Measuring the Impact of RFID in Retailing:

Keys Lessons from 10 Case-study Companies



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SHRINKAGE AND OSA GROUP

By
Emeritus Professor Adrian Beck
University of Leicester

February 2018

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About the Author

Adrian Beck is an Emeritus Professor at the University of Leicester, UK. Over the last 29 years, his research work has focused on helping retailers better understand the impact of loss and how it can be more effectively managed. He is currently an academic advisor to ECR Community's Shrinkage and On-shelf Availability Group.

He is extremely grateful to all those retailers who agreed to take part in this research – their time and patience was very much appreciated. Particular thanks are also due to, Jacky Broomhead, Markus Mueller, Colin Peacock, Hans-Peter Scheidt and Martin Speed for providing feedback on early drafts of this report.

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GS1

GS1 is a neutral, not-for-profit organisation that develops and maintains the most widely used global standards for efficient business communication. It is best known for the barcode, named by the BBC as one of 'the 50 things that made the world economy'. GS1 standards improve the efficiency, safety and visibility of supply chains across physical and digital channels in 25 sectors. Its scale and reach – local Member Organisations in 112 countries, 1.5 million user companies and 6 billion transactions every day – help ensure that GS1 standards create a common language that supports systems and processes across the globe.

For further information: https://www.gs1.org

ECR Community Shrinkage and On-shelf Availability Group

The Group is part of ECR Community, a voluntary and collaborative retailer-manufacturer platform with a mission to 'fulfil consumer wishes better, faster and at less cost'. Over the last 19 years, the Group has acted as an independent think tank focused on creating imaginative news ways to better manage the problems of loss and on-shelf availability across the retail industry. Championing the idea of Sell More and Lose Less, the Group is open to any retailer and manufacturer to join.

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Foreword



The ECR Community Shrinkage and On-shelf Availability Group is delighted to have had the opportunity to co-sponsor this exciting and innovative research project. It is the latest in a long line of research initiatives the Group has supported since its inception nearly 20 years ago. Carried out by our longstanding academic advisor, Professor Adrian Beck from the University of Leicester in the UK, this report makes an important contribution to our understanding of how RFID technologies can help the retailer community to not only further enhance the consumer experience, but also be better prepared to meet the growing challenges of operating in the 21st Century.

As a technology, RFID has taken time to become a realistic proposition for most retailers – it has often struggled due to issues of reliability and an inability to offer a viable and sustainable return on investment. However, as Professor Beck's research with the 10 retail companies that agreed to take part in this research shows, many aspects of the technology have matured to the point where they can now be considered reliable and, in the right retail environment, and by adopting a realistic and measured approach to its use, offer an attractive financial proposition to those willing to invest.

I very much hope you enjoy reading this report and utilising its findings to better understand whether it might be time for you to embark on your own RFID journey.



John Fonteijn
Chair of the ECR Community Shrinkage and On-shelf Availability Group



RFID is a real game changer for retail operations. But as a technology that has been on the radar for some time, its transformative potential has suffered from over-hyping. This report, produced with the ECR Community Shrinkage and On-shelf Availability Group, shows RFID has now surpassed the hype to deliver real benefits to an increasing number of businesses. RFID addresses a lot of the key issues retailers face today; from improving inventory management and improving sales to providing the level of detail needed to deliver omni channel processes. And it aligns with strategic growth objectives by helping them to provide better service and a better experience for their customers.

GS1 has been a long-term supporter of RFID, guiding the development of the industry standard EPC which we now maintain. Developing an industry standard was a key turning point in the evolution of RFID as it gave businesses the confidence to adopt the technology. Agreeing a standardised format also led to a +75% reduction in the cost of RFID tags. Through the use of our standards, GS1's primary role is to make it easier for businesses to trade together. And, as the custodian for EPC, we provide neutral advice to help retailers on their RFID journeys. To support their continued success with the technology we are delighted to partner with ECR Community on this report. The findings uncover must-read content for anyone interested in adopting RFID in retail, including the KPI data of retailers using RFID and their biggest learnings.

We hope you enjoy reading the report and look forward to seeing more successful RFID roll outs in the future.



Gary Lynch FCILT
CEO GS1 UK

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Executive Summary

Background and Context

This report is based upon research focussed on capturing the detailed experiences of 10 retail companies that have invested in RFID technologies – understanding their decision to invest, reflecting on some of the results they have achieved, and charting the lessons (both positive and negative) they are able to share from their RFID journeys. Most of the companies that agreed to take part were Apparel retailers, adopting a range of both small and large-scale RFID systems. Collectively, these companies have overall sales in the region of €94 billion a year and are using at least 1.870 billion tags a year – equivalent to about 60 tags per second.

The Business Context for Investment

Driving Sales: The primary goal of investing in RFID was to deliver improvements in inventory visibility and accuracy, which in turn would grow sales.

Optimising Stock Holding: Respondents also recognised the potential of RFID to enable them to optimise their stock holding, reducing capital outlay and improving staff productivity.

Fewer Markdowns: Most case-study companies regarded RFID as a key tool in helping to reduce the amount of stock they offered at discounted prices.

Helping to Drive Innovation and Business Efficiencies: RFID was frequently viewed as part of a broader organisational change project focussed on putting *enabling* technologies in place to drive transformational change to achieve future success.

Recognising the Omni Channel Imperative: This technology was viewed as a key driver in developing the capacity to deliver a profitable omni-channel consumer experience – in effect the organisational 'glue' that will hold together much of the architecture of 21st Century retailing.

Measures of Success

Increase in Sales: Seven of the 10 case studies shared data showing a sales improvement in the range of 1.5% to 5.5%. For SKUs identified by RFID systems as being out of stock, the growth was even higher. Based upon this data, the 10 companies taking part in the study may have realised an RFID-driven sales uplift of between €1.4 and €5.2 billion.

Improved Inventory Accuracy: Companies typically had an improvement from 65%-75% to 93%-99%.

Stock Availability: Some of the companies taking part were now findings SKU availability in the high 90% region.

Reduced Stock Holding: One-half of the case-study companies shared data on this measure, indicating a stock reduction of between 2% and 13%.

Lower Stock Loss: One company suggested that their shrinkage losses had been reduced by 15%.

Reduced Staff Costs: One company had measured a saving equivalent to 4% of their store staffing costs, which if rolled out across the case-study companies would be in the region of €378 million.

Return on Investment: All 10 companies were unequivocal in their assertion that the ROI had been achieved, and based upon their trial experiences, further roll out across the business was fully justified and embraced by the rest of the business, often with considerable enthusiasm and optimism.

Learning Lessons

Role of Senior Management: The role of the senior management team in both the initiation and subsequent delivery of the RFID project was seen as paramount – without their active support and recognition of the financial imperative, virtually none of the projects would have been initiated.

Choosing a Business Leader: The RFID project leader was typically the person who had responsibility for on-shelf availability/stock integrity, regardless of where they were located within the business hierarchy.

Engaging the Business: Respondents to this research clearly articulated the importance of working hard at getting cross functional buy in – RFID projects have long tentacles embracing most retail functions.

Understanding Your Business Context: Many respondents considered this one of their biggest challenges – understanding how RFID will impact on the business. Undertaking detailed process mapping and recognising how products move through the supply chain was considered key, as was assessing the impact the physical environment might have on

the functionality of the technology and how it would integrate (or not) with legacy systems.

Challenges of Integration: By far and away the biggest headache these companies faced as they progressed on their RFID journey was the thorny issue of integration with legacy retail systems. A number felt they had not planned sufficiently well on how to resolve this issue and counselled future adopters to not only take integration seriously but think very early on in the process the extent to which they want new and existing data systems to communicate.

Seeking External Help: Virtually all of the companies taking part in this research had sought some degree of external advice as they began their RFID journey: RFID consultancies, technology providers, other retailers, and organisations developing common standards such as GS1.

Choosing RFID Technologies: Most companies had adopted a circumspect, modest and highly price conscious approach to the selection and use of their RFID technologies – the mantra of 'keep it simple and highly focussed' was very apparent.

Tag Reliability: No companies had any concerns about the reliability of their chosen tags; a more prescient issue now was ensuring the tag remained attached and its position on the product was optimised.



Choice of Readers: By far and away the predominate reader technology used was handhelds provided to store staff. Relatively few companies were utilising any form of transition readers (to track product moving between different parts of the supply chain), integrated point of sale readers or exit detection readers. As yet, none had committed to using in-store overhead readers beyond some ongoing store trials.

Avoid Tagging in Store: All 10 companies taking part in this research had opted for a long-term strategy that involved the RFID tags being applied at the point of manufacture.

Standards Matter: While case-study companies varied in the degree to which they were sensitised to the importance of adopting RFID-based standards, all agreed that without them, it would be more difficult to innovate and evolve in the future. Standards were highlighted as being key in reducing confusion in the supply chain and avoiding getting locked into any particular provider.

Undertaking Trials: All companies had undertaken a combination of Proof of Concept Trials (does the technology work?), Pilot Trials (how will RFID operate in our particular environment?) and Development Trials (how can we evolve our RFID system?). A number of companies urged caution in the speed with which Pilot Trials in particular were undertaken, to ensure that the full impact of the introduction of the technology can be fully understood across a range of different environments.

Measuring Impact: Ultimately, RFID is an intervention used to enable the business to be more successful in meeting its core objectives of being a sustainably profitable retailer. In and of itself an RFID system is little more than a combination of technologies that provide the user with actionable data. Most case-study companies had relatively few KPIs they wished to achieve, with an improvement in sales being the most prominent. But it is important to understand how any chosen KPI will be delivered, including identifying the organisational drivers/mechanisms that will enable them to be achieved and how they will be measured.

Rolling Out RFID: All companies had committed to rolling out their RFID programmes – a ringing endorsement for how valuable it was considered to be to their businesses. As with the Pilot Trials, some companies counselled caution concerning the speed of roll out, citing numerous difficulties they had faced

by moving too quickly. Of particular importance was timing – avoiding peak times in the retail calendar and investing in high quality and sustainable training for retail store staff.

