaceuticals specifies the date the manufacturer guarantees the full efficacy and safety of drugs. The Figure 1 displays the remaining shelf life for sea bass products with or without the expiration date management. Compared to without expiration date management, the shelf life distribution with expiration date management has a smaller variance, which means the store keeps the products as same quality as possible. As known, the same efficacy is very important for pharmaceuticals. RFID sensed data can provide more effective expiration date management system especially when it is combined with a smart shelf system which has a built-in RFID reader so as to monitor every item automatically for inbound, inventory, or outbound process not to mention to identify misplaced items.

Another opportunities for statisticians to contribute to RFID sensed data lies in finding insurance frauds and abuses if flanked with patients' symptoms. For example, over treatments are detected by analyzing symptom-prescription data. In addition, if a patient's

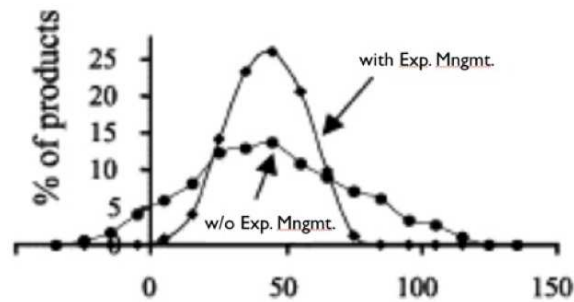


Figure 1: The Remaining Shelf Life Distribution of Fishery Products with and without Expiration Date Management (Koutsoumanis *et. el.* , 2002)

genome informations and feedbacks for the prescribed drugs are provided, the big-data analytics could provide a personalized prescription such as customized drug dosage.

As an analytics expert, real-time monitoring based on RFID sensed data in drug sales in different regions by seasons is very important for future marketing strategies and human resources management. The analysts would find out regional preferences and current possibility of outbreaks for a certain disease.

4. Challenges in RFID Sensed Data

Big data via RFID can give benefits not only to manufacturers and wholesalers, but also to retailers and customers. In order to settle down RFID system in an industry, we have to live in a healthy ecosystem, where companies gain the profits from the data which customers provide and simultaneously customers can receive a better treatment or service from the company. Big data generated by billions of computers, processors and sensors promises to take this relationship to the next level: mass personalization. It uses the mountains of data now being produced by each day and uses it to continuously and uniquely modify products and services to every customer (Peters, 2012).

For better results from RFID adoption, we recommend industries to build a new team within a company which is independent of their present Business Analytics (BA), Information Technology (IT), or Business Intelligence (BI) teams. The newly created team should have the experts dispatched from each team, but it should work independently when doing RFID big data analytics. This team should be positioned right under the C.E.O's (or C.I.O's) supervision.

Lastly, before installing RFID system, we have to consider the following in advance:

- Determine to use active tags or passive tags: Active tags are more powerful and efficient, but cost more than passive tags. We need to consider the required read range, whether is is read in a liquid medium or not, and the desired longevity of the tags.
- Keep in mind that an RFID system can generate a lot of data : There has to be a strategy as to how long the data should be kept in the data base and what happens to it after the expiration.
- Consider the security and privacy of the RFID system: Since the data saved in different locations by different users, the customer information involved in RFID data need to be carefully treated without any abuse or privacy-threatening mistakes.

- Investigating the hazards resulting from electromagnetic radiation, which ranges from human health to ignition of combustible substances such as fuel.

5. Conclusion

The paper gives an overview of RFID and its usage in South Korea as well as the benefits of RFID sensed big data. Even though numerous restrictions and unsolved issues still hinder the widespread application of RFID, RFID is inevitably going to be used in most areas. Moreover, the advanced technologies are under way to overcome the present limitations combined with the government support in South Korea.

Especially in pharmaceutical industry, RFID or 2D barcode should be attached to each product item with item-level serial number, which is mandatory under the new regulation. RFID big data could provide an efficient method to expiration date management strategy and future customer relationship management (CRM) strategies. As a statistician or an analytic engineer in statistics related field, we can see a lots of opportunities and challenges in pharmaceutical industry.

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