

24-KARAT PROTECTION: RFID AND RETAIL JEWELRY MARKETING

David C. Wyld¹

¹Department of Management, Southeastern Louisiana University, Hammond, LA USA
dwylld@selu.edu

Received: 14th January 2019 Revised: 25th March 2019 Accepted: 16th June 2019

ABSTRACT

This article examines the unique value proposition presented by RFID (radio frequency identification) for jewelry retailers' inventory management. The article provides a general overview of RFID technology. The author then presents findings on its use in jewelry retailing to date by innovative companies around the world. The research establishes that RFID-based inventory tracking is exceptionally well-suited to the jewelry industry due a variety of factors, including the values, origins, sizes and form factors of jewelry items. Early adopting jewelry retailers have found that RFID-based inventory tracking can address their needs for better inventory management and control, heightened security, and improved business intelligence.

KEYWORDS

RFID (radio frequency identification) technology, Bar Coding, Retailing, Security, Inventory Control, Business Intelligence

1. INTRODUCTION

The jewelry business is a unique one – and not necessarily one “business” at all. The global jewelry market is estimated to be over \$150 billion today [1]. The U.S. jewelry retail industry alone aggregately generates approximately \$60 billion in annual revenues [2], and at present, there are over 30,000 specialty jewelry retail stores [3]. However, the American jewelry industry is surprisingly fragmented. While there are large, national jewelry chains, such as Zales, Kay, Tiffany, and Sterling Jewelers, there are also a multitude of small, regional chains and independent retailers. From a market perspective, while Wal-Mart is the largest jewelry retailer in America today, this is not a market it controls. In fact, the top fifty jewelry chains collectively hold less than half of the American market [4]. Also, the jewelry market is divided by price points, with often great contrasts in the inventory – and customer needs/demographic/segmentations – between high-end jewelry stores and their products and those that aim at bargain customers with so-called costume jewelry [5]. Like patterns in jewelry retailing have been found around the world, including in the United Kingdom. In the UK, the estimated £3.2 billion market is likewise fragmented. However, British consumers spend approximately half as much per capita on jewelry versus that of their American counterparts [6].

Today, jewelry retailers are increasingly looking to implement RFID (radio frequency identification)-based systems as a way of accomplishing a variety of managerial and marketing objectives. As can be seen in Table 1, there are a variety of potential solutions providers, mostly comprised of small companies around the world that are looking at how to serve this potentially

Table 1. Vendors for RFID-based Jewelry Management Solutions

Vendor	Location	Solution	Website
5Stat	Beatrice, NE USA	INCOMPASS	http://www.5stat.com/
RSI ID Technologies	Chula Vista, CA USA	Pressiza	http://www.rsiid.com/
Jewelry Computer Systems, Inc.	Naperville, IL USA	Unbranded	http://www.jcssoft.com/
The Jewellery Store	Dubai, United Arab Emirates	Unbranded	http://www.tjs.ae/
Innovez One	Singapore	Enterprise Jewellery Software Business Solutions	http://www.innovez-one.com/
Orizin Technologies	Karnataka, India	Jtrack	http://www.orizin.net/
Hong Kong RFIF, Ltd.	Hong Kong	RFID Jewelry Management System	http://www.hk-rfid.com/
DAILY RFID	Guangzhou, China	RFID Jewelry Solution	http://www.rfid-in-china.com/

lucrative market. However, in this distinctive and diffuse marketplace, these vendors are proposing surprisingly similar solutions for the unique issues facing jewelry retailers.

This article examines the prospect for RFID to be applied in the retail jewelry industry. It begins with an overview of what RFID technology is, how it works, and where we are seeing it used today and where it will be employed in the near future. Building upon this foundation, the reader will then see how RFID can be specifically employed in the retail jewelry industry, which presents a uniquely effective application of this technology. The article concludes with an analysis of the managerial issues involved with the use of RFID in the retail jewelry setting and a look to the future of technology in this area and what near-term developments will mean for retailers, employees, and consumers.

2. RFID 101

2.1. Automatic Identification

Automatic Identification, or *Auto-ID*, represents a broad category of technologies that are used to help machines identify objects, humans, or animals. As such, it is often referred to as automatic data capture, as Auto-ID is a means of identifying items and gathering data on them without human intervention or data entry. As can be seen in Figure 1, the omnipresent bar code is itself a form of Auto-ID technology. RFID is thus fundamentally another form of Auto-ID technology. Sometimes referred to as dedicated short range communication (DSRC), RFID is “a wireless link to identify people or objects” [7]. RFID is, in reality, a subset of the larger radio frequency (RF) market, with the wider market encompassing an array of RF technologies, including:

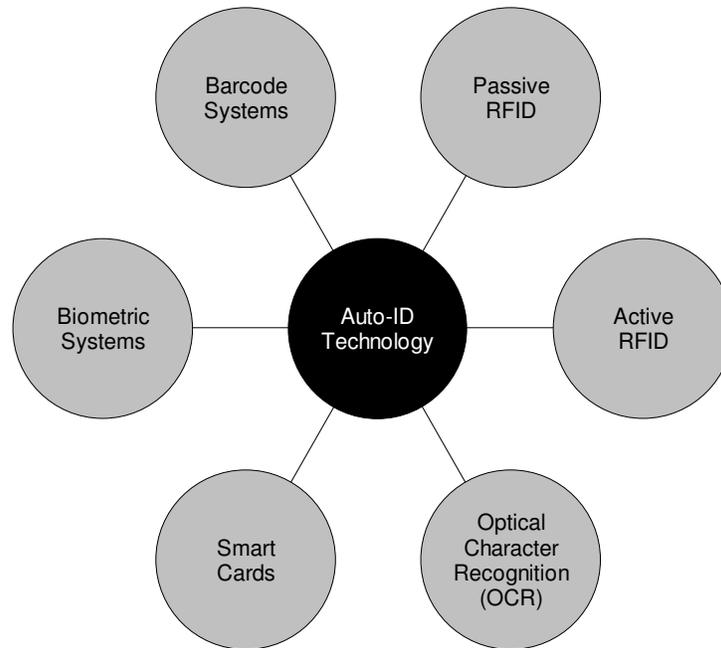


Figure 1. The Family of Automatic Identification Technologies [8].

- cellular phones,
- digital radio,
- the Global Positioning System (GPS),
- High-Definition Television (HDTV), and
- wireless networks [9].

RFID is by no means a “new” technology. In fact, it is a technology that already surrounds us. First off, if you have an automobile that was manufactured after 1994, the car uses RFID to verify that it is your key in the ignition. Otherwise, the car won’t start. If you have an Exxon/Mobil SpeedPass™ in your pocket, you’re using RFID. If you have a toll tag on your car, you’re using RFID. If you have checked out a library book, you’ve likely encountered RFID. If you’ve been shopping in a department store or an electronics retailer, you’ve most certainly encountered RFID in the form of an EAS (Electronic Article Surveillance) tag.

2.2. RFID and Bar Codes

Conceptually, bar codes and RFID are indeed quite similar, as both are auto-ID technologies intended to provide rapid and reliable item identification and tracking capabilities. The primary difference between the two technologies is the way in which they “read” objects. With bar coding, the reading device scans a printed label with optical laser or imaging technology. However, with RFID, the reading device scans, or interrogates, a tag using radio frequency signals.

The specific differences between bar code technology and RFID are summarized in Table 2. In summary however, there are five primary advantages that RFID has over bar codes. These are:

1. Each RFID tag can have a unique code that ultimately allows every tagged item to be individually accounted for,
2. RFID allows for information to be read by radio waves from a tag, without requiring line of sight scanning or human intervention,
3. RFID allows for virtually simultaneous and instantaneous reading of multiple tags,
4. RFID tags can hold far greater amounts of information, which can be updated, and
5. RFID tags are far more durable [10].

Table 2. RFID and Bar Codes Compared

Bar Code Technology	RFID Technology
<ul style="list-style-type: none"> • Bar Codes require line of sight to be read 	<ul style="list-style-type: none"> • RFID tags can be read or updated without line of sight
<ul style="list-style-type: none"> • Bar Codes can only be read individually 	<ul style="list-style-type: none"> • Multiple RFID tags can be read simultaneously
<ul style="list-style-type: none"> • Bar Codes cannot be read if they become dirty or damaged 	<ul style="list-style-type: none"> • RFID tags are able to cope with harsh and dirty environments
<ul style="list-style-type: none"> • Bar Codes must be visible to be logged 	<ul style="list-style-type: none"> • RFID tags are ultra thin and can be printed on a label, and they can be read even when concealed within an item
<ul style="list-style-type: none"> • Bar Codes can only identify the type of item 	<ul style="list-style-type: none"> • RFID tags can identify a specific item
<ul style="list-style-type: none"> • Bar Code information cannot be updated 	<ul style="list-style-type: none"> • Electronic information can be overwritten repeatedly on RFID tags
<ul style="list-style-type: none"> • Bar Codes must be manually tracked for item identification, making human error an issue 	<ul style="list-style-type: none"> • RFID tags can be automatically tracked, eliminating human error

2.3. How RFID Works

There are three necessary elements for an RFID system to work. These are tags, readers, and the software necessary to link the RFID components to a larger information processing system. In brief, the science of a passive RFID system works like this. The RFID tag is the unique identifier for the item it is attached to. The reader sends out electromagnetic waves, and a magnetic field is formed when the signal from the reader "couples" with the tag's antenna. The unpowered RFID tag draws its power from this magnetic field, and it is this power that enables the tag to send back an identifying response to the query of the RFID reader. When the power to the silicon chip on the tag meets the minimum voltage threshold required to "turn it on," the tag then can respond to the reader through the same radio frequency (RF) wave. The reader then converts the tag's response into digital data, which the reader then sends on to the information processing system to be used in management applications. Writing in *Wired*, Singel [11] likened passive RFID to a "high-tech version of the children's game 'Marco Polo.'" In a passive RFID system, the reader sends out a signal on a designated frequency, querying if any tags are present in its read field (the equivalent of yelling out "Marco" in a swimming pool). If a chip is present,

the tag takes the radio energy sent-out by the reader to power-it-up and respond with the electronic equivalent of kids yelling “Polo” when they are found.