Loss Prevention and RFID: Few of the companies regarded their RFID system as an effective tool to actively reduce stock loss, particularly malicious forms of loss such as shoplifting. Primarily this was because the tags being used (swing tags and stickers) were very easy to remove and current exit readers were viewed as being relatively unreliable. However, some were using RFID data to better understand which products would benefit from additional security as well as helping in the evaluation of store trials of stock loss interventions. For one retailer, an indirect benefit of store staff now having more time to be on the shop floor (because RFID had reduced the time other tasks had taken) was that they could increasingly act as a visible deterrent to prospective shop thieves.

Remember RFID is a Journey: Case-study companies were keen to remind prospective users that RFID systems are not a plug and forget technology – they require ongoing commitment to ensure they remain fit for purpose and capable of delivering the KPIs originally required by the business to justify any recurring investment.

Keeping it Simple: The final piece of advice many offered was to keep any planned RFID project simple – do not make it over complicated, and remember RFID merely provides data; if you do nothing with it then it is destined to fail.

Future Developments

The 10 case-study companies highlighted the following areas for future development of their RFID systems:

- Using the technology in fitting rooms and with 'Magic Mirrors'.
- Greater use of RFID along the entire supply chain.
- Broadening coverage across more SKUs and locations.
- Improving data collection interfaces and data integration in the business.
- Improving tags, in particular how they are attached to various products.
- Exploring how overhead readers may be used in the future.
- Delivering checkout-less stores.
- Creating seamless merchandise visibility with a range of technologies beyond just RFID.



Background and Context

Since the term Radio Frequency Identification (RFID) came into common usage within the retail environment, around the end of the 1990s, it has in many respects been an idea driven more by hope and hype than practical realisation[1]. It is closely linked with the 'Internet of Things' concept whereby all manufactured objects have the capability to be uniquely identified and the capacity to do this without the need for line of sight[2]. For retailers it promised a world where supply chains would become fully transparent, with all products identifiable in real time, bringing an end to oversupply and out stocks – the ultimate optimisation tool, allowing retailers to truly deliver 'just in time' supply chains tailored precisely to the needs of their customers[3]. In addition, RFID offered other 'game changing' benefits such as the end of traditional checkouts and associated queuing for the consumer – products would automatically 'checkout' as they left the store, with the consumer's credit card being billed accordingly[4].

Within the realm of loss prevention, the RFID 'revolution' offered much promise[5]. With each item being uniquely identifiable in real time, it was argued shop theft would become a thing of the past as thieves would be automatically identified as they tried to leave the store without paying. Similarly, problems such as returns fraud (where a thief attempts to claim credit for an item they have not actually purchased) would be eliminated as the previous ambiguity around whether they had actually bought 'that' item would no longer exist – the product would 'tell' the retailer its current status (bought or not bought). Back in the early 2000s it seemed RFID was going to totally transform the retail world – indeed, it was described by one of its earliest advocates in the following glowing terms: 'as significant a technology as certainly the Internet and possibly the invention of the computer itself'[6].

If we skip forward 17 years, then it becomes very quickly apparent that RFID, as yet, cannot be remotely put in the same category as the Internet in terms of its impact upon the world or more specifically retailing. Arguably, it is a technology that has seriously struggled to match up to the hype heaped upon it at the end of the 1990s and into the early 2000s[7]. It continually floundered on the rocks of physics and economics, with the 'Faraday Cage' in many respects proving to be the prison 'cell' from which RFID has struggled to escape[8]. But it also struggled to establish a strong foothold because questions about privacy and desirability often remained secondary to delivering the technological utopia of all objects being able communicate with each other and the rest of the world[9]. A such, many of those long in the tooth in retailing have become familiar with the sentence that starts: '…in the next five years RFID will…'!



However, the outlook now appears to be changing fast for RFID and what has been seen in the past few years is a much more enlightened, less evangelistic and more realistic approach to how RFID may be able to play a role within retailing, one that recognises its limitations and plays to its identifiable strengths[10]. The technology has also had the opportunity to gradually mature, away from the spotlight of unrealistic expectations, and begin to show how it can be used to help retailers resolve some of their ongoing and growing concerns. This can be seen particularly in parts of retailing that do not have a concentration of products largely made up of metals and viscous fluids, which have traditionally proved highly challenging for RFID to cope with.

Retailers focussed on apparel and footwear in particular have begun to use this technology to help them manage their supply chains more efficiently, utilising RFID's capacity to bring transparency and ease of audit into the retail space[11]. As pressures within retailing concerning competition and growing consumer demands for greater and more accurate

availability have increased (particularly with the growth of omni channel), then some companies have begun to invest in RFID to help them respond. While we are still some way from RFID becoming 'bigger than the Internet', it would seem that a more gradual and incremental introduction into retailing is underway, one that recognises its weaknesses but at the same time is beginning to take advantage of developments in the technology. This movement is perhaps beginning to show that while the Internet of 'all' Things remains a pipe dream within retailing, the Internet of 'some' Things is not only becoming a reality, but that it seems to be making good business sense for some retailers to begin to invest in it[12].

Capturing Reflections on RFID

It is within this context that the research presented in this report is put forward. Back in 2002 the ECR Shrinkage Group commissioned a project to review the way in which RFID might impact upon the world of retail loss prevention – reflecting upon the prospects, problems and practicalities associated with this technology[13].

Since then, much has changed, and this report offers an opportunity to reflect more broadly on its recent use, offering a fresh understanding about how this technology is now being used and what lessons can be drawn from its development, its implementation and its impact on retail businesses. Based upon the detailed experiences of 10 companies that have made the commitment to invest in RFID, the report sets out to answer the following questions:

- What is the business context within which some retailers decide to invest in RFID?
- How do these companies begin their RFID journey?
- What steps do they follow when undertaking a trial?
- In what ways do they measure the impact of RFID and what have they found?
- How do they begin to roll it out to the rest of the business?
- How have they dealt with the key challenge of integration?
- What role, if any can RFID play in managing loss prevention?
- What lessons have these companies learnt on their RFID journey?
- How might they be planning to use this technology in the future?

The report begins by offering a brief overview of the research methodology used before moving on to answer each of these questions in turn. By the end, it is hoped that any company thinking about embarking on their own RFID journey will be in a better position to understand the pitfalls, practicalities and indeed benefits that may await them.



Methodology

This research was primarily interested in capturing the experiences, both good and bad, of a range of companies that had decided to invest in some form of RFID technology[14]. It adopted a case-study methodology[15] with data being collected via requests for various types of quantitative data relating to the use and performance of RFID, together with primarily face-to-face interviews with company representatives[16].

Those selected to be interviewed varied in their position within the company, but all had been involved to varying degrees with the design, implementation and review of the RFID project in their businesses. Interviews took place either in the Head Quarters of the company or one of the stores participating in the RFID project. Where it was the latter, the researcher was able to view the system in action and talk to store staff about their experiences of using it.

Interviews lasted between 65 and 150 minutes, and all were recorded and transcribed. It is important to note that this report is focussed primarily upon reviewing the experiences of the companies that agreed to take part and as such it is not intended to be a technical review of the specific RFID systems they are utilising. As such none of the technology providers being used by any of the case-study companies will be named – while it will be possible for RFID industry watchers to ascertain from the list of companies below what technologies were used, the report does not intend to offer any recommendations about what RFID systems should be used.

Participating Companies

For the most part, Apparel retailers have been at the forefront of adopting RFID technologies in recent years and so inevitably, but not exclusively, they make up the largest proportion of companies taking part in this research.

A number of companies were approached to take part based upon publicly available information on their use of RFID. It was hoped that, where possible, a range of different types of companies would be included – large and small-scale RFID projects, single and multiple country roll outs, various types of products and types of RFID systems used, and of course different types of retail environment.

Inevitably, as with much of the research carried out on retailing, particularly where some of the information required can be regarded as sensitive and potentially competitive in nature, company selection ends up being driven more by willingness to engage than any overarching systematic methodological framework. However, 10 companies eventually agreed to participate, offering a broad range of RFID experiences – some were on a very big scale (in terms of quantity of tags used), with three purchasing more than 150 million tags each per year, while others were relatively small scale, with significantly less than one million tags a year. Equally, some companies had rolled out their programmes across multiple countries while others had limited it to just one.

The sales turnover of the companies varied between about €150 million and €50 billion, with all 10 having total sales in the region of €94 billion a year. Together they accounted for at least 1.870 billion RFID tags a year[17], equivalent to the use of about 60 tags per second. Geographically, most companies were located in Europe, although one was based in Canada, with their RFID programme covering their North American operations, while another had rolled it out to 800 stores in 17 countries.

The 10 companies that took part in this research were:

- Adidas
- C&A
- Decathlon
- Lululemon
- Jack Wills
- John Lewis
- MARC O'POLO
- Marks & Spencer
- River Island
- Tesco

Confidentiality and Presentation of Data

Throughout this report, direct quotations are provided from the transcripts of interviews carried out with a range of representatives from the companies taking

part in this research. Each quotation has been given an identifying case-study number, but due to the relatively small number of companies taking part and to avoid any particular respondent being identified across multiple quotations, this identifier has been changed for each section of the report. So for instance, code R1 refers to a different retailer in each of the sections in the report. Where respondents have provided quantitative data, this has also been anonymised and checked with the companies that agreed to take part. Where currency exchange has been necessary, the prevailing rate on the 11th December 2017 has been used[18].

Limitations

As with any research, there are limitations in what can be achieved and presented. While this research has attempted to offer an independent and critical review of the use of RFID in the retail sector, the case-study selection process needs to be taken into account when reviewing the findings. Because of the chosen selection criteria and the challenge of obtaining retailer support, no companies are represented that have trialled RFID and decided against rolling it out – the views of these types of company are absent from this research[19].

In addition, there are some companies that have adopted a different approach to using RFID than those represented in this research, namely using a hard tag variant applied either at the point of manufacturer or later in the supply chain. While one of these companies was approached to take part in the research, they declined and so it is not possible to include their experiences and views of using RFID. As such, it is important to recognise that the general approach adopted by these 10 companies is not necessarily representative of all retail companies that are now using RFID.

It is also the case that while some companies were prepared to share limited data on the efficacy of their RFID system, it was not possible to verify in any detail the reliability nor accuracy of the information shared with the researcher. Moreover, companies varied in the ways in which they measured the impact of RFID systems, and the ways in which they defined particular measures such as on shelf availability and stock integrity. Every effort has been made to try and make valid comparisons, but the challenges of undertaking secondary analysis of this type of data needs to be recognised.

