# Getting the most out of RFID:
## A starting guide to radio frequency identification for SMEs

**July 2006**

ISBN 0 642 75359 8

© Commonwealth of Australia 2006

This work is copyright. Apart from any use as permitted under the *Copyright Act 1968* no part may be reproduced by any process without prior written permission from the Commonwealth. Requests and inquiries concerning reproduction and rights should be addressed to:

Commonwealth Copyright Administration
Attorney-General's Department
Robert Garran Offices
National Circuit
BARTON ACT 2600

Or visit *www.ag.gov.au/cca*

## CONTENTS

# ABOUT THIS GUIDE

*Getting the most out of RFID* is an introductory guide designed to help Australian small to medium-sized enterprises (SMEs) understand the potential benefits of radio frequency identification (RFID) technology in doing business.

The guide seeks to provide simple, practical starting advice on:

- what RFID can do for your business; and
- some of the issues to consider when adopting RFID technology.

RFID technology has the potential to revolutionise the way goods and other objects are identified and tracked. It can improve business efficiency and reduce costs, and can make entirely new types of business possible.

Key players in the Australian retail market are likely to be influential in leading a trend towards adoption of RFID technology for supply chain management in the next few years.

A business that is prepared for these trends is likely to be less vulnerable to poor or hasty decision-making in implementing an RFID solution.

This guide focuses on the use of RFID technology in inventory and supply chain management. This is likely to be the highest value and most significant use of RFID—and greatest source of challenges—for Australian SMEs in the next five to 10 years.

However, this is only one of a large range of uses that RFID technology can be applied to. Some of the other potential applications of this highly versatile, multi-purpose technology are also explored.

# ACKNOWLEDGEMENTS

The guide has been developed by the Department of Communications, Information Technology and the Arts (DCITA) in consultation with the RFID Association of Australia (RFIDAA) and an industry reference group consisting of not-for-profit RFID standards organisation GS1 Australia, vendors, users, research groups and other stakeholders.

Case studies were prepared on DCITA's behalf by United Focus Pty Ltd. Survey material was provided by Sensis.

The guide has also been reviewed by the Auto-ID Laboratory, Adelaide, to ensure technical accuracy and relevance.

# WHAT IS RFID?

Radio frequency identification, or 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' (that is, the data extracted) 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 analysed or instantly shared online within an organisation or between different organisations.

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

## THE HYPE

New business technologies like RFID tend to burst on the scene amid a great deal of enthusiasm. There has been considerable speculation and excitement about what RFID can achieve in the long term. Early enthusiasm like this can sometimes result in a 'reality check' and disillusionment as high expectations are not met. This can be damaging to the reputation of very promising technologies.

The promise of a 'fully automated supply chain' is not a new one. Many technologies have been used in the past to speed up and automate supply chain functions, from punch cards to barcodes.

For some businesses, the use of these technologies might simply result in a worsening of inherent or organisational problems with the supply chain itself, such as disputes about ownership and coordination of supply chain functions, or lack of synchronisation in how suppliers and buyers work and communicate. Automation may just make the underlying problems hit faster.

In other cases, the technology has proven a useful aid for certain processes. However, it is often not as revolutionary as its publicity suggested.

## THE REALITY

The hard work in getting the most out of a new technology like RFID is in identifying ways in which it can be used to achieve business value, and putting it into practice. This can be a difficult process involving careful thought and planning, experimentation, and trial and error.

RFID will gain prevalence as a productive technology as its benefits become widely demonstrated and accepted. It will become increasingly stable as it evolves into future generations.

RFID is still an emerging business technology. RFID systems are steadily becoming more complex and versatile in respect of the information they can gather, store, process and transmit, and like all information technology products, unit prices are falling over time.

As with any technology, its theoretical capability is only half the story. Its real worth is in how it is put to work. It is the improvements to *business processes* made possible by RFID—or the *business problems that it solves*—that will yield the real value.

KEY MESSAGE

- RFID technology comes with big expectations. However, getting the most out of RFID involves careful planning and the hard work of identifying ways in which it can be used to achieve business value in your organisation.

# HOW DO YOU GET THE MOST OUT OF RFID?

The key to getting the most out of RFID is to have a business strategy in mind when adopting it. What business problem are you trying to solve with RFID?

Committing to make the technology investment is the relatively easy part. It's the new or transformed business strategy based on improvement of business processes that achieves the real value.

*Getting the Most out of RFID* has four key messages to help you consider some of the issues.

1. RFID is better understood as a new enterprise application rather than just a new technology.

2. Improved visibility in your business from RFID can not only mean cost savings; it can generate new business volume, and completely new lines of business.

3. Pressures to adopt RFID may come from outside, but you can make it work for you to improve your business.

4. A good RFID solution vendor will help you use RFID to redefine your business strategy, and not just sell you the hardware and disappear.

# AN OVERVIEW OF 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 standardisation 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 uses—in automating the tracking of inventory—can 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:

- 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',
    - in some cases from considerable distances, or
    - in bulk (when there are multiple objects in the RF field), or
    - in specified classes or subsets, or
    - through opaque cartons and packaging, all seamlessly and automatically;
- 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

[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.

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.

Removing the need for line-of-sight reading also means that tagged items inside a packing carton or stored out of sight on a warehouse shelf can be scanned. For example, a forklift fitted with an RFID interrogator could read individual bottles in a mixed case of wine, without the need to open the case, and even when the case is stored high above or below the line of sight or behind other items.

## 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 often readable over much greater distances than passive or semi-active tags. An active tag may be read from up to 100 metres away in some cases, while a passive tag may only be readable from as little as a few centimetres to a few metres 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 specialised 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 a unique identifier, which is used to access information about the specific items by querying a database.

## SENSOR NETWORKS

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 specialised contexts. However, this technology will inevitably become more versatile and affordable in the coming years.

KEY MESSAGES

- An RFID system can improve on, or complement, a barcode system by capturing larger amounts of far more specific information.
- RFID tags can be more easily readable because they remove the need for line-of-sight scanning.
- Some RFID systems can also capture and record information autonomously.

## WHAT'S BEHIND THE TAGS?

An RFID system is more than just tags and readers. It also includes a 'back office' system, which organises and processes the data gathered by these devices. Installing a system that works as an 'enterprise application' requires both middleware and data interpretation software, in addition to the system for scanning the tags and capturing the data.

Traditional computer networks consist of a few central servers directing information to a large number of terminals at the periphery. An RFID system is the opposite. The central processor sources information from the tags at the 'edges' of the system.

It is the capability of the back office software to turn this flow of data into useful information that is making RFID such an attractive business technology.

Having a network of tags generating raw data about the presence and status of goods in inventory is not very useful if the data cannot be presented and reported in a form that supports and improves the commercial and operational decisions of the business.

## 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 supply chain contexts is emerging in the form of 'EPCglobal'.[2] EPC stands for 'electronic product code'.

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 realise efficiencies across their supply chains.

## 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 (for example, cartons or pallets of goods).

[2] 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*.

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 synchronised 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.