All of this happens almost instantaneously. In fact, today’s RFID readers are capable of reading tags at a rate of up to 1,000 tags per second. Through a process known as “simultaneous identification,” most RFID systems can capture data from many tags within range of the reader’s antenna almost simultaneously. In reality however, the tags are responding individually – within milliseconds of one another – in a manner to prevent tag and reader collision in their signals through response protocols [10].

2.4. Analysis

While it will take a few years for RFID to become commonplace on retail store shelves and the store of the future to become a reality, RFID is already being used in a wide variety of creative applications, including:

- A worker at a distribution center can instantly identify each and every one of the items contained in every box on a pallet on the tongs of the forklift she is driving;
- A librarian can locate a book that had been hopelessly misshelved;
- A worker at a livestock processing facility can instantly access the identity and history of a cow;
- A hospital can locate critical medical devices instantly, wherever they are located throughout the facility;
- A blood bank can track its inventory with greater accuracy;
- A pharmacist can tell that two bottles in his supply of a high in demand, highly addictive prescription drug are counterfeit;
- A military contractor can instantly locate the necessary spare to repair a Blackhawk helicopter;
- An art museum can use RFID-enabled exhibits to provide enhanced visitor experiences by making exhibits come “alive”; and yes,
- A golfer can instantly locate his errant shot and retrieve the ball from the thicket where it landed.

Futurist Paul Saffo foresees that much of the focus on RFID today is on doing old things in new ways, but the truly exciting proposition is the new ideas and new ways of doing things that will come from RFID. He predicts that: “RFID will make possible new companies that do things we don’t even dream about” [12]. As such, this new, old technology will become one of the driving forces of the 21st century. RFID is thus an exciting technology, one that is poised to enter our lives in many exciting ways over the next decade. The ability of RFID to deliver rich information, instantaneously and automatically, is why major retailers in the U.S. and abroad, including Wal-Mart, Target, Metro, and Tesco, along with the U.S. Department of Defense, are major backers of employing the technology in their supply chains [13]. And, while much of the media and investment focus has been on such warehousing and retailing applications, now, there is increased interest in applying RFID in a wide variety of settings, including health care

[14, 15, 16], sports and entertainment [17], museums and theme parks [18], and yes, casinos [19].

3. RFID AND RETAIL JEWELRY APPLICATIONS

Today, we are seeing exciting in-store RFID applications in bookstores [20], pharmacies [21], electronics retailing [22], and grocery stores [23], bringing about new possibilities in customer service, business intelligence, inventory management, and security [24]. Yet, the very nature of jewelry items makes them unique in the retail marketplace. Think about it. The form factor of jewelry is not conducive to being individually identified. Ever seen a UPC (Universal Product Code) label on a gold necklace? Ever seen an EAS tag attached to a diamond ring? No, and not just because of the physical impracticality. Other than watches – which represent less than five percent of the total jewelry market, the vast majority of jewelry is not branded [3]. Also, the jewelry market is also one where craftsmanship is in many ways as valued as it was centuries ago, and thus, in many cases, there is not a “supply chain” to speak of. In fact, a ring or pin that is made in the store itself may not have to travel more than 100 feet from its point of origin to its point of sale. Thus, this is a high-end market where individual item identification has not been technically or practically possible, until the advent of RFID-based solutions.

Therefore, unlike the vast majority of retail applications, the focus here is not on cases and pallets of goods. In the jewelry environment, the focal point is squarely on tagging the individual item – each ring, watch, necklace, etc. With the value of jewelry items being high, and in many cases, with values reaching into the stratosphere, the ratio of the cost of the tag (with tags currently running between 25 cents to several dollars each, depending on capabilities) to the value of the item being tagged is better in this field than in any other retail application (see Figure 2). Thus, all of the RFID solutions on the market today are focused on managing trays and individual items of jewelry – whether they be in the jewelry display case or in storage in the backroom of the store [25].

How do these systems work? While there are certainly variances between them and certain nuances and benefits offered by each vendor’s solutions, by and large, they all are based on using extremely small form factor tags and a series of readers, which can be positioned on jewelry display cases and doorways. The systems generally employ 13.56 MHz, ISO 15693-compliant passive tags, with some vendors even offering EPC Gen 2 UHF (900 MHz) tags [26]. The tags are generally still attached to items using thin strings or cords. One Dubai-based vendor, The Jewellery Store, is making use of a tag, manufactured by Sokymat, specifically for jewelry tracking. The tag has a 16mm hard plastic casing, and both ends of the cord attach to the case after being looped through a section of jewelry, thereby completing an electric circuit and rendering the tag operable. This unique solution further protects the item by making the tag tamper-proof, as the circuit loop makes it impossible for a thief – internal or external – to remove a tag from a lower priced item and replace it on a higher priced one to “fool” the system [27]. Likewise, the high-end Swiss jeweler watchmaker, De Grisogono, whose products cost an average of €20,000, have deployed RFID-based tracking of individual items and watch trays across all of their 15 worldwide retail locations [28]. When combined with store and chain-level software, such systems offer unprecedented visibility for retail jewelry management.

