Using RFID for SMEs:

an Australian Case

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I. WHAT IS RFID?

Radio frequency identification (RFID) is a name for a set of automation technologies that allow relatively large amounts of data to be associated with objects by attaching a tag to them. These tags usually contain a small integrated circuit (or silicon chip) which is electrically connected to an antenna. The tags can be 'read' automatically via fixed or mobile readers, sometimes called 'interrogators', or via handheld manual scanners.

Just as light is used to illuminate a barcode, and reflected light is processed in a barcode scanner to read the barcode, an RFID tag is read by a reader transmitting a radio frequency (RF) field, and the tag reflecting a response back to a receiver in the reader. However, unlike a barcode, RFID operation does not need a line of sight, and tags can be read through some materials. The data read or 'captured' from the tags are then processed by software and can provide real time information about the tagged items. This information can be analyzed or instantly shared online within an organization or between different organizations.

This information potentially has a large range of business uses, including the tracking of inventory, provision of information about products to customers

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and suppliers, and the automation of supply chains.

For this reason, RFID has become one of the most talked about business technologies in the market today. But like any technology, it is important to measure carefully the big expectations against its real benefits to business.This paper aims at analyzing the real benefits of RFID.

Ⅱ. RFID TECHNOLOGY

The fundamentals of RFID technology itself have been around for many decades. RFID can trace its origins back to radio transponders used to distinguish allied and enemy aircraft via radar during the Second World War. RFID has been used for civilian and business purposes since the 1980s in various forms, including scannable security ID cards, central-locking car keys, library collection management systems, and automated road toll collection.

It is only recently with RFID standardization by standards bodies such as EPCglobal[1] and the drastic falls in the price of tags that it has been possible to consider the large range of RFID business applications now becoming available in the marketplace. One of RFID's main usesin automating the tracking of inventorycan partly be seen as an evolution of 1980s barcode technology. Barcodes have been used for many years to automate elements of inventory and logistics management across supply chains. However, RFID tags can, in certain contexts, have a number of advantages over barcodes. Some of these advantages are as follows[2]:

- an RFID tag can potentially carry, or be used to access, far more detailed information about the unique object it's attached to, including specific information about individual items, rather than just generic information about a whole product line;
- RFID tags can be scanned or read without the need for a 'line of sight',
- RFID tags can in some cases be 'written', or associated with, new or updated information many times, as opposed to barcodes, which are static once they are printed;
- RFID tags can be interfaced with systems that collect and store information (such as temperature) via sensors, and then be commanded to transmit that stored information to a host computer or database.

In a barcode inventory system, individual items in the same product line will generally carry identical or generic identifier information. For example, every identical can of soft drink will carry an identical barcode, which identifies the product line, rather than the individual item. However, RFID tags can identify individual products down to the single instance level and can distinguish them from other, seemingly identical products in the same line. This can be useful for deriving specific information: for example, use-by dates; the exact origin of goods; environmental factors that may

have affected goods before reaching the shelves; and quality assurance data.

Ⅲ. PASSIVE, SEMI-ACTIVE AND ACTIVE RFID

RFID tags can be broadly grouped into three systems: 'passive', 'semi-active' and 'active' tag systems.

Passive tags derive the energy to power up the micro-circuit from the interrogating RF field, and then use the same RF field to send back information, including the unique identity of the item. The information is sent back by reflecting the RF energy back to the interrogator. This is achieved by the micro-circuit altering the antenna load, according to the information it wants to send back. The technical name for this process is 'modulated back-scatter'.

An active tag has a small battery attached, and can transmit information under its own power to a reading device. A semi-active tag also has a small power source that is used to power up the micro-circuit, but its communication from the tag to the interrogator is via modulated back-scatter techniques, like a passive tag. Active tags are oftenreadable over much greater distances than passive or semi-active tags. An active tag may be read from up to 100 metersaway in some cases, while a passive tag may only be readable from as little as a few centimeters to a few meters away.

Active and semi-active tags can also employ in-built sensors to record information (such as temperature) even when the tag is not situated in an RF field. These tags are ordinarily more expensive, and are generally designed and deployed for more specialized purposes, such as tracking high value goods or large lots of goods. Passive tags are more suitable for relatively simple, high volume tracking and information retrieval. Tags can themselves carry information about the goods or objects they are attached to, or can carry aunique identifier, which is used to access information about the specific items by querying a database. As noted, more advanced or high-end RFID systems can be interfaced with sensor networks, which can actively capture and record information about their surroundings. Such information might include:

- the temperature;
- the composition of the atmosphere;
- exposure to chemicals; and
- quantities and measurements of materials.