Given all of that, it is hoped that the data collected from these 10 companies offers some valuable insights about their RFID journeys – the challenges they faced and the ways in which they developed their programmes to ensure that they offered both a meaningful ROI and significant opportunities for future development.



The Business Context

There were a number of reoccurring themes that emerged when respondents were asked to explain why their business had embarked on introducing RFID into their organisations, most of which were orientated around how it could improve the overall performance of the business and meet the future challenges of an increasingly competitive market.

Delivering Inventory Visibility and Accuracy

Most respondents were very clear that the primary goal of their RFID programme was to help them deal with the problem of inventory inaccuracy and its knock-on effect on out of stocks and ultimately lost sales: 'There was growing awareness in the business about how bad our out of stocks were'[R4]. Another respondent put it very succinctly: 'for us, [there was] only one KPI [Key Performance Indicator]: stock integrity, which generates accurate replenishment, which equals increased sales'[R7]. This respondent went on to highlight the impact errors in the supply chain had upon their store stock holding records: '1% of our deliveries are inaccurate and that contributes to about 30% of our stock inaccuracy because it builds every week'[R7]. Others agreed and talked about the need for, and value of, having greater visibility of their merchandise and what it could bring to the business: 'merchandise visibility is the objective – RFID is a means to an end; 'visibility of stock was the main reason for embarking on [our] RFID journey'[R5].

Improving Customer Satisfaction

The problem of out of stocks and it impact upon the business was also highlighted by others who focussed particularly upon its effect on their customers: 'out of stocks was our biggest cause of customer dissatisfaction. That was the main reason for RFID'[R3]. They went on to argue that by improving customer satisfaction then ultimately sales would be improved which would justify the investment in RFID. As detailed below, customer satisfaction became an even more prescient factor when retailers begin offering an omni channel experience – the opportunities for getting it wrong can multiple considerably: 'operating on line is tough – it is very easy to get it wrong and lose customers'[R8].

Optimising Stock Holding

Some respondents highlighted the potential opportunity presented by increased stock visibility to reduce the amount of merchandise held in the business which would impact upon not only capital outlay but also staff productivity: 'Also wanted to reduce stock holding – less stock to handle improves productivity'[R9]; '[we have a] large capital investment in stock but low visibility of where it was in the business, RFID gives us the data to make better decisions about how much we should have in the business'[R5].

> *"merchandise visibility is the objective – RFID is a means to an end"*

Helping to Drive Innovation and Business Efficiencies

While change and reinvention in retailing is nothing new, and arguably the main reason why only some retailers succeed in the long term, the increasingly dynamic nature of 21st Century retailing, epitomised by the growth of omni channel, was also part of the business context within which decisions about whether to invest in RFID were considered. Of particular importance was the perceived need for greater agility driven by improvements in the availability of data concerning not only the visibility and movement of merchandise in the business, but also the behaviours and experiences of consumers. In this respect, many respondents viewed RFID as part of a broader organisational change project – part of the evolution of their businesses where innovation is viewed as a key way to achieve future success.

> *"operating on line is tough – it is very easy to get it wrong and lose customers"*

Some were more explicit, regarding RFID as one of the main ways in which they could continue to drive competitive advantage as part of their broader organisational transformation: '… it is usually best not to be the first, but you must not be the

last to adopt!'[R2]. Some respondents also made the link between improving business efficiency and RFID: 'the business was not good at moving stock around the organisation, we needed better data'[R4]. But they were very clear that RFID in and of itself was not the panacea, it was merely a potentially powerful tool to *enable* change in the business through providing new data points to identify weaknesses and inefficiencies, and review interventions.

The Omni Channel Imperative

Write large across all the initial discussions about the reasons for starting out on a RFID journey was its enabling capacity to help businesses develop and deliver a more profitable omni channel consumer experience. As one respondent clearly articulated: 'there was an acceptance in the business that stock accuracy was crucial to the development of the business, based on the desire to move into omni channel – pick from store, intelligent stock distribution, accuracy in buying, accuracy in stock levels and a seamless view to both customers and staff of stock'[R7]. Other agreed: 'the move to omni channel was also a key driver. This is why RFID would be part of the future of the business'[R1]; 'our long-term vision was that we knew we needed to improve our inventory accuracy to turn on our omni-channel programmes'[R1].

> *"the move to omni channel was also a key driver. This is why RFID would be part of the future of the business"*

The critical role of RFID in helping to improve the visibility and accuracy of stock files was particularly apparent in many of the comments made by respondents: 'it also fits our strategic ambition of omni channel which is about visibility of product to customers across the estate – online and in branch'[R5]. Put simply, if there are significant levels of inaccuracy in an inventory system, it becomes highly challenging to offer any form of online experience/pick up in store service that is going to consistently and satisfactorily meet the wishes of increasingly demanding consumers.

Previous History of Using RFID

Many of the companies taking part in this research had a track record of trying out the technology in the past, which often influenced their decision to subsequently invest. As detailed earlier, RFID has had a chequered history within retailing, initially over-promising and subsequently languishing as inflated expectations faded into the stark realities of still evolving immature technologies and hard to achieve returns on investment.

> *"the business was not good at moving stock around the organisation, we needed better data"*

Some respondents had been part of that early journey: '… [we] couldn't get it to work – the cost was prohibitive and the technology was not reliable enough'[R5]; 'our previous efforts failed due to cost and technical issues'[R2]. But, it also meant that as the technology matured, and the business case become more attractive, these company's previous experiences (where the organisational memory was maintained) enabled them to move forward incrementally and with a fair degree of studied circumspection. For those that had not tried the technology before, most were aware of the previous challenges and had felt that the positive momentum within the RFID industry, particularly around pricing and notable improvements in the reliability of the technology, made it the right time to initiate a trial.

> *"everything is possible, but it comes back to the cost and the benefit it can bring to the business"*

The Role of the Board and Recognising the Financial Realities

For virtually all of the companies contributing to this research, the role of the senior management team in both the initiation and subsequent delivery of the RFID project was paramount: '[the] initiative came from the Board[20]. High initial costs required a strong business case and ROI – could only happen with full Board support'[R2]. This is perhaps not

surprising, given the not inconsiderable upfront investment and business changes required to make it work: 'everything is possible, but it comes back to the cost and the benefit it can bring to the business'[R3].

For some, senior management positively championed the idea: 'it came directly from the Board, top down'[R2], while for others the senior team were more watchful: 'introduction of RFID was more evolutionary than revolutionary – interest from the Board that matured into a business case'[R7]. In only one case was the drive for using RFID from the bottom up but even then, the support of the Board was still key to getting the project moving forward. In many respects this is not unexpected; most if not all RFID projects will span across virtually all elements within a modern retail business and so achieving cross functional buy-in inevitably will require decisions made at the highest level of the organisation. Above all, however, all respondents recognised the critical importance of identifying the financial imperative – 'it needs to be a sound investment and not just a nice to have technology'[R6]; 'they [the Board] will always want to know how much is it going to cost and what will we get out of it?'[R5].

"it needs to be a sound investment and not just a nice to have technology"

The Business Context

While the research interviews elicited many different contexts within which the decision to invest in RFID was made, most had the same core driving imperative: how can the business evolve to remain competitive through continuing to delight the consumer in ways that are both efficient and profitable? Improving the visibility of merchandise across the retail environment was viewed as a key factor in enabling this to happen – in many respects, it was seen as the glue that will increasingly hold together much of the architecture of 21st Century retailing. How that visibility will be realised is still an open debate and will no doubt be achieved through a myriad of technologies and processes, but for the companies taking part in this research, their business context made an investment in an RFID system something worth pursuing.



Starting an RFID Journey

The following sections of this report are written with the prospective RFID retail user in mind, mapping out the various steps taken by the case-study companies on their journey to using RFID in their businesses. This first section focusses upon how they started their journey – who was tasked to lead the initiative, how and why it was important to engage the rest of the business with it, where they sought help and how they went about choosing the technology they decided to use. This is then followed by sections continuing the journey: the process of undertaking a trial; how they went about measuring the impact of RFID and what they found; and then subsequently how they went about rolling out the technology across their businesses.



Choosing a Business Leader

As with all change projects, it requires a leader to drive the initiative forward. For the companies taking part in this research three approaches were adopted. For some, the scale of the project necessitated the establishment of a new business unit, with a leader and support staff drawn from other areas, based upon some existing established expertise considered relevant to the initiative.

For the majority of the case studies, a leader was identified within the business unit largely responsible for operations (the exact title varied between companies, such as Retail Operations, Operations or Sales Support). In two cases, a third approach was adopted: the project leader was based in the loss prevention function.

While the first two approaches are largely self-explanatory, drawing leadership from within loss prevention teams may seem an unusual approach to adopt given the overarching objectives set out by most of the companies introducing this technology. Partly it may be attributable to RFID being associated with 'tagging' and the loss prevention function being historically responsible for another form of retail tagging: Electronic Article Surveillance (EAS). But, for one of the two case studies, it was more to do with how the company defined the parameters of responsibility for the loss prevention team, in this case holding them accountable for stock integrity.

In the other case it was more about the RFID initiative coming directly from the loss prevention leader and this person very much taking the initiative on an ad hoc largely unplanned basis. Other than the last case, the common denominator is that leadership for the project typically came from whoever had/or was given responsibility for on-shelf availability/stock integrity, which, as discussed in the previous section, is a major business driver for thinking about investing in RFID. Even in the loss prevention-driven case study, the view now seems to be that the future roll-out and ownership of the initiative should be moved away from loss prevention and into the function responsible for store operations.

Engaging the Business

As mentioned previously, RFID projects by their very nature, develop long tentacles spreading out across entire retail organisations: '… it touches the entire business'[R7]; 'every function was involved in the project – buying, production, logistics; it was very important to have all functions represented'[R3].