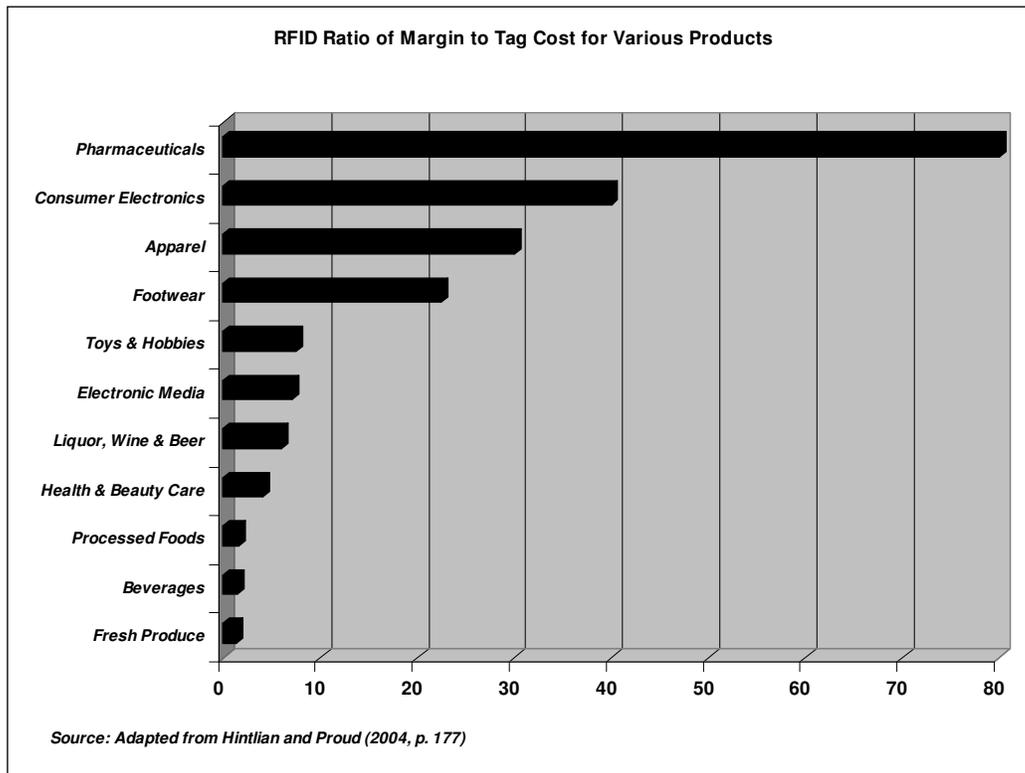


Figure 2. RFID Tag Costs Relative to the Value of the Tagged Item

4. THE RFID VALUE PROPOSITION FOR JEWELRY RETAILERS

Early adopting jewelry retailers have three key needs they are addressing through the use of these specially-tailored RFID solutions. These are:

1. Inventory management
2. Store security
3. Sales monitoring and metrics.

4.1. Inventory Management

By managing jewelry items with RFID, individual store and jewelry chain management can not only protect their significant investment in inventory in new ways, they can also garner unprecedented visibility on their valuable inventory. Due to the lack of UPC-based tracking, the introduction of RFID solutions can enable either constant monitoring or on-demand scanning of their stock. The presently available RFID solutions can scan entire trays of rings in one pass, which can reduce the time and expense involved in manually inventorying hundreds of items in a jewelry display case or perhaps several thousands of items on display in an entire jewelry store in minutes rather than days of painstaking work [28]. Further, with numerous similar

looking (to the untrained eye), unbranded items in a display case, rotating inventory was a heretofore laborious task that has been often left undone in the typical jewelry store. In one installation in the Middle East, RFID has enabled a jewelry retailer to reduce the time it takes for personnel to inventory the store from 2-3 days to 10 minutes [29].

4.2. Store Security

With RFID, jewelry managers and employees can also better protect their stores' valuable inventory. A single ring or watch – not necessarily in a high-end jewelry retailer's inventory – may run several or even tens of thousands of dollars. Likewise, a single jewelry tray often contains many thousands of dollars worth of items, and (perhaps hundreds of thousands of dollars in a single display case). For this reason, jewelry stores are attractive targets for not just single item shoplifters or internal employee theft, but outright robberies and large scale criminal operations as well.

The National Retail Federation defines “retail shrinkage” as inventory losses stemming from:

- employee theft,
- shoplifting,
- organized retail crime,
- administrative error, and
- vendor fraud [30].