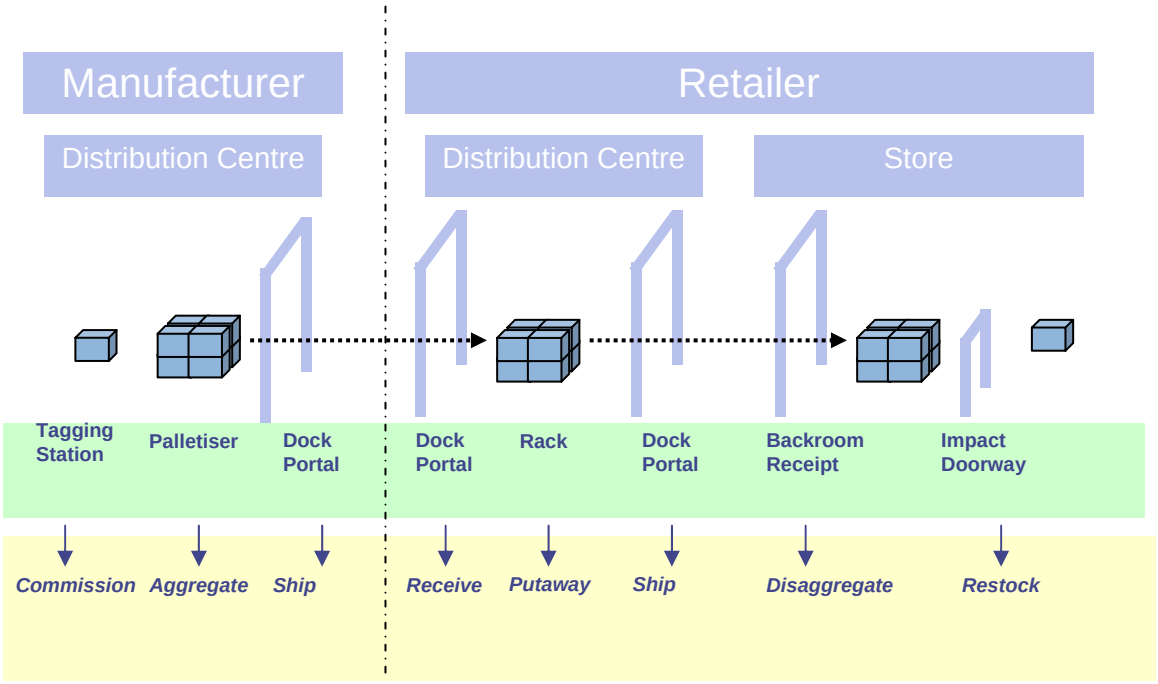
A continuous flow of real-time data coming in from the supplier and the buyer is also utilised by the manufacturer to plan and coordinate production activities.

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.

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 behaviour 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 and a new order has to be raised.




A diagram of a typical RFID supply chain data capture application
Source: EPCglobal

The diagram 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 despatch 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.

KEY MESSAGES

- RFID tags can be used to track goods automatically; from the component supplier, to the assembly line, to the despatch room, to the retailer's shelf.
- This information can be shared along the whole supply chain, so that everyone knows about demand and supply flows and despatch and delivery times, lot by lot or even item by item.

# WHAT CAN ICT DO FOR YOUR BUSINESS?

RFID is an information and communications technology (ICT). Like other types of ICT (such as a broadband Internet connection or computer-aided design tool), RFID has the potential to improve the productivity of a business. Some general messages about strategies to maximise the business value from capital investment in ICT have been explored in previous DCITA reports.

## MANAGING ICT IN YOUR BUSINESS: ACHIEVING VALUE

Recent research in DCITA has demonstrated that the effective management of ICT can improve firm productivity and performance, regardless of the size of an organisation or the industry in which it operates.

The 2005 report *Achieving Value from ICT: Key Management Strategies*[3] found that, in businesses that manage it effectively, ICT has:

- informational benefits such as an increase in the quality, quantity and availability of business and other information;
- strategic benefits such as creating competitive advantage;
- transactional benefits leading to efficiencies and cost savings; and
- transformational *benefits* associated with positive organisational change.

*Achieving Value from ICT* made three strategic findings about the features of organisations that get the most value out of their ICT investments.

First, managers need to be *ICT-aware*. The best way to make the most of an ICT investment is to have managers who understand and appreciate the benefits that technology can bring. ICT-aware organisations invest in technology to gain advantage. They are not merely trying to keep up with competitors or succumbing to pressure from trading partners. Instead, they make deliberate decisions to move ahead of the pack.

Secondly, managers need to be *open to organisational change*. Change always accompanies the successful implementation of a new technology. Management of that change is entirely in the managers' hands. Some of the benefits of a new technology are only discovered when it is integrated with other systems and processes. ICT can provide more than just increased efficiency and reduced costs. It can also lead to entirely new ways of doing business.

Thirdly, managers need to be *persistent* in realizing ICT benefits. Successful use of ICT involves an ongoing cycle of learning and development. The impact of new technologies

[3] *Achieving Value From ICT* (2005) can be downloaded from *www.dcita.gov.au/ie/publications*

on organisational practices and procedures is rarely simple or superficial, particularly in the longer term. There is often a time lag between the initial investment in ICT and the ability to realise the full benefit of that investment. Time is required to learn the new system and how to use it to advantage. Time is also required to integrate the new system with other business processes.

Although these points may seem simple, they're not always easy to achieve. *Achieving Value* makes it clear that ICT needs to be driven by management, and not just the 'techies'. Unless there is recognition at the highest levels of an organisation that technology is critical to its ongoing success—and there is the drive and patience to pursue technology strategies from management—then the chances of a successful implementation of ICT are significantly lessened.

## FROM PAPER TO PROCUREMENT: THE SUPPLY CHAIN IN TRANSFORMATION

Another DCITA publication, *From Paper to Procurement*,[4] identified a number of productivity benefits to be gained from using ICT to automate information exchange in a supply chain.

These include:

- selling more, more quickly;
- minimising data errors;
- reducing set-up costs;
- better tracking;
- getting paid for sales more promptly;
- improving maintenance efficiencies; and
- minimising non-core business activities.

A key message of *From Paper to Procurement* was that the use of ICT and automation technology in your business should be driven by clearly identified business objectives and business process improvements, like those listed above.

## THE 'JUST-IN-TIME' SUPPLY CHAIN

'Just-in-time' (JIT) is a management science that forms the basis of virtually all manufacturing and wholesaling today. At the core of JIT is the identification and removal of activities that don't add value to the core business, known as 'wastes'. Idle or poorly utilised resources, such as excessive warehouse space, are often identified as wastes in a JIT analysis.

[4] *From Paper to Procurement* (2004) can be downloaded from *www.dcita.gov.au/ie/publications*.

JIT itself is not an approach to automation of the supply chain. However, automation via ICT systems, such as RFID, can help a business to apply JIT to its greatest effect.

A key element of JIT is having the required stock in the warehouse only when it is needed. This can lower the cost of owning warehouse space, reduce idle time, reduce overproduction, and minimise the depreciation of stock while it is held in the warehouse. In a perfect JIT supply chain, theoretically the purchase of an item by a consumer in a supermarket will 'pull' the manufacturing and supply process right along the chain in order to replace that product on the shelf.

RFID is potentially a very powerful technology to help implement, exploit and improve JIT management in many organisations.

One of the major problems with JIT is an 'out of stock' situation, when the flow of inventory in and out of the warehouse gets 'out of synch' with production and supply processes. One cause of this can be data capture errors. With barcode technology, a stocktake may involve periods of downtime resulting from a manual barcode scanning process. With RFID tracking of stock, a firm can potentially call up accurate real-time information about what is in stock and what is out of stock. This can help to eliminate the out-of-stocks that can occur in a JIT inventory model.

KEY MESSAGES

- There is significant research to indicate that careful investment in information and communications technology can benefit your business.
- To maximise the benefits of this investment, management needs to be engaged in the decision making process. ICT investment is about improving whole business processes, not just improving technical capability and automating functions.
- Your investment in RFID technology should be based on clearly defined business objectives and improvements in business processes. What business problem are you trying to solve?

# RFID AND THE SME IN A SUPPLY CHAIN

As for any capital investment, a business looking to adopt RFID technology should undertake a business case analysis and implementation planning process. Below are a few tips to help ensure that these processes are conducted in an effective way.

## PLANNING AND IMPLEMENTATION

A first step in planning for a technology-based improvement in business processes would be to put together a cross-functional team in your organisation.

This team could consist of people with expertise in the manufacturing or other core business processes, as well as operational and management functions like warehouse management, security and financial control. The members of the team need to bring their specific expertise to the table, but they also need to have a working knowledge of technology options available. They do not need to be technical experts, but should be engaged enough with technical issues so that they have the necessary information to make decisions.

The team needs to focus on a clearly identified problem in the organisation, and work to solve it. The problem and the strategy for solving it need to be described in terms of factors that the organisation itself can control and influence. The work of the team will culminate in a business case analysis that clearly justifies a new approach and maps out a 'return on investment' forecast.

Once the investment has been made and the technology solution has been implemented, the business case should not be put away. On the contrary, it should be subject to regular progress reporting and review to ensure that the organisation is reaping the maximum benefits.

A few examples of business process improvements that might be achieved with RFID technology in small and medium-sized supply-based businesses are as follows.

## REDUCING INVENTORY COSTS

Better information about your stock can help reduce costs in the warehouse. RFID can be a tool for maximising the benefits of JIT warehouse operations. Stock will less often draw needlessly on warehouse resources, because it can be managed to arrive just in time to fill an order, and is out the door more quickly. This lowers the cost of ownership of storage facilities.