This information can be used to aid business processes such as quality assurance in manufacturing, climate control in horticulture, and the management of storage conditions for hazardous materials. For example, such a system could be programmed to sound an alarm if the temperature moves above or below an acceptable range, or to automatically generate report documentation proving that goods have been kept at required temperatures. Sensor networks are largely still either in the research and development phase,

or deployed in very specialized contexts. However, this technology will inevitably become more versatile and affordable in the coming years.

Ⅳ. TECHNICAL STANDARDS

To the extent that RFID is a business technology designed to improve communication and visibility, it relies on the development of technical standards to ensure that systems interoperate. RFID systems operate in many different formats and for many different purposes, but sources indicate that a global standard for use of RFID in inventory control and supplychain contexts is emerging in the form of 'EPCglobal'.[3] The goals of the EPCglobal standard, as applied to supply chain logistics are to allow:

- suppliers to track shipments from the warehouse to the store;
- manufacturers to collaborate with retailers to ensure products are always in-stock; and
- inventory control to become a highly efficient business practice.

EPCglobal has expanded the EPC concept to other applications and fields, such as health care and life sciences, and transport and logistics. EPCglobal is also in the process of engaging with other industry sectors, such as apparel and footwear, the automotive industry, aerospace and defence, food and beverage production, oil and gas production, the chemical industry, and the electronics industry. Major buyers in key supply chains are adopting EPCglobal, including Wal-Mart, Tesco, Target and the Department of Defense in the United States. Major retailers in Australia have also been engaged in trials. These buyers are in turn influencing their suppliers to adopt EPCglobal standards to realizeefficiencies across their supply chains.[4]

Ⅴ. A TYPICAL RFID INVENTORY MANAGEMENT SETUP

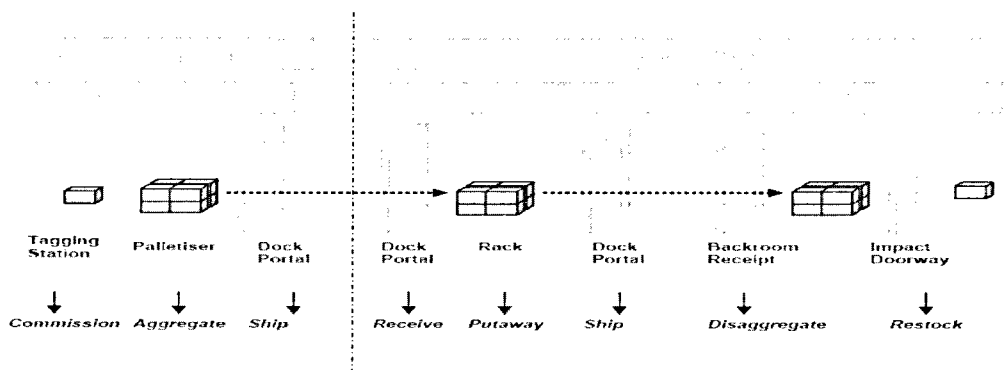
A typical RFID inventory management setup would begin at the point of manufacture with RFID tags being attached to individual products or packages of products. The tagged products are transferred to the manufacturer's warehouse, ready for delivery to a buyer. The products would be tracked in the warehouse by the RFID system, which would have automatic scanners in critical areas. The location of products in the warehouse could be called up at any time by reading location information based on the most recent automatic read of the tags. For example, if the products have passed through a scanner installed on the door of a freezer, the warehouse manager is able to call up information about whether, and when, exact items have moved in or out of the freezer.

Other value-added information like a use-by date, storage environment requirements, or a depreciation curve

could also be collected from the tags themselves or by querying the database via the tag's unique identifier. Assuming the data are synchronized and interoperable with the manufacturer's business partners, these data could be shared in real time across the supply chain. The production of a good on an assembly line could result in a signal to a supplier of components to the manufacturer that more components are needed. It could also signal to a buyer that a replacement product is available. With RFID, this can be done with minimal errors and in considerable detail about specific events and conditions.

A continuous flow of real-time data coming in from the supplier and the buyer is also utilizedby the manufacturer to plan and coordinate production activities. As the products are moved to the loading dock for delivery to the distribution centre and ultimately the buyer, the tags are automatically read again to update status, location, destination and so on.[5]

When the goods arrive at the buyer's premises, an automated process based on scanned data identifies the appropriate shelf location for the goods, and could even allocate shelf space based on analysis of customer behavior patterns and preferences. A further scan could make a wide range of product information available to the consumer, not just about a product line, but about specific lots of goods or, if item level tagging is implemented, specific information on individual products. Real-time scanning of the tagged goods lets the buyer know when supplies of a given product are running low anda new order has to be raised.