Recent reports that have pegged the inventory shrinkage problem for American retailers as a whole at approximately \$42 billion annually [30], and an astonishing \$3 billion for Wal-Mart alone [31]. Industry analysts say that crimes against jewelry stores alone result in over \$125 million in losses annually [32]. These include losses due to not only strong-arm tactics, such as armed robberies and sometimes kidnapping - and worse - of jewelry store employees, but other unarmed criminal strategies. These include so-called “smash and grab” scenarios, where criminals literally use hammers and other similar items to break the glass on display cases and run out of the store with entire trays of merchandise. Similarly, jewelry store employees can fall prey to distraction schemes, where teams of perpetrators distract the attention of a salesperson so that they can remove single items or again, entire trays of merchandise from the store [33]. With the growing threat of Organized Retail Crime (ORC), shoplifting is fast-shifting from being predominantly a crime of opportunity carried-out by individuals to the focus of criminal enterprises. According to the Federal Bureau of Investigation, organized retail crime accounts for as much as \$30 billion in retail losses annually, including not just shoplifting, but other nefarious activities including credit card theft, extortion, and loan fraud [34]. These organized shopping gangs exact far more economic damage on retailers than traditional shoplifters (swiping a CD or a dress) or an economically-motivated shoplifter (stealing food or drug items for personal or family use) [35]. In fact, while the typical shoplifting case perpetrated by an individual averages a loss to the retailer of just over a hundred dollars, according to National Retail Federation, the average loss from each ORC shoplifting case is over \$7,000, with jewelry being a leading target of organized retail crime enterprises [36]!

With the new RFID based inventory management solutions, store management can be alerted if an individually tagged item is out of a display case beyond a specified period of time, signalling a warning to salespeople that a shoplifting attempt may be in progress – thus acting as an “early warning system” for jewelry retailers. This can be contrasted with the use of video cameras in

jewelry stores, which can only be used as “after the fact” evidence tools of a shoplifting having occurred, unless the retailer invests in personnel to constantly monitor the activity on the store floor via video feeds. Finally, as with all retail, internal theft is especially concerning for jewelry retailers due to the size, nature, and value of items that can easily be taken by employees – valuable items that have not to date had the protections of the vast majority of other retail items. And jewelry industry employees have proven especially creative in their thievery, as there have been documented cases where employees have surreptitiously inserted cubic zirconium fakes for the real diamonds in engagement rings and even removed items from stores in various body orifices. With monitoring of jewelry trays and display cases, store management can be alerted if an unsold item is missing from a tray at the end of the day when they are returned to the store’s backroom and/or the location’s safe.

Thus, inventory shrinkage – both from internal and external causes – has been a very real and intractable problem for jewelry retailers. RFID tagging of individual items can thus go a long way in protecting and monitoring a store’s valuable inventory, and thus, increased protection and visibility, combined with loss prevention, are significant parts of the ROI equation for RFID implementations in the retail sector. One jewelry retailer in the Middle East reports that its annual losses in a single store have declined from a quarter million dollars a year to zero since installing RFID-based inventory tracking, making its ROI on its RFID investment roughly 400% [29]. An illustrative case recently came to light as one of the few jewelry stores in the United States making use of active RFID used the security system to actually recover a stolen Rolex™ watch. Sissy's Log Cabin, a jewelry store in Pine Bluff, Arkansas, had implemented an RFID-based inventory management solution from Jewelry Computer Systems, Inc. of Naperville, Illinois. The store’s employees were alerted when a shoplifter stole a Rolex watch from one of the store’s display cases. While the perpetrator got away, the store owner, Sissy Jones, credits the RFID security system with being alerted to the theft and identifying the article. She stated: “We noticed that there was one empty hole [where a watch should have been] and we got our scanner out and scanned them. In 10 to 15 minutes we knew which one was missing” [37]. Being able to trace the item by its serial number, the watch was recovered in a pawn shop over 500 miles away in Dallas, Texas in just two days [37].

4.3. Sales Monitoring and Metrics

Finally, there is the issue of sales monitoring and metrics. Even with relatively low-end jewelry, personal selling is key – especially given the unbranded nature of jewelry items, their cost, their similarity, and the infrequency of such purchases for most people. Thus, RFID inventory solutions can also offer a powerful sales management tool to jewelry retailers. In a nutshell, from the perspective of RSI ID's sales and marketing vice president, Tawnya Clark: “It helps the store manager understand what the salesperson is doing” [38]. With software tailored to the jewelry industry, several of the competing systems can enable store and chain managers to be able to answer questions such as:

- Which items are selling...and which are not?
- Which salespeople are showing and selling which items?
- How often are particular items being shown to customers?
- How long is each item being displayed before it is sold?
- How many times is an item shown before it is sold?
- Which items are not being shown to customers?

- Which items are aging in inventory and need to potentially be looked at for markdowns?

Thus, RFID tracking will enable a whole new era of jewelry store management through the visibility such systems provide not just on the inventory itself, but on the efforts and effectiveness of jewelry salespeople.

4. ANALYSIS

Across the globe, the jewelry market certainly presents an intriguing application area for RFID. The business case can be made very well in this unique market, due to not just the value of the items being sold, but the very solid results in inventory management and security, as well as sales effectiveness, that can be made. Vendors in this area speak of ROI being in months, as opposed to years, even for small store installations. Thus, the retail jewelry sector can be expected to rightly be one of the hot growth areas for RFID solutions providers in the next few years. And, with the demonstrated growth in the world-wide market for jewelry [1, 2], the potential size of this market area will likely attract even more RFID solutions tailored to meet the unique needs of the retail jewelry environment.