Some types of goods, such as computer hardware and foodstuffs, can depreciate rapidly during storage. RFID tracking can help you to map out stock depreciation curves and plan the timing of your sales to maximise revenue.

RFID tracking can also be used to keep tabs on assets such as returnable pallets and containers, the loss of which can be a major cost for supply-based businesses.

## FILLING MORE ORDERS

Implementing RFID in your warehouse can give you greater visibility of your stock. Information from the RFID system can be read into an electronic catalogue that gives you a real-time overview of what you have in your warehouse, where it is and in what quantity. It can also make other information like use-by dates instantly available.

You can therefore respond to orders more quickly and efficiently. Being able to fulfil more orders more quickly means an increase in sales revenue.

The information generated by the RFID system can also be analysed to provide for demand forecasting and other decision support tools, which can assist in strategic planning in your business.

## REDUCING LABOUR COSTS

RFID can be used to automate inventory functions and other processes that used to be labour intensive, such as manual scanning and counting of stock and despatch functions such as manual delivery address labelling, remittance advice, and manifest generation.

## REDUCING STOCK LOSSES

Better visibility of inventory via RFID tracking can reduce stock losses to internal theft, supplier or customer fraud, spoilage, put-away errors and other factors. Automated data capture can remove the human factor in track-and-trace operations, which can in turn minimise losses caused by human error and malicious activity.

## AUTOMATION OF REPETITIVE OR TEDIOUS PROCEDURES

Highly trained staff can be underutilised if they spend a portion of their time manually scanning or counting inventory. This is not only a waste of resources (in the form of the skills of the personnel), but also has the potential to create employee morale and wellbeing issues. Automating the data capture process can free up skills resources in order to maximise the value of the human capital in a business.

## IMPROVING ENVIRONMENTAL MANAGEMENT

RFID tags with sensor functionality can be used to keep tabs on physical and environmental conditions in the warehouse, such as the temperature of perishable goods, humidity and moisture levels, or the presence of corrosive substances.

## MASS CUSTOMISATION

As well as improving existing business processes, RFID technology can potentially allow you to conduct entirely new types of business. One of these new types of business can broadly be defined as ‘mass customisation’. Better information about stock means that it may become efficient and economical to fulfil smaller, more specific, or more complicated orders.

A business that has traditionally filled orders for large amounts of a single product can use the flexibility gained from RFID tracking to meet a wider scope of buyer requirements for made-to-order or supplied-to-order goods.

## BRANDING AND CONSUMER INFORMATION

RFID tags can carry useful information right along the supply chain, including to the end consumer. Products such as premium foods and beverages can have tags attached to convey information about the product, including a unique brand, the product’s origin or provenance, its nutritional characteristics, and serving suggestions.

In countries such as Japan and Korea consumers are already able to read information from RFID tags on items in supermarkets with personal RFID readers incorporated into mobile phones, or at in-store RFID kiosks. Australian exporters of premium food products are already taking advantage of this opportunity to provide value-added information to the consumer in these markets.

Again, the tag itself can carry information, or can simply act as a unique identifier that is used to query a database of information about specific items.

## BETTER CONTRACT RISK MANAGEMENT

Supply contracts are often geared to share risk across a supply chain, depending on the willingness of the various players to take a risk on supply and demand in the market for a commodity or product.

A manufacturer may undertake to supply a product in particular quantities over a particular period, taking a risk on the availability of the inputs to manufacture sufficient product to fulfil the contract. It may do so in order to secure a favourable price in the market. Failure to fulfil the contract may result in a penalty.

A retail buyer may also take a risk on its capacity to shift a certain quantity of product from its shelves, and therefore undertake to purchase a given amount in the wholesale market in return for a volume discount. Again, a penalty may apply if the retailer finds itself overstocked and unable to fulfil the contract.

An RFID system can generate information to support decisions about contractual risk. A manufacturer could use data about the availability patterns of inputs and its own production volumes to make an informed judgment about the level of contractual risk it

can take on. Likewise a retailer could use tracking information obtained from an RFID system to make similar decisions from the perspective of the buyer.

This could not only result in better risk management across the supply chain. It could also mean that suppliers and their partners are able to explore better risk-managed contractual arrangements, and even entirely new types of supply contract. Better real-time information about inputs and outputs could support a more aggressive approach to risk management in a supply chain.

KEY MESSAGES

- Improved visibility in your business from RFID can not only mean cost savings; it can generate new business volume and completely new lines of business.
- A technology like RFID can help you not only improve your existing business processes, but make whole new types of business available to you.

# RFID: ISSUES TO CONSIDER

The potential benefits of RFID technology are large, but with benefits come issues that need to be considered and planned for. The following are a few issues that you may wish to raise with business partners, vendors and others stakeholders when planning the implementation of an RFID system in your organisation.

## RFID, BARCODES AND OTHER TECHNOLOGIES

It is important to stress that RFID technology is not a replacement for barcode track-and-trace systems, which have been responsible for some very significant efficiencies in businesses worldwide over the course of a number of years. Barcode technology continues to work very well for many applications in inventory management, logistics and retailing. Also, the cost of printing a barcode on an item remains far lower than the costs associated with RFID tagging.

Just because RFID is currently a hot topic in track-and-trace and inventory management does not mean it is automatically the best technology for your needs. Like any technology investment, it is important to approach RFID technology with a critical mindset. Is it the only technology that can solve the business problem you have identified? Does it offer the most competitive return on investment? Are there cheaper technologies that can solve your business process problems?

Consideration of RFID technology may be a starting point for analysis of your business processes, but not necessarily the right answer to the questions it raises. The concepts behind RFID systems might make you take a careful look at the quality of your inventory data, for example. You may identify features of data capture processes that create errors. However, RFID may not necessarily be the solution to those problems. The data capture processes themselves could be at fault, rather than the data capture technology.

## SYSTEM INTEGRATION

System integration is a key consideration in RFID business solutions. It is very important that the data generated from an RFID setup are in a format that is compatible—or ‘integrated’—with all of the relevant equipment, software and other data.

The more interoperable your RFID system is, both with your own legacy systems and with the systems of suppliers and customers, the greater the potential value you can derive from it. There is little point in collecting a large amount of data from an RFID system if it is not in a form that can be easily used by your own back office and by your business partners.

Third party data formats, communication protocols, hardware platforms and software systems need to be carefully considered for compatibility issues and the potential for effective integration when installing an RFID system.

Don’t assume that the RFID system you implement will be interoperable with the systems of your business partners. You need to consult with your vendor, suppliers and customers and perhaps also run trials to confirm this.

## SECURITY

Like any computer network system, the capacity of an RFID setup to be secured against unauthorised access, theft or damage is an issue to consider.

You may not wish to share the product information and other types of data stored on your RFID tags with your competitors. RFID systems may also be subject to malicious and accidental damage, either through a physical attack, or via vulnerabilities in the associated computer systems, networks and software.

The data generated and used in your RFID system are an asset that should be characterised by:

- confidentiality—information should only be available to those who rightfully have access to it;
- integrity—information should be modified only by those who are authorised to do so; and
- availability—information should be accessible to those who need it, when they need it.

Information generated by an RFID system and shared across a network can be protected using authentication and encryption technologies, as is the case in any other computer system.

The e-security pages of the website of the Department of Communications, Information Technology and the Arts (*www.dcita.gov.au/ie/e-security*) are a good place to start in getting the information you need to assess online security issues.

## AUTHENTICATION

In some circumstances, it would be useful to be able to verify or authenticate that the information read from a tag, or the item itself to which the tag is attached, is genuine. For example, a tamper-proof tag with an electronic authentication system could help isolate goods that are not authentic, such as pirated media or substitute food products.

Currently, basic RFID tags provide only a fixed identifier, which is used to query a database for information about the tagged item. There is not necessarily any system in place to verify that the tag providing the number is not a copy or a fake. This is similar to ‘logging in’ to a computer system with only a username and no password.

Authentication systems are currently in development to enable better verification of whether something is genuine or not. Such systems could potentially provide for variable identifiers to be assigned to tags according to a scheme controlled by the owner of the

authentic goods. Alternatively, a system could require the scanner equipment and tags to 'challenge' each other for some kind of authentication information, like a password, before the identifier can be read.