Respondents to this research clearly articulated the importance of working hard at getting cross functional buy in to their RFID project: 'there was a lot of education [of the rest of business] needed on the benefits of RFID technology – [it] wasn't clear to the rest of the business what a change it would bring along'[R10]. At least one of the companies used stakeholder analysis[21], a very common but valuable

business tool, to identify who should be involved and to what degree there may be resistance to its introduction: '[we] used stakeholder analysis to identify all our key players in the business and how they might feel about being involved in a project'[R4]. Indeed, it should not be assumed that everybody will be immediately supportive of the project: 'people were nervous about introducing this technology and whether the resource was available to deliver it'[R3]; '[the] rest of the business was largely positive – some pockets of resistance'[R2].

"the rest of the business needed educating on the benefits of RFID Technologies"

A group that was considered particularly important to engage in the project, especially when it begins to roll out more broadly across the organisation and become part of business as usual (BAU), was the Buying function: 'Buyers have to be on board very early – [for us] nine months before the product enters the supply chain'[R4]. For the most part, the case-study companies did not experience much resistance: 'thought it would need a really strong buy in from the business but actually the complete opposite, IT very early on saw the benefits and wanted to integrate – the whole organisation has embraced the initiative'[R7].

Approaches to raising awareness varied considerably between companies: RFID open days, store mock-ups in Head Quarters showing how RFID would work, cross functional briefing events and so on. But all agreed that in the early stages of the development of the project, getting the rest of the business not only aware of what RFID is and its potential, but also clearly articulating what the responsibilities of other functions are going to be was vitally important. In this respect, active support from senior management was considered key; they not only sign off on the required expenditure but can also generate the requisite organisational leverage to ensure key players are engaged.

Seeking External Help

Virtually all of the companies taking part in this research sought some degree of external advice as they began their RFID journey, although it varied considerably in the degree to which it was formalised. Three approaches were evident: employ the services of a RFID specialist consultancy; rely upon the advice available from the chosen technology provider; and finally, reach out to other retailers who had already embarked on introducing RFID into their businesses and organisations that have developed standards such as GS1.

Numerous RFID consultancies are now available and two of the case-study companies made use of their services to varying degrees. Some of the services provided included: advice on which technology to select; drawing up procurement documents; developing the business case to be presented to the Board; carrying out reviews to understand the size of the problems that RFID might address; overseeing implementation of a trial and roll out; and measuring impact. Clearly there is a cost associated with this approach, but for those using this service, it was regarded as a sound investment, especially where organisational knowledge on the topic was limited.

Another approach is to rely upon the experience and knowledge available from the one or more of the technology providers selected by the business. For most of these providers, this will not be their first RFID project and so they will often have a wealth of experience to offer, particularly in terms of the practicalities of delivering RFID in a retail environment. The obvious concern with this approach is that these companies may well have a vested interest in the advice and choices they present, which may not always be the most advantageous nor appropriate for the retail client.

"leadership typically came from whoever had responsibility for on-shelf availability/stock integrity"

Finally, the majority of respondents suggested that they reached out to other retailers for advice, mainly through attending trade shows and conferences and/or through personal contacts. A number of retail companies have been very active in the RFID sphere for some years and regularly present at conferences such as RFID Live[22]. These presentations, while often only ever able to provide overviews of the approach

to adopt and the pitfalls to be aware of, can be extremely useful, particularly in terms providing access to a company representative that can be contacted after the event. A number of companies had also made use of the information made available by standards bodies such as GS1 that regularly provide conferences and have built up a considerable knowledge base on how to utilise RFID technologies[23].

Whatever approach is adopted, virtually all of the respondents recognised the value and importance of seeking help from outside their own organisation – initiating an RFID project can be a daunting project, especially when the capital outlay can be considerable, and the technology choices are many and varied.

Choosing RFID Technologies

One of the main reasons why the RFID euphoria in the early to mid 2000s quickly faded away was the realisation that while the concept it *promised* was genuinely revolutionary (transparency of all merchandise throughout retail supply chains, checkout less stores, the end of retail crime etc.), the reality was very different, mainly due to the immaturity of the technology necessary to deliver it. Early adopters, some of whom took part in this research, ran into too many issues around reliability and cost. This next section looks at some of the decisions made about the choice of technology used but it is important to stress that it is not a review per se of any given technology nor its provider – it is not the purpose of this report to provide a technical review. The first part looks at choices made around tagging technologies while the second part focusses upon the other technologies used to both read them and make sense of the ensuing data.

It is worth noting that, for most of the companies taking part in this research, the approach adopted to developing their RFID 'system' can be best described as circumspect, cautious, modest and highly price conscious. The majority of systems reviewed by this research are relatively simple using just a few technologies. Most rely mainly upon handheld readers used by store staff to capture RFID data and none have invested in overhead readers beyond some experimental trial stores.



Some have invested in transition readers to capture data flows between different parts of the supply chain and zones in retail stores, but not many.

Moreover, one-half have yet to fully integrate a read capability into their POS systems and properly resolve the thorny issue of data integration with existing inventory systems (something which will be discussed later in the report). As one respondent put it: 'we only have handheld readers, nothing else. No connection with till, no front or back readers'[R4]. In many respects this was both surprising and refreshing: surprising because media hype often tends to suggest we are entering a retail future of startling technological complexity akin to a *Minority Report* landscape, much of which will be delivered by objects communicating with each other and various systems at all times. But it was also refreshing because most of these companies had built a successful business model, with verifiable Returns on Investment (ROIs), mostly focussing upon fixing often only one issue and doing it with the minimum of technological investment. The overarching philosophy for most of these companies when it came to developing their RFID programme was focussed pragmatism driven by financial probity – keep it simple and make it pay.

"the overarching philosophy was focussed pragmatism driven by financial probity – keep it simple and make it pay"

Tags

One of the technology challenges in the early to mid 2000s was the manufacture, supply and application of RFID tags that were sufficiently reliable ***and*** financially viable for a retailer to purchase on a large scale[24]. For this group of retailers, the issue of tag reliability did not seem to be an issue of concern anymore: 'never found a tag that didn't read'[R4]; 'had so few tag failures that we stopped checking and recording them'[R3]. Indeed, one respondent offered some data on the extent to which their chosen tags were actually performing better than traditional barcodes: 'had only 20 errors with tags not correctly set up out of 1.5 billion products; with barcodes it was 1.5% and with RFID tags it is 0.003%'[R8]. Other respondents were of the same view in terms of the reliability of the tag but did highlight associated issues that were more of a concern: 'tag quality is not the problem anymore – [tags] falling off is more of an issue to us'[R2]; '[it is] not about reliability of the tag per se, more about where it is positioned and affixed and whether it is on the product at all'[R6].

Virtually all of the respondents to this research had opted for a combination of swing and sticker tags, with only one initially utilising a hard tag variant although they too are now planning to use swing tags and stickers as the initial approach was deemed impractical in the planned roll out phase. The decision to use this type of tag was driven mainly by pragmatism – they offered the most straightforward approach to application in the manufacturing process. All respondents bar one had opted very early on in their RFID journey for source tagging at the point of manufacture – it was deemed the most sustainable and cost-effective way of applying them: 'for us, source tagging was the only way we could make this work in the long term – DCs are too busy and stores are not reliable enough to do it consistently, especially at busy times'[R3].

Some companies had considered the extent to which the tag could and should be incorporated into the merchandise, such as being sown into the care label, but this raised two main concerns associated with privacy and practicality: 'didn't want to sow into garment for privacy reasons and worries about the impact of the manufacturing process on the tag[R2]; 'we did not want the company associated with any issues relating to privacy and data protection … it would also impact upon the look and feel of the product'[R3]. However, two of the case-study companies viewed greater integration of the tag as a critical next step in their RFID journey, principally to deal with the ongoing problems of accidental and malicious removal of the tag.

"it's not about reliability of the tag per se, more about where it is positioned and affixed and whether it is on the product at all"

It was very apparent that most of the companies had taken a considerable amount of time to test and refine the design and positioning of the tag

and at which point in the manufacturing process it should be applied. For some of the larger users (in terms of volume of tags purchased and range of SKUs being tagged) they had established teams to advise on tag location and design, including developing detailed guides for suppliers on how the tags should be applied. The key message was that in order for the RFID project to be successful, the impact of all supply chain processes on the tag, the way in which particular products will impact upon tag performance, and where the tags will be read, needed to be carefully researched and documented.

Finally, views differed on the extent to which retailers should be utilising one or more tag suppliers. Some had opted for more than one supplier to reduce risk and increase competition while others regarded this as too complex to manage and instead preferred to use only one provider. Clearly, there is no right or wrong answer and the decision will come down to any given company's appetite for risk and ability to manage complexity in their supply chain.

Reader Technologies

As mentioned earlier, most of the case-study companies had adopted a relatively straightforward and arguably simplistic approach to how they went about capturing RFID-related data within their businesses, driven by the realities of their own retail environment, organisational ambition and budget. The 10 case-study companies had experience of a combination of five different forms of readers to enable them to capture RFID data at different locations and points in the retail process: Handheld Readers/Wands; Point of Sale (POS) Readers; Transition Readers (overhead and fixed stations); Overhead Readers; and Exit Readers (Table 1).

By far the most common were Handheld Readers/Wands, which were employed by all of the companies and were provided to store staff. There were used to perform a number of tasks including regular stock counts both in the front and back of their stores and receiving stock deliveries.

Each chosen Handheld Reader/Wand technology had varying degrees of functionality although giving the user statistical awareness of the number of products they were aiming to scan and/or their progress towards reaching the required product recognition target was considered very important. Indeed, one respondent highlighted the operational necessity of doing this: 'we needed to get [store] staff to understand to work to the [company SKU] target rather than 100% – 100% accuracy generally costs too much money to achieve in terms of productivity'[R2]. In this example, overly assiduous store staff were considered to be spending too much time seeking a 'perfect' SKU score when the added value to the business of achieving this was less than the cost of the time it took to deliver: '[it is] important to remember that it is not about getting 100% accuracy, the goal is to meet the aims of the project – improve on where we were which was nowhere near 100%!'[R6].