What is around the corner? Certainly, tags will be coming in much smaller form factors. An Indian firm, Orizin Technologies, has begun marketing an RFID tag that is 26 x 23 x 7.3 millimeters in size, with a read range of 20 meters [39]. Likewise, the China-based Daily RFID Company, Ltd. [40] has recently introduced a tiny RFID tag, with a thickness of just .6mm, which is specifically aimed at the jewelry market. The tag, which costs just over one U.S. dollar per unit, can be applied both individual items of jewelry and jewelry boxes, trays, and cases to enable in-store and shipment tracking. Scientists at Hitachi Research Labs in Japan have devised the tiniest RFID tag ever. Measuring just 0.05 millimeter by 0.05 millimeter, the so-called powder chip is smaller than the width of a strand of hair. While such a small tag can have a wide variety of uses in items such as passports, gift certificates, and currency, perhaps the most exciting application could be in the jewelry industry. Such a small tag could be invisibly embedded in items such as rings, necklaces, and watches, enabling them to be better tracked in retail locations and the supply chain. The powder tag would also make it possible for jewelry makers to introduce an e-pedigree to jewelry items, enabling “track and trace” capabilities and making it possible for all parties to verify the authenticity and legitimacy of items [41]. Such a capability could prove to be an extremely effective means of not just fighting counterfeiters and the large trade in counterfeit jewelry, but to severely restrict the ability of criminals and black marketers to sell stolen jewelry, as the value of unverifiable items would be far less than verifiable items.

Finally, as the noted management expert/futurist Don Tapscott (2007) recently posited, such an e-pedigree could be used to verify that diamonds have not been sourced from the so-called “Blood Diamond” areas of Africa, an issue thrust in the public spotlight by the movie of that same name [42]. Indeed, a voluntary system, known as the Kimberley Process Certification Scheme, was established by South African diamond producing states in 2000 to certify that a diamond has not been sourced from an area where the sale of such objects could help finance the operations of rebel groups. The certification scheme aims at preventing these “blood diamonds” from entering the mainstream rough diamond market, and its development was aimed at trying to assure consumers that their purchase of a diamond engagement ring, pin or broach would be possibly helping finance civil wars and human rights abuses [43].

Thus, RFID in this market can enable those in the jewelry industry to “do right by doing good,” making a compelling case for RFID in this global marketplace.

REFERENCES

- [1] Anonymous, "Global jewelry sales could reach \$280 billion by 2015," *Israel Diamonds*, February 1, 2007. [Online]. Available: <http://www.highbeam.com/doc/1G1-160480711.html> [Accessed: October 15, 2009].
- [2] P.N. Danziger, "Consumers' taste for high-end jewelry grew in 2006," *Unity Marketing*, September 4, 2007. [Online]. Available: http://www.unitymarketingonline.com/cms_jewelry/jewelry/pr_main/Jewelry_Report_Intro_2007_9-4-07.php [Accessed: December 16, 2008].
- [3] First Research, "Industry research: Jewelry, retail," July 2, 2007. [Online]. Available: <http://www.firstresearch.com/Industry-Research/Jewelry-Retail.html> [Accessed: September 29, 2009].
- [4] Research and Markets, "Jewelry Report, 2006 update: The who, what, where, why and how much of jewelry shopping", June 2006. [Online]. Available: <http://www.researchandmarkets.com/reports/342327> [Accessed: December 20, 2008].
- [5] International Diamond Exchange, "America's best jewelry market niches," *IDEX Magazine*, October 10, 2006. [Online]. Available: http://www.idexonline.com/portal_FullMazalUbracha.asp?id=26324 [Accessed: January 7, 2009].
- [6] U.S. Signet Group, "UK jewellery marketplace," November 2006. [Online]. Available: <http://www.signetgroupplc.com/pages/205/UK+Jewellery+Marketplace.stm> [Accessed: December 20, 2008].
- [7] S. d'Hont, *The cutting edge of RFID technology and applications for manufacturing and distribution: A white paper from Texas Instruments (Released July 2003)*. [Online]. Available: http://www.ti.com/tiris/docs/manuals/whtPapers/manuf_dist.pdf [Accessed: April 23, 2004].
- [8] D.C. Wyld, "The RFID revolution: How radio frequency identification is poised to transform business and enhance our lives," *Journal of Digital Business*, 1(2), pp. 1-13, December 2006.
- [9] R. Malone, "Reconsidering the role of RFID." *Inbound Logistics*, August 2004. [Online]. Available: <http://www.inboundlogistics.com/articles/supplychain/sct0804.shtml> [Accessed: September 18, 2004].
- [10] D.C. Wyld, *RFID: The right frequency for government - A research report from The IBM Center for the Business of Government*, September 2005. [Online]. Available: http://www.businessofgovernment.org/main/publications/grant_reports/details/index.asp?gid=232 [Accessed: October 3, 2005].
- [11] R. Singel, "American passports to get chipped." *Wired*, October 21, 2004. [Online]. Available: <http://www.wired.com/news/privacy/0,1848,65412,00.html> [Accessed: December 2, 2004].
- [12] J. Van, "RFID spells media revolution, futurist says." *Chicago Tribune*, 24(104), p. B1, April 16, 2005.
- [13] D.C. Wyld, "RFID 101: The next big thing for management." *The Engineering Management Review*, Vol. 35, No. 2, pp. 3-19, May 2007.
- [14] D.C. Wyld, "The implant solution: Why RFID is the answer in the highly unique orthopedic supply chain, providing ROI for suppliers and assurance for patients and their surgeons." *ID World*, Issue 15, pp. 12-15, June 2008.
- [15] D.C. Wyld, "Playing a deadly game of match: How new efforts to use RFID in blood banking and transfusion can save patient lives and safeguard the blood supply chain." *Global Identification*, Issue 37, pp. 24-26, March 2008.
- [16] D.C. Wyld, "The importance of pedigree: Why instituting RFID-based tracking of pharmaceuticals is essential to counteracting counterfeiting and maintaining both the health of