For the time being, some businesses have adopted more low-tech approaches to authentication, such as destroying tags as soon as they have served their useful purpose, which discourages the theft of tag information or tags themselves. Another simple way of detecting some types of fraudulent activity is to note the existence of duplicate tag entries in the database.

## SYSTEM PERFORMANCE

Environmental and human factors can negatively affect the performance—particularly the 'read rates'—achievable within an RFID system. The presence of dense liquids and metals can interfere with RFID signals. Poor or incorrect use of reader equipment, or 'collision problems' caused by too many simultaneous reads, can impede RFID performance and impact the data collected, although the risk of bad data is decreasing significantly as technology improves.

It is important to be aware of these factors in relation to your specific business, including the nature of your premises, the training and competencies of staff and the composition, and the scale or amount of goods to be tagged.

Proper training and facilities management, along with proper assessment of conditions affecting system performance and professional installation of tags and equipment, will minimise any system performance issues. Some background research and careful consultation with your vendor will assist. Trial installation to verify that conditions will support an acceptable level of system performance should also be considered.

## ELECTROMAGNETIC SPECTRUM

RFID readers utilise a particular segment of electromagnetic spectrum licensed for this purpose by spectrum regulator the Australian Communications and Media Authority (ACMA). The licensing arrangement specifies the power at which readers can operate within this spectrum. This affects the physical distances at which tags can be read.[5]

It should be noted that other communications devices and services may be operating within this spectrum and in adjacent bands, and that interference may result if power or frequency settings conflict. Within the class-licensed 900 MHz band, no protection is granted from other equipment operating in accordance with the class licence. It should also be noted that different countries currently have different spectrum licensing arrangements for RFID equipment (including different frequencies and different power restrictions). Readers that are set up for overseas regulations may not be suitable for use in Australia and vice versa.

[5] More information about these spectrum licensing matters is available on the website of GS1 Australia (*www.gs1au.org/services/epcglobal/4w/_4w.asp*).

Currently, ACMA has issued a class licence, which allows UHF band RFID services to operate between 918 and 926 MHz at a maximum power of one Watt. However, it has become evident that four Watts is required for effective system performance. ACMA therefore issued GS1 Australia with a 'scientific' apparatus licence allowing operation at four Watts on the basis that such systems may not interfere with systems operating in adjacent bands. This will facilitate research into spectrum requirements, leading to a decision about whether to grant a four Watt class licence. However, at four Watts the allowed frequency range is only 920 to 926 MHz.

End users need to apply to GS1 Australia for a four Watt licence, but need not be GS1 members.

## ELECTROMAGNETIC EMISSIONS AND HEALTH

There is long standing concern in the community about the effect of electromagnetic emissions (EME) on human health. Research has not identified any health issues associated with exposure to normal emission levels of devices such as mobile phone handsets and base stations, electricity distribution infrastructure, and RFID scanning equipment.

For example, concerns may still arise among employees who are required to work near scanning equipment for long periods. These concerns may require sensitive management, whether they are regarded as legitimate or not. It may be prudent to obtain and share expert occupational health and safety advice or other authoritative information on EME issues in order to reassure affected personnel.

## PRIVACY

Perhaps the biggest issue of a public policy nature associated with the growing use of RFID technology is privacy. There is concern in some quarters that the monitoring capabilities of RFID tags will be used to invade the privacy of individuals. The possibility of an RFID tag on a consumer item being used to track the movements of an individual subsequent to a purchase, for example, has generated discussion. This concern may be especially significant if that tracking information can be associated with identity and credit card details, or other personal information.

It is often suggested that RFID technology is 'unregulated', meaning that there are no restrictions on the use of RFID to invade the privacy of individuals or misuse personal information. While there is no specific privacy regulation of RFID systems by governments in Australia, there is general legislation applying to all forms of business including the commercial use of RFID.

For example, the Commonwealth *Privacy Act 1988* sets out 10 National Privacy Principles (NPPs), which place obligations on many businesses in relation to how they collect, handle, store, use and disclose personal information. The NPPs have general applicability to businesses with a turnover of more than $3 million per annum. Businesses

with a lesser turnover are generally exempt from the NPPs, with the exception of health service providers and some others.[6]

Businesses can address the privacy concerns that arise in connection with RFID technology by considering the privacy implications early. One example is through the use of a privacy impact assessment process. If there is any potential to link RFID data to information that may identify an individual, or in some other way link RFID data to individuals (including staff and customers), then there are likely to be privacy implications that will require careful consideration.[7]

Privacy commissioners from around the world have recommended that basic principles of privacy law be adopted when designing, implementing and using RFID technology. These include the following:

- RFID tags should only be linked to personal information or used to profile customers if there is no other way of achieving the goal sought;
- individuals should be fully informed if personal information is collected using RFID tags;
- personal information collected using RFID tags should only be used for the specific purpose for which it is first collected, and destroyed after that purpose is achieved; and
- individuals should be able to disable or destroy any RFID tag that they have in their possession.

As noted, the spectrum licensing arrangements by ACMA for RFID equipment specify the power at which equipment can be used, and as a consequence the read range. This effectively prevents the tracking of tags and the objects or people carrying them over wide areas.

In addition, the *Trade Practices Act 1974* regulates the potential use of unfair practices by traders, some of which may involve the abuse of RFID technology.

The prospect of widespread item-level tagging in the retail sector appears to be a source of concern from the point of view of customers being unaware that items they are carrying around may be subject to tracking. Based on current market and technology trends, large scale item-level tagging in the retail sector in Australia is still some years away, but businesses looking to adopt RFID technology need to be aware that these issues and concerns exist and need to be addressed.

[6] For more information on the coverage of the *Privacy Act*, see Information Sheet 12 on the Office of the Privacy Commissioner's website (*www.privacy.gov.au/publications*).

[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).*

An indication of the types of issue of concern to privacy advocate groups can be found on the website of the Electronic Privacy Information Center (*www.epic.org/privacy/rfid*).

KEY MESSAGES

- RIFD technology has large potential benefits for business, but it is not without issues that need to be considered before it is adopted.
- Careful consideration and planning in respect of issues such as system integration, security, system performance, spectrum usage, and privacy can head off problems that might emerge later.

# MAKING RFID WORK FOR YOU

Beyond any consideration of achieving value from RFID in your own business, there are also a number of trends and developments in the broader business landscape that have to be taken into account. These trends may affect your decision-making when adopting an RFID system.

## A 'MANDATE' FROM A LARGE CUSTOMER

Experience in other economies, particularly the United States, has shown that pressure for businesses to adopt RFID technology often comes from large, powerful retail buyers. Wal-Mart's decision to require pallet-level RFID tags from many of its suppliers is perhaps the best known example. Despite opposition from some of Wal-Mart's suppliers, this 'mandate' is gaining traction.

Another huge buyer in the US market is the Department of Defense, which has announced a mandate for RFID tagging for its supply contracts. The Department of Defense buys a diverse range of goods, from aircraft carriers and fighter jets, to socks and underwear. Much of its business also affects defence organisations in other countries. The long term influence of the Department of Defense mandate may prove to be even more far-reaching than the strategy of Wal-Mart.[8]

While take-up of RFID in Australia is still in the early stages (see the survey data in Appendix B), these US market trends are likely to be reproduced here.

Australian SMEs need to be aware of the intentions of key players in their market. A supplier that is unprepared for a mandate or new strategy from a powerful player is likely to be more vulnerable to poor or hasty decision-making in implementing an RFID solution.

## REGULATORY COMPLIANCE

Regulatory requirements may also put pressure on businesses to generate information about a range of activities in order to comply with regulatory returns. Examples may include regulation of hazardous substances, GST and input credit accounting, and transparency and disclosure requirements for listed companies.

RFID systems may assist in generating this information, or making compliance easier. Again, poor planning in respect of compliance requirements may add unnecessary risks to the implementation of the best RFID system for your business.

Australia's biggest RFID track-and-trace project to date has regulatory compliance as a key aim. The National Livestock Identification System (NLIS) is an RFID-based system

[8] 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*).

for the identification and tracing of livestock. It is a permanent, whole-of-life identification system that enables individual animals to be tracked from the farm of origin to slaughter. This helps to ensure food safety, product integrity and access to markets with regulatory requirements in these areas, such as the European Union. Data captured about life cycle and movement of livestock through the supply chain via NLIS can assist in reducing the financial and social impact of a livestock disease incident and gaining access to customers and markets demanding whole-of-life, property-of-origin traceability.