Table 1 Business as Usual In-store Use of RFID Readers

Case-study Companies	Store Readers					
	Handheld	Transition		Integrated POS	Overhead	Exit
		Pad	Overhead			
1	✓	✓				
2	✓					
3	✓	✓		✓		
4	✓					
5	✓	✓	✓			
6	✓			✓		✓
7	✓	✓		✓		
8	✓	✓		✓		✓
9	✓		✓			
10	✓					
All	**10**	**5**	**2**	**4**	**0**	**2**

The next most common form of reader in use was Transition Readers – either a fixed pad/device, usually at the back of the store, that staff could use to manually register RFID-enabled merchandise, or overhead devices that automatically recorded when tags moved through their read field. For those companies using this technology, the primary purpose was to better understand where stock was located, principally in the front or back of the store. As will be discussed below, one of the key drivers of lost sales is stock not being moved in good time from the back of the store to the sales floor, generating what some retailers describe as Not on Shelf But On Stock (NOSBOS) events – lost sales not because the store does not physically have the merchandise but that it is not in the 'right' place at the 'right' time to enable a customer to purchase it.

Only two of the 10 companies were using overhead transition readers, with one-half using fixed readers/pads, which require staff to manually transition/record stock as it is moved from one place in the store to another. As will be discussed later, RFID systems typically work best when the amount of human interaction in the data collection process is kept to a minimum, and so overhead readers would seem a better option. But, all of the companies that were either using overhead readers or had tested their use, had significant concerns about their reliability and cost effectiveness: 'we asked ourselves, do we really need overhead readers – do they work well enough and will they deliver enough to justify the cost?'[R3].

"we looked at linking to EPOS but it would require 23 different systems to change to make it work"

Less than one-half of case-study companies had currently invested in some form of integrated RFID Reader at the POS whereby a member of staff was able to either scan/read the product tag just once as part of the customer purchase transaction. As will be discussed below, this point of integration has generated the greatest difficulties/challenges for many of the companies taking part in this research, not least because of complexity and scalability issues, and associated costs: 'would love to link to EPOS at some point but considerable cost involved'[R6]; 'we looked at this [linking to EPOS system] but a lengthy project would be required – would require 23 different systems to change to make it work'[R2].

Where companies tried a compromise arrangement at the POS, such as a separate RFID reader, recording accuracy became an issue: 'every day [staff] missed between 3-6% of tags despite all best efforts'[R5]. Another user had found a similar error rate: 'getting a read rate of 90% to 95% at the checkout'[R9]; and a third found a similar rate in their trial period that persuaded them it was not a long-term option for them: 'had [RFID] pads at POS but only got 80% read rate. We realised had to go for integration at POS'[R10].

As can be seen in Table 1, no case study company had rolled out any form of fixed overhead reader technology as this stage, although one company was currently undertaking a concerted trial to understand whether they might be a viable option for some of their retail environments in the near future.

A number of the other companies had explored the possibility of using fixed overhead readers as they potentially offer an exciting extension to an RFID system, effectively removing the need for staff to carry out any manual scanning of tagged merchandise, which would lead to considerable staff productivity savings. But, most were of the view that it was currently impossible to achieve a ROI on this technology:

> we cannot make the finances stack up. We reckon the pay back was 13 years but [could be] up to 26 years for large stores – just not going to fly[R9]; long way to go with fixed readers but they will be there in the future[R2].

Where the technology was being trialled, impressive read rates had been observed but it was still questionable as to whether either a subsequent sales uplift due to greater stock accuracy and/or reductions in staff costs would warrant the investment.

In terms of reader technology at store exits, two companies were using this technology across their retail estate and others had tested them but they had also come up against issues of read accuracy: 'a high percentage of [our] products have a metal component so exit reads were poor – stops them [Exit Readers] getting a really clean read[R10]; 'we have exit antennae but we have had problems with them – if people walk too fast or it is windy or people have bags – only getting 70% read rate at the exits'[R3]; 'we are getting 85% accuracy at the readers at the exits'[R8].

As will be discussed later, when the issue of RFID and Loss Prevention is discussed in more detail, with the RFID technologies currently adopted by these case-study companies, getting a reliable read rate at exits clearly remains a challenge and may explain why few currently regard RFID as a viable store security intervention.

RFID Software Systems

The final piece of the 'technology' picture[25], is the use of a software system to record, assimilate and, where possible integrate, the RFID data generated by the various readers as they capture the presence and movement of RFID tags in the retail supply chain. There was a broad range of providers used by the companies taking part in this research, chosen for a host of different reasons including: previous experience, perceived compatibility with existing systems, price and recommendation.

The integration of RFID data with existing systems has proved to be one of the biggest challenges these companies have faced: 'the integration issue is still the problem – still a lot of noise'[R10].

Understanding how any proposed RFID software system will not only meet the objectives of the programme, but crucially work with the current business systems was something most companies struggled with and continue to try and address: 'we didn't think this through enough when we started and in hindsight we would have chosen a different piece of software, but we are where we are'[R3].

Starting an RFID Journey

For most of the companies taking part in this research their RFID journey began with an understanding of a problem that needed to be resolved and a recognition of the importance of gaining cross-functional support from the business.

It was also clear that many of them had worked very hard to develop a good understanding of how a RFID-based system might interact within their given business context and how this would affect the choice of technologies to be used. Much of this learning came from undertaking various types of trials and it is to these experiences that we turn to next.



Undertaking a Trial

Perhaps not surprisingly, given the potential cost and impact upon the business, all the companies taking part in this research had undertaken or were continuing to undertake various forms of trials to better understand what the value of investing in an RFID system might be and how it should be designed to work most effectively within their organisational eco system. While the participating companies all adopted different ways in which to trial RFID, some common themes can be identified, not least the use of feasibility studies or proof of concept trials, followed up by more detailed pilot studies and then development trials.



Proof of Concept Trials

While some of the case-study companies had used RFID technologies in the past, all felt that it was important to start out with relatively small-scale proof of concept trials to understand at a basic level, whether the proposed technologies would actually work in their environment. On average this was undertaken in about 3 stores, usually on just a few SKUs and was designed to keep store disruption to a minimum.

At this stage, most companies simply opted to apply the RFID tags either at one or more of their own Distribution Centres (DCs) or in the participating stores, with responsibility for gathering data undertaken by the project team rather than store staff. Above all, these types of trial were mainly about simply understanding whether various types of RFID technology would actually work or not and whether they should be used in any subsequent pilot trial: 'tried Portals between back of house and shop floor but didn't have high read rates and [so we] abandoned that option'[R5].

While the period of time for these types of trial varied considerably between the companies, most were relatively short, in the region of about 3 months, not least because of the cost and effort involved in undertaking them. It could be that in the future, as the technology continues to improve and previous concerns about the reliability of the technology fade (as has been found in the case studies presented in this study), then Proof of Concept Trials may become less necessary and prospective users are able to begin their RFID journey with Pilot Trials, skipping this technology verification step.

RFID Pilot Trials

After this initial feasibility testing, companies typically embarked upon more detailed trials to try and answer the following questions:

- To what extent will RFID deliver the proposed improvements in agreed KPIs and achieve an ROI?
- How well or not will the technology work in various retail settings?
- How will RFID operate within current business processes and what would need to change?
- How will staff respond to and use the technology?
- What needs to be put in place to ensure any future roll out will be sustainable and successful?

Different companies adopted different approaches to how these trials were carried out with some lasting many years while others were remarkably and perhaps regrettably short:

> Had to resolve the process-related issues in the [pilot] stores and 2 months was not enough time … [store] staff felt overwhelmed by everything – using different systems; the technology was completely new to them; they didn't understand the unique identification of all products – [it was] hard to explain why this mattered given how they had viewed stock in the past; [they] felt like [it was] more work not less; couldn't see how it would help them[R8].

For others, the approach adopted was much more incremental, designing the pilot phase to identify whether the RFID system would deliver the planned improvements in KPIs across different retail settings and how it would impact upon the business: '[we] needed to systematically and rigorously understand the people and process elements of the business and how they will be impacted and or respond to the use of RFID'[R8].

One respondent described how they gradually ratcheted up their trial programme to fully test the potential impact of growing levels of retail complexity: 'we started with just a few small stores with average levels of historical stock accuracy where we did all the counting …[then] we progressed to stores where the staff did the counting … [then] moved on to trying it in bigger stores with more complex spaces, such as remote stock rooms and multiple levels'[R9].

For 9 out of the 10 case studies, an early decision was made that source tagging at the point of manufacture was the only feasible way in which RFID could be rolled out across the business and so many of the trials were designed with a temporary and unsustainable tagging strategy in place, which invariably impacted upon the scale, timing, length and location of the trials: 'the DCs did struggle to support the trial'[R8]; 'we had entire teams in the DC just tagging'[R5].

"for most companies it was decided that source tagging at the point of manufacture was the only feasible way in which RFID could be rolled out across the business"

As detailed in the previous section, a number of the technological issues that plagued previous RFID trials carried out in the early to mid 2000s have now been addressed to a fair degree and so a significant proportion of the learning in the trials was more about understanding how RFID would assimilate with business processes and be understood and used by store staff: 'the process and people parts were the hardest – complex processes and infrastructure in the business … [we] needed to systematically and rigorously understand the people and process elements of the business and how they will be impacted and or respond to the use of RFID'[R8].

Some retailers also used pilot trials to prepare the business for a future roll out of RFID, in particular how staff would be trained to use the system and suppliers would be advised about tag application. As will be discussed below, rolling out RFID programmes across large and complex retail organisations can be challenging and for some businesses, the pilot phase enabled them to work through what some of these challenges might be and how they might best be resolved:

"the process and people parts were the hardest ... we needed to understand how they will be impacted by RFID"

> this [trial period] was less about checking the technology and more about checking the quality of the roll out materials – the viability of the distance learning pack, the tagging guide, how to use the equipment and so on. We were not going to use face to face training, it was all going to be online and so we needed to test it would work[R9].



Given that all 10 companies taking part in this research have moved to roll out RFID across their organisations, it can be argued that their trial process was successful – it enabled them to generate evidence to support the financial case for RFID, identified what the impact on the

business was likely to be, how the system had to be designed to fit within existing systems and processes and what the limitations of the technology were within a given context: 'trials went pretty much as we expected … our worst fears were not realised – tags didn't fall of as much as we thought they might!'[R7].

Development Trials

For many of the companies in this study, the roll out of an RFID system across their business is a significant but also incremental step in their RFID journey – a number continue to test new ideas and technologies to see how the original system can be built upon and enhanced.