<Figure1> AdiagramofatypicalRFIDsupplychaindatacaptureapplication(Source:EPCglobal)

Figure1 illustrates the operational stages in a segment of a typical RFID-tracked supply chain. The manufacturer affixes a tag to a product. This 'commissioning' process is accompanied by an initial scan. The product is now known to the system. It is then aggregated in a pallet lot, a process which is observed and tracked by further automatic scans. Shipment to the retail distributor is then documented, again by an automatic scan at the dispatch dock, as is receival at the distribution centre. The pallet is 'put

away' in the retail distribution warehouse, all the while observed by scanners at strategic points. Distribution to the retail store is logged, as is the unpacking or 'disaggregation' process in the retailer's backroom, and the restocking of the shelf on the shop floor.

VI. THE FUTURE OF RFID

The tracking capabilities of RFID technology can be used to synchronize the availability of a product with key events in a marketing campaign. For example, the availability of a product on retail shelves can be timed exactly to the broadcast of a television commercial. If a national network television commercial for a particular product is booked for a Saturday morning the real time inventory tracking capabilities of RFID technology can be used to ensure that from that moment convenience stores have the product readily available to accommodate the resulting demand. This was demonstrated by the marketing campaign launch of the Gillette Fusion razor during the telecast of the 2006 US Super Bowl.[6]

RFID tags embedded in plastic cards or other devices such as mobile phones could be used to store cash value and make payments without the need for a physical act like handing over notes and coins, signing a credit card slip, or swiping a magnetic stripe card. A shopper in a supermarket may one day simply take goods from the shelves and arrange for the total cost to be debited automatically from a stored-value device. The transaction could be completed by the shopper choosing to walk through an identified

scanner at the supermarket exit.[7]

RFID technology in the home could be used to suggest recipes based on the ingredients available in the fridge and instantaneously program the oven to cook them perfectly. An RFID-enabled fridge could use tags to track each food item's expiry date and display information about its nutritional value. Similarly, an RFID washing machine could program itself according to fabric and care instructions scanned directly

from garments. These uses of RFID technology are emerging now, or will become part of our lives in the future. The potential applications of RFID are seemingly endless.