## ON-COST OR OPPORTUNITY?

While outside pressures such as the terms of a supply contract or regulatory obligations might compel an SME to consider RFID technology, this investment need not necessarily be seen as merely an on-cost of doing business in a given market.

It may seem initially that it is your business making the investment in tags and data collection, while others elsewhere in the supply or compliance chain are reaping the benefits.

However, this can be turned to your advantage. For example, a system that allows a large retail buyer to increase margins is likely to have flow-on effects in the long term for suppliers. Efficient and successful buyers tend to expand their businesses and place more orders.

An RFID system implemented by the supplier because of external pressures should also be leveraged to yield direct value in the business itself. This is because RFID is such a flexible and multi-purpose technology.

Greater visibility and a more efficient supply chain are as beneficial to the supplier as they are to the buyer. RFID is a multi-purpose technology that can be customised and have a number of different uses.

## A TEMPORARY PHENOMENON?

Some businesses may choose to ‘ride out’ the first wave of adoption in their market in the hope that:

- those seeking to impose a technology solution in the supply chain might reconsider in response to teething problems; or
- bugs in the system are identified and fixed by early adopters, at their expense, leaving later adopters to benefit.

Businesses may also delay adoption of the technology in the interest of careful business planning and a desire to ensure that the business has the best possible strategy in place for when RFID is switched on.

Conversely, other businesses may adopt a 'first-to-market' strategy. These companies may make a rapid and significant investment in RFID technology in order to be the first to meet contractual or regulatory compliance requirements, in the hope of sewing up market share.

There is no easy solution to these strategic issues. Like all capital investment, it is important that you make a careful strategic decision that is suited to your business and based on the best information available to you.

## UNEXPECTED BENEFITS

DCITA research into the use of ICT in businesses shows that the full return on investment can take some time to realise. Furthermore, elements of this return on investment can come from unexpected sources.

The growing familiarity of your staff with a new system may lead to unplanned-for productivity and efficiency benefits over time. Similarly, the interaction of a new system with existing plant and processes can yield unanticipated upsides.

Managers need to be aware of this potential for unplanned benefits, and be open to reconsidering elements of the business strategy to maximise value.

### KEY MESSAGES

- There may be outside pressures to adopt RFID, but you can make it work for you to improve your business.
- You need to consider any RFID investment in the context of wider regulatory and market developments, but don't rule out opportunities to reap benefits within your own business. Be open to the possibilities.

# CHOOSING A GOOD VENDOR

## PRODUCTS AND SERVICES: SHOPPING AROUND

There is no substitute for doing your homework on the products and services available in the marketplace before choosing one that is right for your business.

Issues to consider include:

- the technical expertise of the vendor;
- the total cost of ownership of the technology to be provided by the vendor;
- how well that technology will integrate with existing systems;
- ease of use of the vendor's technology and any requirements to invest in retraining;
- the level of after-sales support provided by the vendor;
- the specialisation of a particular vendor to your industry;
- the track record of the vendor, including past experiences of your business as a customer of that vendor; and
- the capacity of the vendor to provide an end-to-end solution, involving not just the technology, but a complete business package.

One general issue to consider is the importance of making a technology investment with your overall business strategy in mind. This may mean engaging an end-to-end service provider, which will help you adapt and improve your business processes and strategies in the longer term, rather than just selling you tags and reader equipment.

A good end-to-end service vendor will:

- help you review your business strategy to maximise the return on your technology investment;
- help you maximise value from specific business processes, such as inventory and logistics management, by solving identified problems in your business;
- not extend the scope of your planning and implementation simply to generate more vendor business;
- ensure that appropriate training for your personnel is provided for; and
- provide strong after-sales service and advice.

## OUTSOURCING

Rather than upgrading in-house technology and equipment with an RFID system, some firms are electing to outsource entire business units, such as warehouse management and data control.

This can be an efficient way to achieve value from an ICT investment. Outsourcing has the potential to eliminate many of the risks and wastes associated with non-core business functions.

KEY MESSAGE

- A good RFID vendor will help you use RFID to redefine your business strategy, and not just sell you the hardware. Expertise in *business* and not just technology is one hallmark of a good vendor.

# PARTNERSHIPS

You do not need to enter the new world of RFID on your own. Forging partnerships with industry peers, government and research organisations, and investors can furnish valuable information and assistance.

## INDUSTRY PARTNERSHIPS

Other firms in your industry may be willing to share experiences and ideas on a non-competitive basis. This type of horizontal communication between businesses can result in very productive information sharing, which benefits everyone.

Companies can even collaborate in ways that can benefit every player non-competitively, for example, on research and development, and export strategies. This practice has been referred to as industry 'clustering', and has had considerable success in Australia in industries such as wine growing and biotechnology.

Regular contact with your suppliers and buyers can ensure that you have the best information to achieve the maximum value from your investment.

Your relevant industry organisation or professional association may also be able to provide advice and assistance. Examples include the Australian Retailers Association (*www.ara.com.au*), the Australian Logistics Council (*www.ozlogictics.org*) and the Australian Automotive Aftermarket Association (*www.aaaa.com.au*).

## RESEARCH BODIES

A number of research institutions are engaged in research and development activities relating to RFID.

For example, the Auto-ID Laboratory (*autoidlab.eleceng.adelaide.edu.au*) at the University of Adelaide was established by the Auto-ID Center based at the Massachusetts Institute of Technology as one of six laboratories in the world working on research and development for the EPC network. The work of the Auto-ID Center was taken on by EPCglobal in 2003. The expanded number of laboratories continues to work on the EPC network partially funded by EPCglobal.

The Auto-ID Laboratory in Adelaide has established the Australasian Adoption Research Initiative (*www.rfidautomation.org/aari.htm*) to allow Australian companies to network on RFID issues, and to assist in the deployment of EPCglobal network solutions tailored to Australian needs. Regular newsletters and seminars also allow relevant, practical, and up-to-date information on RFID to be disseminated.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO, *www.csiro.au*) also has a strong research and development profile in RFID technology.

The CSIRO has undertaken several RFID projects with industry in order to investigate and resolve implementation problems in complex applications.

## RFID ASSOCIATION OF AUSTRALIA

The RFIDAA (*www.rfidaa.org*) is the peak national body representing interests relating to RFID technologies, standards, and best practices in Australia. Its role is to encourage opportunities for Australian businesses to achieve maximum benefit from RFID technologies.

The RFIDAA assists in the clarification of RFID standards both domestically and globally. It provides its members with advice on implementation solutions, access to business case studies, and networking opportunities with other firms of similar interests and experiences.

## GS1 AUSTRALIA AND EPCGLOBAL AUSTRALIA

GS1 Australia (*www.gs1au.org*) and its subsidiary EPCglobal Australia (*www.gs1au.org/services/epcglobal/_epcglobal.asp*) are able to provide members with detailed information on RFID deployment, including project management advice. A great deal of EPC network information is also publicly available.

## GOVERNMENT CONTACTS

A number of Australian Government and state and territory government programs and points of contact can provide advice and assistance to Australian businesses in the areas of research and development, technology investment, export strategy development, and industry clustering and collaboration. Many of these programs may have relevance to aspects of your RFID investment.

A good starting point is the website of AusIndustry (*www.ausindustry.gov.au*). You can also call their hotline on 13 28 46, or email them at *hotline@ausindustry.gov.au*. AusIndustry is the Australian Government's business program delivery division, and offers a range of more than 30 business assistance programs worth nearly $2 billion to 10 000 Australian business every year.

The website of the Department of Communications, Information Technology and the Arts contains a considerable amount of information about investing in ICT to achieve productivity outcomes in your business (see *www.dcita.gov.au/ie*).

The industry development department in your state or territory will also have relevant programs and information.

KEY MESSAGE

- Staying in touch with your peers, business partners, vendor, and other key sources of advice and assistance will maximise your chances of achieving the full benefit from your technology investment.

# THE FUTURE OF RFID

This starter guide has focused on one very significant application of RFID technology—the management of inventory in a supply chain context. However, the range of commercial, social and government activities to which RFID technology could be applied is virtually limitless.

Three areas of significant potential for RFID technology are marketing, payment transactions and the networked home.

The tracking capabilities of RFID technology can be used to synchronise 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.

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.