As mentioned previously, most of the RFID systems rolled out by the companies covered in this research might best be described as modest – currently almost exclusively store-based with data capture mainly reliant upon the active involvement of store staff and many integration issues yet to be resolved. But all see this as a viable and sustainable (financially at least) model upon which to build future iterations. As such, some companies continue to carry out developmental RFID trials such as testing the use of overhead and transition readers, ways to better integrate the data with existing systems, and new ideas concerning tag performance and applicability to a broader range of merchandise.

"financial prudence that embraces most if not all of the programmes studied by this research will not doubt remain a key driver of future developments"

While RFID-based technologies will undoubtedly evolve further, it is likely that these companies will continue to experiment but only where there is a justifiable business case to be made – the financial prudence that embraces most if not all of the programmes studied by this research will not doubt remain a key driver of future developments.

Measuring the Impact of RFID

For all the companies taking part in this research, the primary objective of investing in an RFID system was to improve their profitability by reaping various benefits delivered through having the ability to more accurately and effectively identify merchandise as it moved through their retail supply chains – from point of manufacture right through to the point of sale and sometimes beyond such as managing returns.

How this was measured and the ways in which RFID systems actually deliver these benefits varied considerably. As with any intervention, understanding the way in which Key Performance Indicators (KPIs) – the verifiable and agreed measures associated with the introduction of change, is frequently shrouded in rather confused and confusing terminology[26]. For instance, KPIs are metrics that actively measure specific, directly attributable, planned outcomes related to agreed goals, but they are often confused with other variables that are more concerned with measuring the performance of the intervention – in effect is it doing what it is supposed to do?[27] One company considered the latter to be Key Performance Drivers (KPDs), measures of whether RFID operations are operating correctly and optimally, such as the reliability of tags or the success rate of Readers to identify them[28]. In and of themselves, they do not directly contribute to the delivery of a project goal – they are measures of system efficiency and reliability and not indicators of the consequence of introducing an intervention.

It is also important to understand the ways in which KPIs are actually delivered within a business context and how these are measured. For instance, the goal of introducing a technology such as CCTV may be to reduce crime and make people feel safer. The KPIs might therefore be levels of certain types of crime and public perceptions of feeling safe and secure. But understanding how CCTV will actually deliver any difference in these KPIs needs to be understood – the 'Intervention Mechanisms' and how these are converted into 'Intervention Measures' have to be clearly articulated. For instance, crime will not be reduced simply because a camera has been installed on a pole in a public street – in and of itself it has no impact – it cannot leap off its pole and arrest a thief! But, crime could be reduced because would-be offenders who see the camera may now feel it has become too risky to commit crime in that area because they feel they are more likely to get caught. It may also be the case that crime goes down because more offenders get caught because the camera operator is able to raise a physical security response to a crime scene and the offender is arrested, subsequently incarcerated and can no longer commit any further crimes for a period of time. In the first instance, crime will be reduced because offenders are less likely to commit crime in that location and in the second instance, crime will be reduced because there are fewer criminals around to commit crime. Either way, understanding how an intervention will trigger *mechanisms* that will in turn deliver changes in KPIs is vitally important to understand if they are to be designed and managed effectively.

"understanding how various interventions trigger mechanisms that will deliver changes in KPIs is vitally important to understand"

Outlined below in Table 2 is a summary of the KPIs and associated Intervention Mechanisms and Intervention Measures that could be identified across the 10 case studies taking part in this research. It is important to stress that it is an aggregation of all the companies – none made use of all the KPIs detailed nor described all the associated Intervention Mechanisms and some are based upon the researcher extrapolating from the comments made by those interviewed. It is also not intended to be an exhaustive list of all the possible KPIs, Mechanisms and Measures that could be associated with the use of an RFID system.

Table 2 Measuring the Impact of RFID

Intervention	Capability	KPIs	Intervention Mechanisms	Intervention Measures
RFID Systems	To improve the identification of merchandise across retail supply chains	Increase Sales	Reduce incidents of out of stocks.	Increased sales through fewer out of stocks.
			Improve stock availability on actual and virtual sales floor.	Increased sales through improved stock availability.
			Improve customer satisfaction.	Increased sales due to improvements in customer loyalty.
			Improve staff service.	Increased sales through improvements in staff availability.
		Reduce Staff Costs	Less time spent counting stock.	Reduction in staff hours required to count stock.
			Less time spent restocking.	Reduction in staff hours spent sourcing and restocking shop floor.
			Less time processing customer sales.	Reduction in staff hours spent processing customer sales at checkout.
			Less time protecting products	Reduction in hours applying security tags to products.
		Reduce Stock Loss	At risk products identified more quickly.	Reduction in losses through targeting high-risk products with additional security.
			Fraudulent returns identified more easily.	Reduction in losses caused by fraudulent customer returns.
			Theft reduction interventions tested more quickly and easily.	Reduction in losses because new interventions can be evaluated and introduced more quickly and cheaply.
			Potential thieves identified exiting the store in real time.	Reduction in losses because thieves are caught when exiting the store and product is retrieved.
			More thieves deterred because of increase in perceived risk.	Reduction in losses because thieves are deterred by perceived increased risk of being detected when exiting the store.
			Reduction in stock damages through less overstocking.	Reduction in value of stock either marked down or written off due to in-store damages.
			More stock delivery inaccura-cies identified.	Reduction in unknown losses recorded by stores.
		Fewer Mark Downs	Fewer products sold at less than full price.	Increase in profit because better stock management means fewer items are sold at a discount.
		Reduce Stock Holding	Less stock held in business.	Increase in profit because company can hold less stock in the business.
		Reduce Audit Costs	Fewer full location audits required.	Reduction in audit costs because the number of location-specific full physical audits is reduced.

Key Performance Indicators

The research identified six key metrics used by the participating companies to measure the impact of using RFID systems:

Case Study Use	KPIs
9	Increase Sales/Turnover
6	Reduce Stock Holding
5	Fewer Mark Downs
2	Reduce Stock Loss
1	Reduce Staff Costs
1	Reduce Audit Costs

By far and away the most popular measure used by the case-study companies was the impact upon sales/turnover – 9 of the 10 companies explicitly measured the impact on this metric. For some it was the only metric that was used and as will be seen below, a relatively modest improvement was more than sufficient to generate a satisfactory ROI: 'for us, only one KPI: increased sales … which is driven by stock integrity, generating accurate replenishment'[R4]. The second most popular measure was the capacity for RFID to enable businesses to reduce their stock holding without have any adverse impact upon their operations. The biggest cost to a retailer is the purchase of stock and so developing the capacity to reduce the amount of merchandise within a business clearly has the potential to produce significant financial benefits.

The third most used KPI related to the extent to which RFID could reduce the amount of stock that was sold at a discount. One of the great challenges of retailing is ensuring that the right stock is in the right place at the right time because this significantly increases the opportunity to achieve the desired price. When this does not happen, particularly with highly seasonal and/or promotional products, inevitably price discounting has to take place to ensure some value for the stock is achieved. Because RFID can significantly help to minimise this margin-erosion problem, it is understandable why this was a KPI for many of the companies taking part in this research.

The remaining three KPIs: reducing stock loss, staffing costs and audit costs were much less frequently used by the case-study companies – only two had some form of measure for stock loss and only one had a KPI for staff saving and audit costs. In terms of stock loss, as will be discussed later in this report, most companies did not believe that their RFID system, as currently configured, had much prospect for dealing with most forms of malicious stock loss – the tags were too easy to remove and the exit reader technology was either absent or deemed to be too unreliable.

While only one company actively sought to measure the value of introducing RFID to reduce staff costs, a number of other companies recognised its ability to do this in the future and as can be seen in Table 4 below, a significant number had 'banked' RFID-enabled staff time to help deliver improved sales through better customer service and engagement. Finally, only one company had reached the point where they were able to measure the impact of using RFID on reducing the cost of physical stock audit. However, a number of other companies suggested that this was certainly something that would accrue to them over time as their RFID systems bedded down and accounting and auditing practices began to understand and accept the use of data derived from these systems.

Intervention Mechanisms

As detailed above, RFID in and of itself cannot deliver KPIs – it is merely a technology that generates data that can then be used to enable changes or mechanisms to be triggered, in this respect, it is a *facilitator technology*. It is also worth noting that Intervention Mechanisms can be both positive and spaces can lead to the displacement of crime – crime is not reduced, it is simply moved to another location.

> *"RFID in and of itself cannot deliver KPIs – it is merely a technology that generates data that can enable change"*

The case-study companies also varied in their ability to measure these mechanisms – some are inevitably much more tangible and amenable to measurement than others, such as levels of out of stocks compared with improved customer satisfaction (Table 4 below lists those that were measured). It is also worth noting that while the overarching KPI associated with one or

more Intervention Mechanisms was not actively measured by a company, some still considered the underlying mechanisms as being part of their RFID programme. For instance, while most did not have a KPI for a reduction in staff costs, some recognised that RFID delivered a staff time benefit that could be utilised to enable another KPI such as an improvement in sales or a reduction in stock loss.

As can be seen in Table 2, it was possible to begin to identify, for each of the KPIs used, the Intervention Mechanisms that can be associated with the case-study companies taking part in this research. It is important to note that this list of Intervention Mechanisms is not necessarily complete – it is merely those that were gleaned from the data collection process for this research.

Increase Sales

Four Intervention Mechanisms were associated with this KPI: reduced out of stocks, improved stock availability, improved staff service and increased customer satisfaction. The link to improved sales for the first two is relatively straightforward – if the right stock is not available on the shelves for customers to buy then clearly sales will be impacted. As detailed below, some companies were able to share data on the way these mechanisms were affected by the introduction of RFID. The latter two mechanisms are rather more tangentially linked to increased sales: by reducing the amount of time staff had to spend auditing merchandise and restocking, RFID had enabled staff to potentially spend more time on the shop floor assisting customers and encouraging sales.

It was also the case that by ensuring more customers were able to purchase the products they wanted at the right time and place (because RFID had enabled better stock accuracy both in stores and online), then they may be more inclined to shop with that retailer in the future and hence increase sales.