- the public and the potency of the American drug industry.” *Competition Forum*, 4(1), pp. 261-266, October 2006.
- [17] D.C. Wyld, “Sports 2.0: A look at the future of sports in the context of RFID’s ‘Weird New Media Revolution.’” *The Sport Journal*, 9(4), pp. 3-17, December 2006.
- [18] D.C. Wyld, “DaVinci uncoded: RFID is enhancing the management and experience of art galleries and museums...and even becoming a part of the artists’ palettes for creating works of art.” *Global Identification*, Issue 26, pp. 36-40, May 2006.
- [19] D.C. Wyld, “Radio frequency identification: Advanced intelligence for table games in casinos,” *Cornell Hospitality Quarterly*, Vol. 49, No. 2, pp. 134-144, June 2008.
- [20] J. Collins, “Bookstore RFID-enables its operations: One of Holland’s largest booksellers has integrated RFID into the operations of its brand-new store,” *RFID Journal*, April 18, 2006. [Online]. Available: <http://www.rfidjournal.com/article/articleview/2273/> [Accessed: November 15, 2008].
- [21] M.C. O’Connor, “Wegmans eyeing RFID for prescription management: The supermarket operator is planning to test whether placing RFID tags on customers’ prescription orders will make locating and ringing up the orders faster and more accurate,” *RFID Journal*, January 10, 2008. [Online]. Available: <http://www.rfidjournal.com/article/articleview/3844/> [Accessed: July 6, 2008].
- [22] C. Swedberg, “Best Buy eager to use RFID to eliminate checkout lines: The greatest obstacle to deployment, according to Best Buy CIO Bob Willett, is the current cost of tags and readers,” *RFID Journal*, June 20, 2007. [Online]. Available: <http://www.rfidjournal.com/article/articleview/3422/1/1/> [Accessed: January 16, 2008].
- [23] C. Swedberg, “Canadian grocery pilot finds ROI in RFID: By implementing RFID, retailers and suppliers should markedly reduce out-of-stocks and improve promotional execution, according to a seven-month project involving Loblaw and four of its suppliers,” *RFID Journal*, June 20, 2007. [Online]. Available: <http://www.rfidjournal.com/article/articleview/3428/1/1/> [Accessed: June 21, 2008].
- [24] D.C. Wyld and M.C. Budden, “Upping the ante: Using RFID as a competitive weapon to fight shoplifting and improve business intelligence,” *The International Journal of Managing Information Technology*, 1(1), pp. 1-10, November 2009.
- [25] Cybermedia News, “Orizin’s RFID sold for jewellery makers: Jtrack would help the manufacturers to collect data from hundreds of items in few seconds,” *DQ Channels*, April 19, 2007. [Online]. Available: <http://dqchannels.ciol.com/content/reselleralert/107041902.asp> [Accessed: December 20, 2008].
- [26] C. Swedberg, “RFID tracks jewelry sales, inventory in Mideast: Fifteen retail locations in the United Arab Emirates, Qatar and Bahrain have begun using a system that tags and tracks jewelry items,” *RFID Journal*, May 18, 2007. [Online]. Available: <http://www.rfidjournal.com/article/articleprint/2348/-1/1/> [Accessed: August 26, 2009].
- [27] M. Vienet, “RFID tag targets jewelry industry,” *Product News Network*, March 6, 2006. [Online]. Available: http://findarticles.com/p/articles/mi_m0PIL/is_2006_March_6/ai_n16090917/pg_2 [Accessed: June 24, 2009].
- [28] M.C. O’Connor, “Swiss jeweler RFID-tagging inventory: Swiss watch and jewelry maker de Grisogono is using TAGSYS 13.56 MHz tags and interrogators in an RFID tracking and inventory system aimed at increasing accuracy and reducing theft,” *RFID Journal*, February 9, 2007. [Online]. Available: <http://www.rfidjournal.com/article/articleprint/2143/-1/1/> [Accessed: August 3, 2009].
- [29] R. Wessel, “Saudi Arabian Jeweler Puts a High Value on RFID,” *RFID Journal*, November 19, 2008. [Online]. Available: <http://www.rfidjournal.com/article/pdf/4451/.../rfidjournal-article4451.PDF> [Accessed: October 13, 2009].