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.

# FURTHER INFORMATION

There is a wealth of freely available information on the Internet about RFID technology developments, market trends, vendors and business strategies. Unfortunately, it can be of variable quality and should be carefully sourced.

A number of specialised journals are available on subscription. Bodies like the RFIDAA and the Auto-ID Laboratory, Adelaide are valuable sources of advice and assistance.

GS1 Australia and EPCglobal Australia publish research and information of general use and application when considering issues associated with RFID technology. EPCglobal International also freely publishes all of its technical standards (see *www.epcglobalinc.org/standards_technology/ratifiedStandards.html*).

Many vendors also have large amounts of general information about RFID technology on their websites and can be located via a search of the Internet.

# Glossary

| | |
|---|---|
| *Achieving Value from ICT* | A 2005 publication from the Department of Communications, Information Technology and the Arts providing advice on how to maximise the value of an investment in information and communications technology. It is available on the Department's website (*www.dcita.gov.au/ie/publications*). |
| ACMA | The Australian Communications and Media Authority. ACMA is the Australian Government agency responsible for the management and licensing of electromagnetic spectrum, including spectrum for RFID technology. |
| Active tag | An RFID tag that has a transmitter (usually battery-powered) to send back information under its own power, rather than merely reflecting back a signal from the reader, as a passive tag does. |
| Agile reader | An RFID reader that can read tags at different frequencies or using different methods of communication between the tags and readers. |
| Antenna | An RFID tag's antenna is the conductive element that enables the tag to send and receive data. |
| AusIndustry | The Australian Government's business program delivery division. AusIndustry offers a range of more than 30 business assistance programs worth nearly $2 billion to 10,000 Australian business every year. |
| Authentication | The term 'authentication' is used to refer to processes and technologies that verify the authenticity of an electronic communication. This is often done by confirming the identity of the device or person originating the communication with an encoded electronic signal. The use of authentication with RFID technology can potentially reduce the risk of forged tags or unauthorised scanning of tag data. |
| Automation | A process by which tasks or functions are undertaken by machines rather than human effort. RFID technology can be used to automate many tasks and functions. This can reduce human error and improve efficiency. |
| Auto-ID Lab | The Adelaide Auto-ID Lab is a part of the University of Adelaide. The Lab is involved in RFID core research, hardware and software development, technical services and education. |

| | |
|---|---|
| Back office | A term used to refer to the software and computer systems that convert raw electronic data captured from RFID tags into usable information. 'Middleware' and 'savants' are terms for types of back office system. |
| Back-scatter | A method of communication between passive tags and readers. A radio frequency field sent out by the RFID reader 'excites' the antenna of the RFID tag, causing radio waves to scatter back to the reader. The reflected signal is 'modulated' to transmit data. |
| Barcode | A printed pattern of parallel lines or bars containing encoded information. The barcode is a standardised method for identifying information about a particular item (for example, its manufacturer and product category). The barcode came into wide use in supply chains in the 1980s. The bar pattern is easier for an optical scanner device to read than sequences of letters or numbers. Some key drawbacks of barcodes are that they do not identify unique items and scanners have to have 'line of sight' to read them. |
| 'Commissioning' a tag | A term sometimes used to describe the process of writing an identifying number to a tag (or programming a tag) and associating that number in a database with the product or object that the tag is attached to. |
| Data capture | RFID is often referred to as a data capture technology. This means that RFID can be used to collect and analyse large amounts of data about a set of objects, such as physical movements or other properties. |
| DCITA | The Australian Government Department of Communications, Information Technology and the Arts. |
| EME | Electromagnetic emissions, a term used to refer to the electromagnetic energy emitted by devices such as mobile phones and mobile phone base stations, as well as RFID devices. Exposure to EME is sometimes perceived as a health hazard. |
| EPC | Electronic Product Code, the serial number written to a tag in an EPCglobal RFID system, which is used to call up information about the associated product or object from an online database. |
| EPCglobal | EPCglobal is the company formed to develop standards for the EPCglobal RFID network. The term is also used to refer to the standards themselves. |
| EPCglobal network | The Internet-based technologies and services that enable companies to use the product codes on RFID tags to automatically retrieve data about the tagged items. |

| | |
|---|---|
| GS1 Australia | A non-profit organisation involved in the development of standards and the administration of, among other things, RFID systems. |
| ICT | Information and communications technology. ICT encompasses computers, software, networking, databases, telecommunications services, and any technology that aids communication and the management of information. ICT is transforming business and virtually every aspect of our lives. RFID is an example of an ICT. |
| Integrated circuit | A microelectronic semiconductor device comprising many interconnected transistors and other components. Also known as a 'chip' or 'microchip'. A typical RFID tag consists of an integrated circuit and an antenna. |
| Interface | Different technologies or electronic systems are 'interfaced' when they are set up to work together. For example, RFID tags can be interfaced with electronic sensors. The sensors capture information about physical stimuli and the RFID tags allow that information to be 'read' into a computer system. |
| Interrogator | See 'reader'. |
| ISO | The International Organization for Standardization, based in Switzerland. The ISO is involved in standards development for RFID. |
| JIT | See 'just-in-time'. |
| Just-In-Time | Just-In-Time (or JIT) is a management science involving the identification and removal of activities that don't add value to the core business of an organisation. These activities are known as 'wastes'. Idle or poorly utilised resources, such as excessive warehouse space, are often identified as wastes in a JIT analysis. RFID can be a powerful technology for implementing or improving Just-In-Time processes. |
| Licence plate | See 'number plate'. |
| Line of sight | Optical scanning systems such as barcode systems require 'line of sight' for scanning to occur. RFID tags are scanned via radio waves, and can therefore operate without line of sight. For example, tagged goods packed into a cardboard carton can be scanned without the need for the carton to be opened. |

| | |
|---|---|
| Mandate | In relation to RFID, the term 'mandate' is often used to refer to a requirement for items to be tagged, which has been imposed as a precondition for doing business with an organisation. In the United States the Department of Defense and retail chain Wal-Mart have imposed RFID mandates on some suppliers. The coverage of RFID mandates can reasonably be expected to broaden as RFID is adopted in other countries and other industry sectors. |
| Modulation | Modulation is the process by which radio waves can be made to carry information. An RFID tag modulates the radio waves it sends back to a reader device in order to communicate data over the air. |
| National Privacy Principles | A set of principles enshrined in the *Privacy Act 1988* that protect the privacy of personal information, including personal information collected for or by RFID systems. |
| NLIS | The National Livestock Identification System, an Australian RFID system used to track the movements of cattle. |
| Number plate (or licence plate) | This term describes an RFID system in which the tag carries only a serial number or identifier, which is used to retrieve information about the tagged item from a separate database. EPCglobal is an example of a 'number plate' RFID system. This can be contrasted with RFID systems in which the tags themselves contain detailed information about the associated object. |
| Outsourcing | The practice of allowing selected business processes to be undertaken by an outside company on a contract basis. The usual rationale for outsourcing is to improve the efficiency of business processes that cannot be performed economically by an organisation itself. |
| Passive tag | A passive tag is an RFID tag without a battery or other independent power source. When radio waves from an RFID reader reach the tag's antenna, this energy is converted by the antenna into electricity that can power up the integrated circuit in the tag. The tag is then able to reflect or send back information stored on the integrated circuit via what is know as a 'back-scatter' method. |
| Radio Frequency Identification (RFID) | A method of identifying and/or tracking unique items using radio waves. Typically, an RFID 'reader' communicates with a 'tag', which holds digital information on an integrated circuit. |
| Reading | 'Reading' is the process of retrieving the data stored on an RFID tag by sending radio waves to the tag and converting the radio waves that the tag sends back into data. Reading is also known as 'scanning' or 'interrogating'. |