Reduce Stock Holding and Fewer Mark Downs

For both these KPIs, only one Intervention Mechanism was apparent for each of them – the reduction in the amount of merchandise held by the business, either overall or in particular locations, and the amount of stock sold at a discounted price. While the former measure was thought to be relatively easy to calculate, the latter often required fairly detailed analytics to extract the value added offered by RFID.



Reduce Stock Loss

While as a KPI it was used by only two companies, the complexity of the issue generates the most number of Intervention Mechanisms of all the KPIs found in this research. In terms of shop theft (assuming the tag remains on the product and can be read by a reader), two mechanisms can be triggered: thieves leaving the store can be identified and stolen product recovered (assuming there is a human response available); and thieves are more likely to be deterred from trying to steal because they become aware of the potential of the system to facilitate their detention. In addition, fraudulent returns are potentially easier to identify (assuming the original tag is still attached to the product) because the EPC associated with the returning product is capable of establishing whether it has been purchased in the first place.

Case-study companies also identified other potential Intervention Mechanisms associated with reducing stock loss, including better identifying those products more prone to theft (which could then be better protected with other forms of security) and being able to test loss prevention interventions more quickly and easily. Historically, testing the impact of loss prevention interventions has been notoriously difficult, principally because getting reliable and verifiable stock data before, during and after the intervention has been introduced has been neither easy nor cheap.

With the introduction of RFID and associated regular, frequently weekly stock counts, loss prevention managers can now potentially test loss prevention interventions much more quickly and have access to much better data to understand their impact.

Two Intervention Mechanisms were associated with having an impact on non-malicious forms of loss: a reduction in damaged products that are either not possible to sell or must be sold at a reduced price (because of an associated KPI – Reduced Stock Holding), and greater visibility of stock delivery errors. For the former, typically, if retail stores have less stock, then they are much less likely to damage it – store rooms are easier to manage, product is sold through more quickly and so on. For the latter, gaining greater visibility of actual stock deliveries to stores can positively impact upon levels of unknown stock loss (shrinkage), particularly where stock can be shown to have not been delivered or the wrong stock has been sent.



Reduce Staff Costs

While only one company used this KPI, a number of companies pointed to the use of some of the associated Intervention Mechanisms as valuable outcomes of using RFID, and which enabled other KPIs to be delivered. Most common was the saving associated with the amount to time staff had to spend restocking as a consequence of RFID – it enabled staff to have much better visibility about not only what needed to be restocked but also where it was located in the backroom area. Similarly, a number of companies pointed to the significant time savings they had accrued because staff could now count stock so much more quickly, mainly using the hand-held scanners provided.

Two other mechanisms were identified – less time required to process customers at the point of sale and less time required to apply security tags. In terms of the former, one company in particular had undertaken detailed analysis to understand the value of this saving, while for the latter, this was obviously only the case where RFID was seen as a replacement to an existing security technology such as EAS, or had enabled a more nuanced and selective approach to the number of products having an EAS tag attached to them.

Intervention Measures

While Intervention Mechanisms provide stepping stones between an intervention's capability and its associated KPIs, there is also a need to understand the way in which potential Intervention Mechanisms should be measured to enable the KPI to be achieved. Table 3 provides an illustration of how each of the identified Mechanisms have a related Measure. For the most part, these are relatively straightforward.

Table 3 The Journey from Intervention Capability to Measurable KPI

Intervention Capability	Intervention Mechanism	Intervention Measure	KPI
improve identification of merchandise across retail supply chains	Reduce OOS	Increase sales through fewer OOS	Increase Sales
	Identify Fraudulent Returns	Reduce Shrinkage	Reduce Stock Loss

What is important is to identify how any given Intervention Mechanism may be measured, although it is recognised that for some this may prove challenging and/or impractical to achieve as part of an RFID programme. In this respect, as found in this research, while companies may elect to identify only those Intervention Mechanisms and associated Measures that are possible to measure when building a business case, it may well be worth thinking through what some of the other more intangible outcomes of introducing RFID might be as these could be used as part of the overall business case.

Table 4 below summarises how the case-study companies varied in the ways in which they actively recognised the use of both KPI metrics and some of the underlying Intervention Mechanisms outlined in Table 2 above.

Measuring Success

While the case-study companies that agreed to participate in this research were prepared to share their experiences and detailed knowledge of using RFID-based systems, only some were willing to offer an indication of the actual results they had garnered from their use. This is not surprising given the sensitivity of some of the data and the growing view that successfully delivering RFID can be seen as part of maintaining a competitive edge in an increasingly challenging economic environment, particularly as omni-channel retail becomes more prevalent and important.

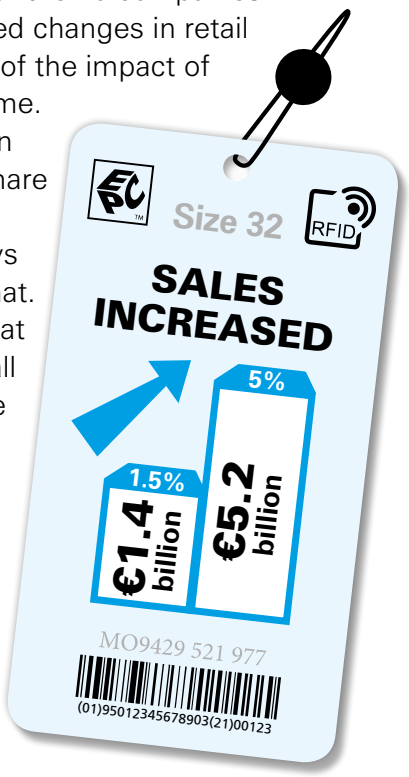
It is also worth noting that this study set out to collect mainly qualitative data, offering a detailed review of how some retail companies went about their RFID journey. As such, the data below cannot be regarded in any way as representative of all retailers who are now using RFID nor the impact it has had on their companies – other methodologies are much more appropriate to achieve this type of goal[29]. In addition, companies that were prepared to share some data, often had different ways in which they framed their results, partly because of how they went about measuring the various metrics relating to RFID, but also because of concerns about disclosing sensitive information to a third party. In addition, where data has been provided, it has not been possible to carry out any form of detailed verification beyond questioning those offering the numbers on how the data was generated (such as timeframe, number of stores, definitions etc.). As such, the following results should be treated with a fair degree of caution, fully recognising the limitations outlined above.

Table 4 Key Performance Indicators and Intervention Mechanisms Identified by Case-study Companies

KPIs	Intervention Mechanisms	Case-study Companies										
		1	2	3	4	5	6	7	8	9	10	All
Sales/Turnover			✓	✓	✓	✓	✓	✓	✓	✓	✓	9
	Improved On-shelf Availability	✓	✓		✓	✓	✓	✓		✓		
	Improved Stock Accuracy		✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Improved Staff Availability				✓		✓	✓	✓			
Staff Costs		✓										1
	Less Time Restocking	✓			✓			✓		✓		
	Less Time Looking for Stock	✓		✓	✓	✓						
	Less Time at POS						✓		✓			
Stock Loss							✓	✓				2
	Stolen Stock Identified Leaving Store						✓					
	More Staff Available as Deterrent								✓			
	Theft Interventions Tested More Easily										✓	
Mark Downs					✓	✓	✓	✓		✓		5
Stock Holding			✓		✓	✓		✓	✓	✓		6
Audit Costs								✓				1

Sales

As detailed above, of the 10 companies taking part, nine used changes in retail sales as a measure of the impact of their RFID programme. Of those nine, seven were prepared to share some data on this issue, but not always in a consistent format. In terms of those that measured the overall impact on sales, the improvement was typically between 1.5% and 5.5%. One company was prepared to say that for every 3% improvement in stock accuracy they had experienced a 1% uplift in sales.



For two companies, they were prepared to share more nuanced RFID/Sales-related data – the impact on sales where the explicit use of RFID enabled genuine Out of Stock events to be more quickly corrected, either by identifying that stock was in the back of the store but not in the front, or correcting current inventory records for a given SKU to zero, triggering an automated restock. In retailers where restocking is almost exclusively driven by inventory records triggering a restock, then this can have a profound impact on sales. For one of the case-study companies they calculated that impacting on these events had generated an uplift in sales of 8% while for another, it was a remarkable 300%.

If the range of sales improvement detailed above (between 1.5% and 5.5%) was generalised to the sales turnover for the 10 companies taking part in this research, then on this one KPI alone, RFID could have contributed between €1.4 and €5.2 billion to their businesses. It is perhaps not surprising then that for a number of case-study companies this was the ***only*** KPI they needed to deliver to make RFID a success.

Inventory Accuracy

As detailed above, one of the Impact Measures contributing to the delivery of improved sales is inventory accuracy – it was a metric virtually all of the case-study companies measured as it was seen as a critical enabler for improved sales. As has been seen in numerous other RFID studies, these companies found that their level of inventory accuracy improved dramatically, typically moving from somewhere in the region of 65%-75% to 93% to 99%[30].

Out of Stocks/Stock Availability

Far fewer companies were able/prepared to offer data on the impact of RFID on out of stocks or levels of stock availability. For those that did share data, the impact of RFID was again impressive – in one instance, the percentage of SKUs that were now available to the consumer increased from the high 80s to the high 90s, while another suggested that their stock availability was now in the region of 98-99%. For another case study company, they had seen a 20% reduction in the number of SKUs being found to be out of stock while another estimated that whereas between 15% and 20% of items that were only out of stock because replenishment had not taken place from the back of the store, had been reduced to just 2%.

Stock Holding

The second most frequently used KPI for measuring the impact of RFID was the extent to which it could enable companies to reduce their stock holding. By doing this, retailers can benefit in a number of ways, including: freeing up working capital/ reducing business borrowing; reducing the amount of storage space required; reducing handling costs; decreasing the risk of stored product becoming damaged and being written off or reduced in price; and reducing the risk of excess seasonal stock having to be marked down to clear. In addition, the growth of omni channel retailing and the associated need to ensure stock availability when a consumer is shopping online and may request a pick



up in a particular store, has led to some retailers holding additional 'buffer' stock to compensate for possible errors in inventory records.

By offering the prospect of much improved stock visibility and integrity, RFID was viewed as a valuable tool in enabling many of the case-study companies to reduce their levels of stock holding. Of the six companies prepared to share some data on this issue, five had experienced a reduction in stock holding between 2% and 13%, with the other company declaring that RFID had enabled them to reduce their total number of SKUs by 17%[31].