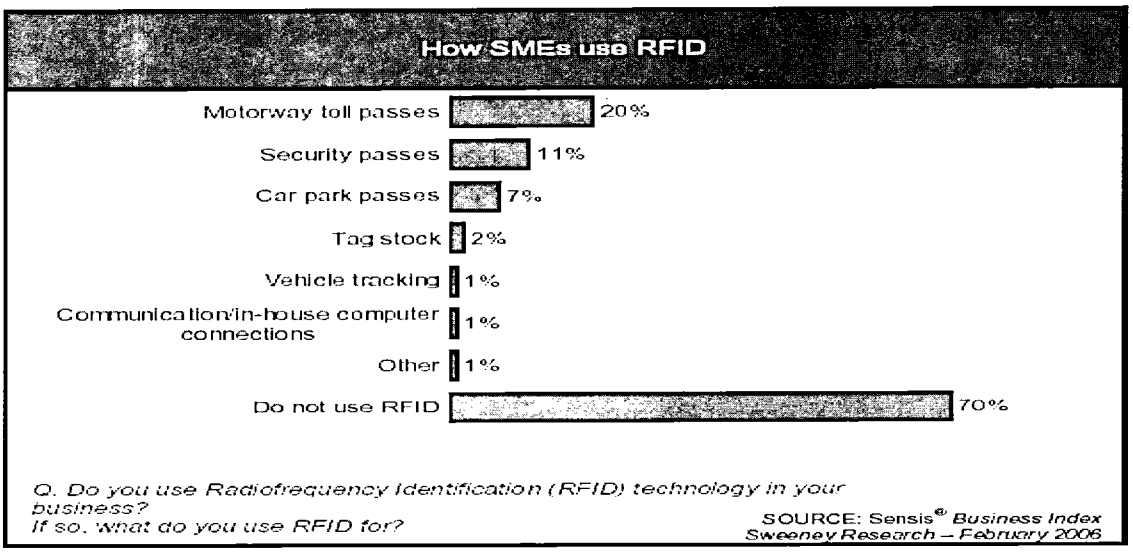
Appendix : SURVEY DATA in Australia

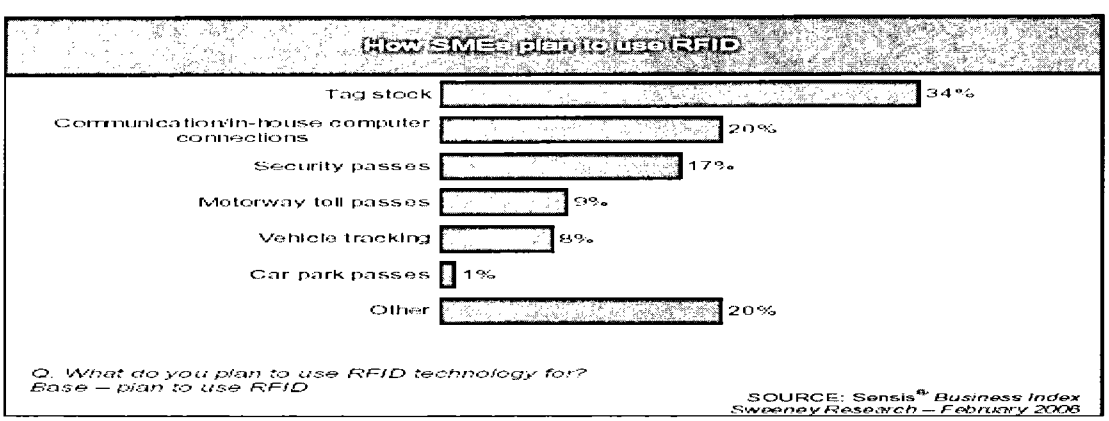
The following graphs illustrate the results of questions on RFID use included in the

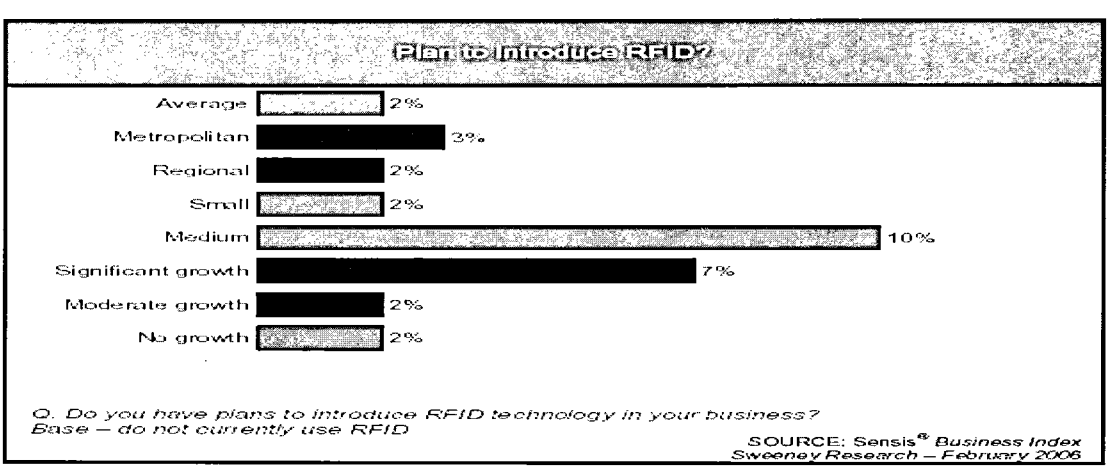
Sensis Business Index SME survey conducted in February 2006. The results indicate that RFID is in wide use for established applications such as motorway toll collection and security passes, but is very much an emerging technology for newer applications such as supply chain management and track-and-trace.

Uptake in these new areas is still far too small for this type of survey to

allow for meaningful analysis of data, included.
but some indicative breakdowns are







References

1. EPC stands for 'electronic product code'. EPCglobal is a joint venture between GS1 International and GS1 US, both not-for-profit standards development bodies.
2. Achieving Value From ICT (2005) can be downloaded from www.dcita.gov.au/ie/publications
3. EPC stands for 'electronic product code'. See for example 'RFID: Can it help your business?' on the website of ZDNet Australia at www.zdnet.com.au/insight/0,39023731,39196148-2,00.htm and 'RFID: The Next Generation' on Ferret.com.au at www.ferret.com.au/articles/8b/0c03aa8b.asp.
4. From Paper to Procurement (2004) can be downloaded from www.dcita.gov.au/ie/publications.
5. More information about these spectrum licensing matters is available on the website of GS1 Australia (www.gs1au.org/services/epcglobal/4w/_4w.asp).
6. The US Department of Defense has established a homepage to share information about its RFID policies and requirements with its suppliers (www.acq.osd.mil/log/rfid).
7. Standards body GS1 Australia in conjunction with the Australian Retailers Association is currently developing a privacy code of practice for RFID use in the Australian retail industry. EPCglobal has also published privacy principles. More information is available from the website of GS1 Australia (www.gs1au.org).