| | |
|---|---|
| Reader | An RFID reader is a device used to retrieve the data stored on RFID tags. The reader creates a radio frequency field via which the tag communicates data. Readers can be hand-held or fixed at key positions. They are also known as ‘scanners’ or ‘interrogators’. |
| Radio frequency (RF) field | An RF field is a physical area in which radio waves are emitted. An RFID tag outside an RF field created by a reader is out of range and cannot be read. |
| Read range | The distance at which a reader device can effectively read information from an RFID tag. Depending on the power and technical specifications of the equipment being used, this can vary from as little as few centimetres or a few metres, to up to 100 metres. |
| RFID tag | An RFID tag typically consists of an integrated circuit coupled with an antenna, and is constructed in such a way as to allow it to be attached, fastened or glued to an object. Tags come in many shapes and sizes and many types and classes. |
| RFIDAA | The RFID Association of Australia, the peak national body representing interests relating to RFID technologies, standards and best practices in Australia. |
| Scanner | See ‘reader’. |
| Semi-active tag | A semi-active RFID tag employs ‘back-scatter’ to communicate with a reader, much like a passive tag, but also incorporates an independent power source to run its integrated circuit. This means its integrated circuit can be ‘live’ even when the tag is not in an RF field. |
| Sensor | A sensor is a device that can respond to a physical stimulus and capture data about that stimulus. RFID tags can be coupled with sensors so that data about physical stimuli can be ‘read’ from the tag. For example, a tag that incorporates a thermometer can communicate information about the temperature conditions affecting the tagged object or an identifiable location. |
| Smart label | A term often used to refer to a barcode label that also integrates an RFID tag. The functions of both RFID and barcode systems are available in a ‘smart label’. |
| SME | Small-to medium-sized enterprise. An SME is sometimes defined as a business with fewer than 100 employees. The vast majority of Australian companies are SMEs. |

| | |
|---|---|
| Standards | Like any complex information system, RFID technology requires technical standards to be defined. There has been, and continues to be, considerable RFID standards development activity. EPCglobal and the ISO are examples of organisations involved in the development of RFID standards. Supply chain logistics is particularly reliant on workable technical standards because it is based on effective interaction and communications between organisations in the supply chain. |
| Supply chain | A supply chain is a chain of business partners that trade with each other in order to manufacture and supply a product. In simple terms a typical supply chain consists of manufacturers, distributors and retailers. |
| System integration | It is very important that the data generated from an RFID system are in a format that is compatible—or 'integrated'—with all of the relevant equipment, software and other data. This is known as 'system integration'. |
| Track-and-trace | A set of business processes by which an organisation collects and processes information about the whereabouts of physical objects, normally stock or assets. RFID is a powerful track-and-trace technology. |
| Ultra-high frequency (UHF) | Ultra-high frequency refers to electromagnetic spectrum between 300MHz and 3Ghz. As an example, the EPCglobal system employs UHF spectrum in a range between 860MHz and 960MHz. |
| Visibility | A term used to refer to the amount and usefulness of information about a business that is available to its managers and employees. Increasing visibility can improve efficiency and allow new lines of business to be developed. RFID can be a powerful technology for increasing visibility. |

# APPENDIX A: CASE STUDIES

## GRIBBLES MOLECULAR SCIENCE: CRIMINAL EVIDENCE TRACKED WITH RFID

### About the project

Forensic laboratories to date have had to manually complete and check DNA documentation, forensic data and samples all the way through the forensic process.

According to Professor Ian Findlay, Director of Forensics at Gribbles Molecular Science (GMS), 'We were manually tracking and tracing the movement of criminal evidence and samples through our labs and this was not 100 percent efficient. Samples would be dropped off and we would have to manually time and date stamp them for each person involved in each process.

'Criminal evidence would then be bagged and marked according to the case number and the name of the technician, and would be sent through the laboratory for testing and processing to identify the sample. All of this is a time-consuming and labour-intensive process, which was taking approximately eight hours to complete for each batch of samples', Findlay said.

Professor Findlay identified early on that automated authentication was the key to reducing manual processing within their laboratories. He saw that GMS needed an automated solution that could track and trace in real-time and could be extended all the way through the forensic process—from crime scenes to police to the GMS labs, and finally through to a court of law.

This system had to be flexible and modulated, yet be a stand-alone laboratory solution specifically customised to meet their requirements.

Crucial to the project was a solution that could track people as well as samples, so that the chain of responsibility could be tied seamlessly to the solution.

GMS set out to find an Australian company that was implementing real RFID solutions and that understood the technology. They found Sunshine Technologies, a Queensland company, which has extensive RFID implementation knowledge and experience. The two companies worked well together, shared a common vision, and have now formed a joint venture company called id-DNA.

The aim of this joint venture was to develop an RFID authentication solution that could accurately track and trace both criminal evidence and the people who handle the forensic samples within their own laboratories—a solution that could identify the chain of responsibility all the way through a laboratory process and accurately link people to individual samples at any given time.

As a result, GMS has spent the last 12 months implementing what it believes is a world-first: a forensic laboratory that has installed an integrated RFID electronic tracking and laboratory information management system (LIMS) authentication solution to track and trace forensic samples all the way through the DNA testing process.

## How RFID was used

Id-DNA designed a customised RFID solution for GMS laboratories that was based on Sunshine's RFID smart card and smart label technology. Contactless RFID smart labels are used to create an efficient and accurate track-and-trace system that Sunshine has designed for a significant number of asset management projects. The technology is probably best known in the access control business.

In the simplest terms, the smart labels or cards are embedded with an RFID chip and antenna, which is read within the laboratory without a requirement for line of sight. Multiple items can be read in a field at one time, which dramatically speeds up the process and ensures chain of custody security.

Every person who has permission to access the laboratory receives a contactless smart card, and the software ensures that physical access is restricted to areas determined by GMS.

Smart cards are linked to a customised software system that logs in all staff and guests who visit the laboratory, and are read through an RFID terminal and tracking system that has been installed in all the entries and exits of the building. Smart card technology can accurately track and trace on-site staff movements 24 hours a day.

This system controls the comings and goings on the GMS site, including who enters the laboratory at any given time, how long they are in the laboratory, where they go and where they have been. The system is also designed to link into the track-and-trace system for the criminal evidence and forensic samples, and merges the information together so that every sample is linked to each technician at every stage of the process.

The software ensures that people are associated with samples and therefore authenticates the chain of responsibility. It also authenticates the chain of custody and informs management by way of alarm events if samples do not reach the next stage in the process on time.

## The benefits

RFID technology has the ability to rigidly control processes and provide real-time information on every stage that a sample is passing through. Hundreds of samples can be tracked simultaneously, short-cuts are eliminated, and the number of staff involved can be reduced.

The entire chain of responsibility is now automated, reducing manual processes and paperwork by 70 percent, and reducing the time of the whole operation from eight hours

to three hours. The use of smart cards and labels has also improved security, consumable inventory management, and access control.

‘Automated tracking of forensic samples and criminal evidence leads to a much higher throughput for GMS, as well as significant cost efficiencies. The GMS labs can now process up to 1000 forensic samples per week, which we could never do before’, Professor Findlay said.

RFID-enabled laboratories are considered the next generation for forensic evidence and criminal sampling, and Australia is fortunate that a world-first forensic laboratory is right here on our doorstep.

## VICTORIAN MACHINE VISION: RISE—RFID IN SPORTS EVENTS

### About the project

Victorian Machine Vision and iCrystal have designed and developed a system for tracking sporting competitors using a cutting-edge RFID tracking solution coupled with high speed video capture.

The system is known as RISE—RFID In Sports Events—and provides real-time information throughout a race event on each competitor, benefiting race officials, coaches, participants, and spectators. The product was officially launched in December 2005.

Unlike many existing tracking systems, which employ active tags and use fixed and cumbersome infrastructure, RISE uses passive tags and inexpensive overhead readers. This means that the system is very affordable, which puts this technology, previously only available for elite sporting events, into the hands of amateurs at the club level.

Because passive RFID technology is used, the tags are inexpensive and loss or breakages are inconsequential. They can be attached to race numbers, and there is scope to combine the technology with smart RFID licence cards that can be scanned for competitor details when officials record entries.

The RISE system can publish real-time information to computer displays for officials, team managers and coaches, to a screen for spectators, and to the Internet. The system will also produce a printout of results.

The real-time information from the RFID tags is augmented by the photo finishes and lap-by-lap placings, which can be captured by a high speed camera triggered by the RFID readers.

The information being provided to sporting organisations is used for a number of purposes. It is of great interest to officials, spectators and competitors, as it allows them to have a better understanding of the race as it unfolds.

The system also provides a record of the event for each competitor, which is a very helpful tool for coaches and competitors who wish to analyse the data to improve results.

The system is portable, very easy to use and is adaptable to a number of sporting events. Currently, solutions have been developed for cycling (RISE-C) and harness racing (RISE-HR). Plans for 2006 include adaptation for horse racing, triathlons and marathons.