- [30] National Retail Federation, *Press release: Retail losses hit \$41.6 billion last year, according to National Retail Security Survey*, June 11, 2007. [Online]. Available: http://www.nrf.com/modules.php?name=News&op=viewlive&sp_id=318 [Accessed: June 12, 2009].
- [31] A. D'Innocenzio and M. Kabel, "Theft rising at U.S. Wal-Mart stores," *The Boston Herald*, June 14, 2007. [Online]. Available: http://www.boston.com/business/articles/2007/06/14/theft_rising_at_us_wal_mart_stores?mode=PF [Accessed: December 15, 2008].
- [32] R. Bates, "JSA (Jewelers Security Alliance): New lows for jewelry crime," *JCK-Jewelers Circular Keystone*, March 28, 2007. [Online]. Available: <http://www.jckonline.com/article/CA6428830.html> [Accessed: January 30, 2009].
- [33] L. Martinez, "A gem of a theft: Fighting jewelry store robberies. From distraction thefts to recent "gate-cutting" incidents, a look at the newest tactics you need to stand guard against," *Security Info Watch*, January 12, 2006. [Online]. Available: <http://www.securityinfowatch.com/article/article.jsp?id=6876&siteSection=382> . [Accessed: August 6, 2009].
- [34] Reuters, "Retailers face organized shoplifters, e-fencing," *CNBC.com*, June 4, 2008. [Online]. Available: <http://www.cnbc.com/id/24960983> [Accessed: September 1, 2008].
- [35] J. Groover, "Organized crime: Retailers combat growing number of professional shoplifters," *Shopping Centers Today*, October 2006. [Online]. Available: <http://www.icsc.org/srch/sct/sct1006/index.php> [Accessed: September 15, 2008].
- [36] National Retail Federation, *2008 Organized Retail Crime Survey*, June 2008. [Online]. Available: http://www.nrf.com/modules.php?name=News&op=viewlive&sp_id=522 [Accessed: July 3, 2008].
- [37] A. DeMarco, "RFID to the rescue," *JCK Online*, May 4, 2009. [Online]. Available: http://www.jckonline.com/article/280490-JCK_Special_Report_RFID_to_the_Rescue.php [Accessed: October 31, 2009].
- [38] C. Swedberg, "RSI ID Technologies' system uses EPC RFID to track jewelry, eyewear: Retailers would be able to track their high-value items in showcases and act on data indicating which items were being shown, and by which employees," *RFID Journal*, April 6, 2007. [Online]. Available: <http://www.rfidjournal.com/article/articleprint/3215/-1/1/> [Accessed: February 7, 2009].
- [39] Anonymous, "Indian company claims 'world's smallest' active RFID tag," *RFID News*, November 24, 2008. [Online]. Available: <http://www.rfidnews.org/2008/11/24/indian-company-claims-worlds-smallest-active-rfid-tag> [Accessed: June 17, 2009].
- [40] Daily RFID Company, Ltd., *Press Release: RFID OEM tag - The smallest RFID tag for jewelry*, January 10, 2009. [Online]. Available: <http://www.rfid-in-china.com/2009-01-04/RFID-oem-rfid-tag-for-jewelry.html> [Accessed: July 7, 2009].
- [41] G. Stemp-Morlock, "Talking jewelry: Radio tags smaller than pepper flakes could make diamond rings and other valuables more secure," *Popular Science*, June 2007. [Online]. Available: <http://www.popsci.com/popsci/technology/8240a311ed203110vgnvcm100004eecbccdrd.html> [Accessed: January 18, 2009].
- [42] C. Kremkow, "Blood Diamond: Little impact over the counter," *Modern Jeweler*, February 2007. [Online]. Available: [http://www.modernjeweler.com/print/Modern-Jeweler/emBlood-Diamond-em-Little-Impact-Over-the-Counter/1\\$216](http://www.modernjeweler.com/print/Modern-Jeweler/emBlood-Diamond-em-Little-Impact-Over-the-Counter/1$216) [Accessed: December 20, 2008].
- [43] P. Ross, "Diamond sector puts in sparkling performance," *African Review of Business and Technology*, October 2006. [Online]. Available: <http://www.allbusiness.com/specialty-businesses/minority-owned-businesses/3981019-1.html> [Accessed: January 10, 2009].

Author

David C. Wyld (dwylld@selu.edu) currently serves as the Robert Maurin Professor of Management at Southeastern Louisiana University in Hammond, Louisiana. He is the Director of the College of Business' Strategic e-Commerce/e-Government Initiative, the Founding Editor of both the *Journal of Strategic e-Commerce* and the *International Journal of Managing Information Technology* (current editor). He is a frequent contributor to both academic journals and trade publications. He has established himself as one of the leading academic experts on emerging applications of technology in both the public and private sector. He has been an active consultant, a qualified expert witness, and an invited speaker on the strategic management of technology to both trade and academic audiences.