## Why RFID was used

RFID technology was adopted for three main reasons. The first and most important was that this technology was the most suitable for this sort of application. An RFID system is capable of providing the timing information required, and is flexible enough to be used in almost all situations.

Secondly, RFID technology is developing rapidly, and significant advances are being made. This means that the capabilities of RFID are increasing at the same time that the cost is decreasing. Thus any solution that uses RFID will improve in terms of cost and performance each year as the technology advances.

The third reason is that project partner Victorian Machine Vision was actively looking to move into a niche place through combining RFID with vision systems. There are now numerous opportunities opening up as a result of having successfully achieved this unique fusion.

## The future

The RISE project required that passive RFID tags were read at distances of up to 15 metres and at speeds of up to 60km/hr. This was a real challenge, and to solve it the project team needed to push the bounds of the technology.

To date the initial goal of reading tags at 15 metres has been achieved—an almost unheard of accomplishment for passive tags. However, tags moving at speeds of 60km/hr can be reliably read only at a distance of 10 metres. There are a number of further optimisations that are being tackled, but which require a deep understanding of physics and RF engineering to solve. These problems are now being tackled through collaborative efforts with a number of Melbourne universities.

## Lessons learnt

When looking at adopting RFID technology it is important to understand what can and can’t be achieved. Even with the very strong technical background that the project team had, there was a steep learning curve when first working with RFID.

It is clear that, although RFID technology has been standardised, it is still essential to understand the physical requirements of laying out a RFID environment to minimize RF interference from hardware and to optimise read rates.

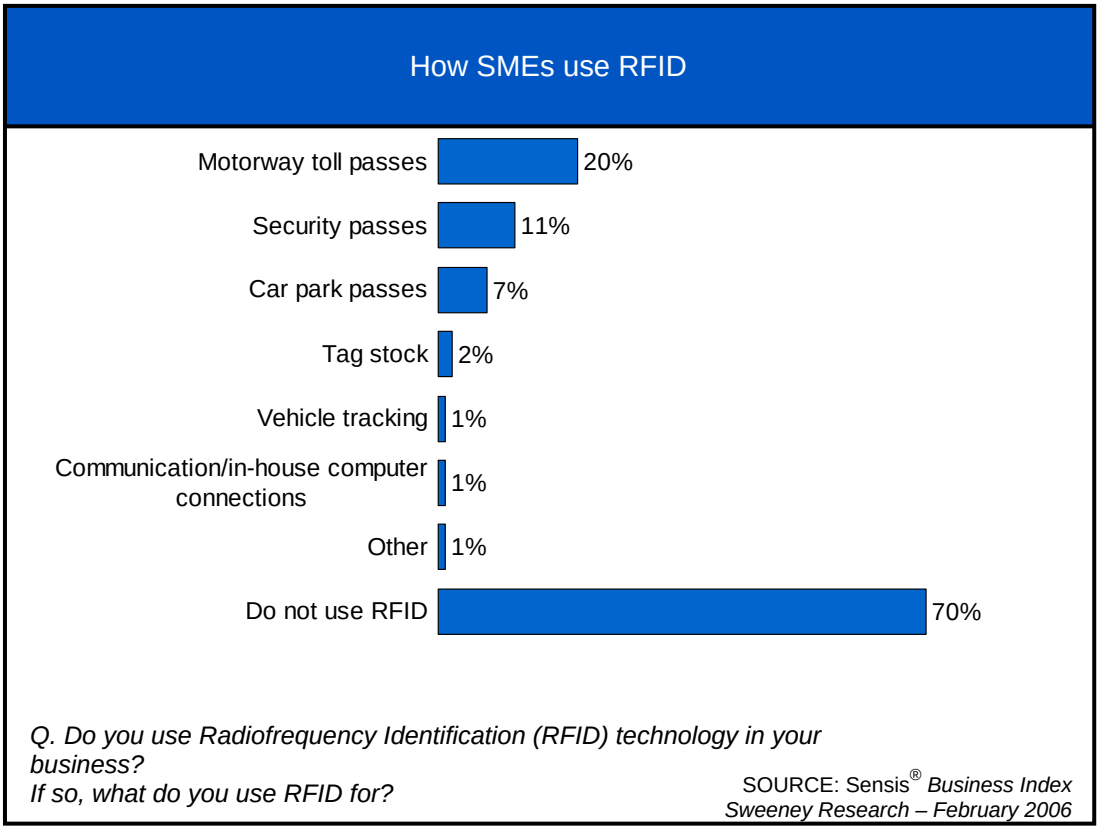
Experienced consultants greatly reduce the amount of time required to get a project operational—both through consulting on specific matters, and through helping to train personnel.

## APPENDIX B: SURVEY DATA

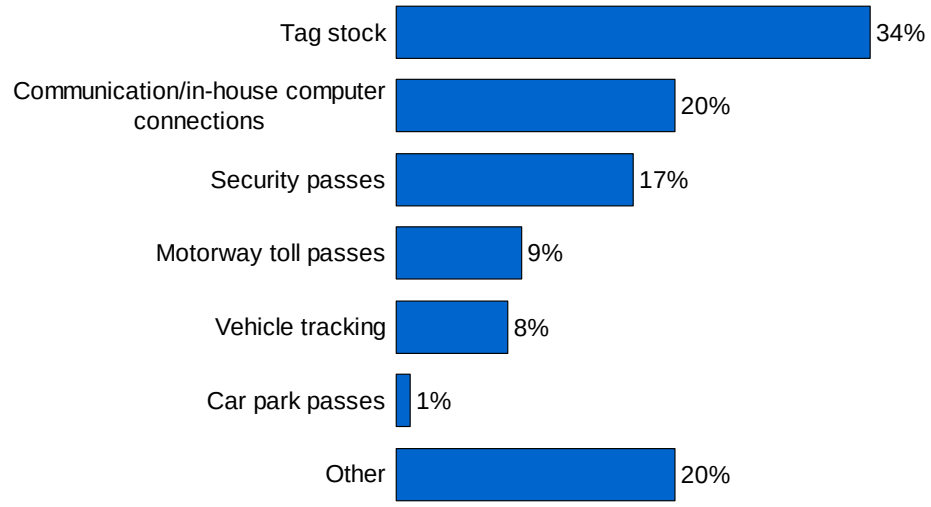
The following graphs illustrate the results of questions on RFID use included in the Sensis Business Index SME survey conducted in February 2006.

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, but some indicative breakdowns are included.



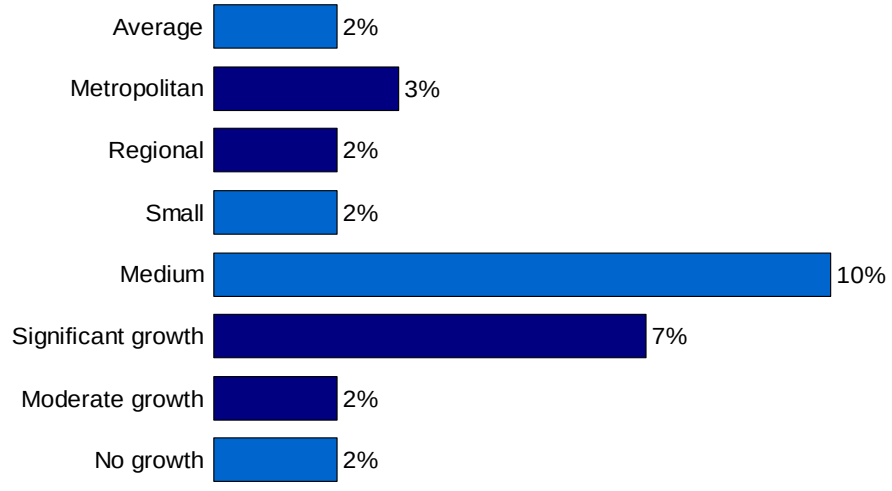
## How SMEs plan to use RFID




*Q. What do you plan to use RFID technology for?*
*Base – plan to use RFID*

SOURCE: Sensis® *Business Index*
*Sweeney Research – February 2006*

## Plan to introduce RFID?




*Q. Do you have plans to introduce RFID technology in your business?*
*Base – do not currently use RFID*

SOURCE: Sensis® *Business Index*
*Sweeney Research – February 2006*