Stock Loss

As discussed elsewhere in this report, few of the companies taking part in this research regarded their RFID programme as offering much current potential to actively deal with the issue of stock loss.



Only two suggested that it was a KPI they were actively measuring, although only one was prepared to share any numbers on this topic. For this company, they attributed a 15% reduction in their shrinkage number due to the introduction and use of RFID, mainly due to more thieves being deterred by the interactive nature of their exit controls (store guards were provided, via a handheld device, with an exact description and picture of the products(s) leaving the store that had not been purchased), and a reduction in process-related losses due to greater stock visibility.

Mark Downs

While one-half of the case-study companies suggested that they had used the impact on the number of products that were marked down in value as a measure of the performance of RFID, none were prepared to share any data on this KPI because of issues of commercial confidentiality.

Given the relatively high number of companies opting to measure this metric, it can be assumed to be important, but to what degree, remains an open question.

Audit Costs

There was only one company that claimed to be using the savings in inventory auditing costs as a measure of the contribution of RFID, although quite a few others suggested that this was something they were either in the process of reviewing, or were looking to better understand how their audit procedures may change in the future, particularly as confidence in the quality of RFID data grew and external auditors become more willing to utilise it[32].

The costs associated with undertaking physical stock audits can be considerable, especially when third party companies are employed to undertake this work on a regular basis. But even when it is done internally, it can still generate real costs such as having to pay overtime to store staff to complete the work, sometimes the closure of stores while the stock counts are undertaken and disruptions in stock movements when distribution centres are audited. So, the ease of undertaking stock counts offered through the use of RFID could potentially deliver some considerable costs savings.

While the company measuring the reduction in audit costs was not prepared to share specific data, they indicated that as a consequence of introducing RFID, they were now moving from undertaking physical audits once a month to just once a year, claiming to save 75% of the budgeted staff costs for this activity.



Staff Costs

Only one of the 10 case-study companies had decided to explicitly measure the performance of their RFID system based upon anticipated savings in staff costs, although others recognised that it could enable staff to have more time to undertake

other activities such as helping customers and driving sales. By introducing RFID, this company estimated that they had been able to reduce their store staff costs by about 4%. If this were to be replicated across the case-study companies, then it could lead to a RFID-related saving in the region of €378 million[33].

Key Performance Drivers

While KPIs are intended to directly measure the impact of a given intervention, it was clear that many of the case-study companies were also collecting and reviewing a series of other indicators that were more concerned with measuring whether RFID was both operating as planned and being used as intended by staff. In this respect they can be regarded as 'health' indicators of the RFID system, monitoring its capacity to deliver the relevant Intervention Mechanisms and associated KPIs[34]. These varied considerably between case-study companies and included indicators such as:

- Tag reliability – both the ability to be read and to remain attached to merchandise.
- Read rates – the performance of RFID readers, both in terms of consistency and speed.
- Frequency and accuracy of store RFID audits, including different merchandise locations.
- Frequency of store inventory updates based upon RFID-derived data.
- Accuracy of in-store tag application (such as dealing with merchandise that has been returned).

For many of the companies taking part in this study, the use of these KPDs was particularly important in the trial phase of their RFID journey – understanding how well and in what circumstances the technology would function for instance. But for some companies, they are important measures to monitor to ensure RFID remains fit for purpose and able to continue delivering the planned benefits to the business[35]. As one respondent noted: 'it isn't plug in and forget [technology]… we needed a team behind it and we need to keep making incremental improvements to get better and better'[R1].

> *"it isn't plug in and forget technology… we needed a team behind it and we need to keep making incremental improvements to get better and better"*

It is also worth noting that none of the case-study companies explicitly mentioned any ongoing measurement of consumer concerns relating to privacy, such as requests for RFID tags to be 'killed'[36]. It could be that previous speculation about levels of consumer concern relating to this issue were overblown, or consumers now no longer view it as a problem, or they simply do not know that RFID tags are being applied to the products they are purchasing. More research would be required to satisfactorily answer this question, but anecdotal evidence collected from the companies taking part suggest that consumer concerns about privacy relating to the use of RFID tags were almost non-existent.

Return on Investment

For those thinking about embarking on an RFID journey, the key question is of course whether this investment will be worth it – will it 'wash its face' as one respondent put it?[37] Perhaps not surprisingly, given how the case-study companies viewed the sensitivity of data relating to a considerable number of the KPIs discussed above, none were prepared to share explicit data on the ROI on their RFID project. The only numbers some were prepared to share related to the length of time it was anticipated the project would realise a positive return and whether this varied with reality: 'the plan was three years and the ROI was achieved in two'[R10]. For, others it was as expected: 'a two-three year pay back was planned and expected'[R10].

> *"the plan was three years and the ROI was achieved in two"*

While it would have been interesting to have greater financial detail about the ROIs experienced by these companies, perhaps the most important measure is the fact that all 10 companies were unequivocal in their assertion that the ROI had been achieved, and based upon their trial experiences, further roll out across the business was fully justified and largely embraced with considerable enthusiasm and optimism: 'the reaction of the business has been overwhelmingly positive'[R7].

Measuring the Impact of RFID

In and of itself, RFID will not deliver any benefits to a retailer that decides to invest in it – it is very much a facilitator or enabling technology, creating the opportunities for benefits to be accrued. It is also important to distinguish between KPIs and KPDs – the former focus upon tangible metrics of the benefits RFID can provide, while the latter are measures of its capability to deliver them. In addition, while KPIs are the desirable outcomes of an intervention, it is not always clear how they will be delivered and so it is important to identify the underlying Intervention Mechanisms, and associated Measures that enable them to be realised.

The companies taking part in this research, opted for a range of KPIs although three were most evidently in use: an increase in retail sales, a reduction in stock holding and a reduction in the volume of merchandise marked down in price. Where data was able to be shared, it seems clear that a persuasive ROI was highly achievable, often with only a very modest set of KPIs – the business case for investing in RFID seems clear and unambiguous. The next part of this report will now focus upon how these companies went about obtaining this benefit through rolling out RFID across their organisations.

"all of the companies were unequivocal that the ROI had been achieved and therefore further roll out across the business was fully justified"

Rolling out RFID

All the companies taking part in this research had taken the decision to roll out some form of RFID system after their initial trial periods although they varied in the extent to which this had happened. This section looks at their experiences of the roll out phase of their RFID journey including issues relating to the training of end users and what impact if any, the introduction of this technology had on policies and practices relating to carrying out physical stock audits.

Making the Case

As detailed in the previous section, all of the companies were able to generate a sufficient ROI to persuade the broader organisation that it made sense to roll out RFID: 'it was pretty clear what direction the company wanted to take … just based upon one KPI it was sufficient to persuade the business to roll it out'[R3]; 'the reaction of the business has been overwhelmingly positive'[R9]. Most companies had to build a revised business case for the roll out although the positive numbers generated by the trials typically made this a relatively straightforward task: '[we] had to build a new business case to roll out across the estate – it was not a difficult sell, [there was] real momentum at Board level – [they] wanted to invest in it'[R7].

> *"just based upon one KPI it was sufficient to persuade the business to roll it out"*

Planning the Roll Out

Companies varied in the degree to which the roll out was planned and the pace at which it happened – for some, organisational enthusiasm to reap the promised rewards led to what some respondents considered to be overly accelerated roll outs: 'my advice would be don't do a tight and fast roll out – business wanted to keep to their original deadline, but maybe do it more slowly!'[R10]. Another retailer echoed this view: 'Roll out was too quick, it was like trying to build a car while racing it down the highway!'[R3]. Planning and business preparation was key, particularly for some of the companies that were rolling out across multiple countries: 'we rolled out across 17 countries in 800 stores!'[R5].

For most, the issue of moving to a source tagging model required the greatest level of advanced business planning: 'we had to start the tagging process one year before roll out'[R5]; 'it will take about 1.5 years for roll out to be complete to take account of the various seasons of merchandise that will be source tagged'[R2].

> *"we had to start the source tagging process one year before roll out; it will take about 1.5 years for it to be complete in order to take account of the various seasons of merchandise"*

As detailed earlier in this report, such fundamental changes required careful co-ordination and cross functional buy-in to the roll out programme to make it a success, not least from the Buying function that would typically negotiate contracts with suppliers, especially where the cost of the RFID tag moved from being part of a trial budget to being regarded as part of business as usual. Timing was also an issue for some of the companies, not least ensuring that the roll out timetable did not clash with peak retail times such as Christmas: 'it was a failure, time frame was too short, and the implementation team had become complacent … didn't provide the proper support and training; it was the wrong time'[R6].

Rolling Out

For virtually all of the companies taking part in this research a key element of the roll out was dealing with legacy stock, primarily in the retail stores, to ensure that an RFID tag was retrospectively applied to the applicable merchandise. Various approaches were adopted such as organising 'tagging parties' in stores to encourage staff to actively participate, or sending third party support to assist staff in the tag up process. Either way, an important part of the roll out programme was planning and delivering a strategy to ensure selected current stock could begin to be identified by the RFID system.

For some companies there was also considerable work to be done to deal with certain store environments that presented challenges to the effective implementation of RFID: '80% of roll out was straightforward – the remaining 20% of stores were challenging for a number of reasons – lacking Wi-Fi, layout, construction of buildings and so on'[R1]. The limitations of RFID technologies are well known and most of those companies that were interested in being able to differentiate between stock held in the front and back of the store quickly recognised that as part of the roll out process, some form of shielding needed to be installed to remove the possibility of 'data bleed', where tags in one location were inadvertently read and assumed to be present in another location. This took the form of special paints and coverings being applied to the walls separating the sales floor from the backroom areas (only visible in the backroom areas and not on the sales floor).

Training and Awareness

A key part of any roll out is ensuring that the staff who will be using and interacting with the technology are provided with sufficient awareness of why it is being introduced together with training on how to use it: 'you have to explain that it will actually reduce workload – it will help you [the member of staff] to do things better or do other things for the customer'[R4]. Another company reiterated this point:

> you know, we had to educate staff as to why it becomes important to tell a system when they are moving stock around – they had never done this before. We had to spend time explaining to staff why RFID is a benefit to them … will be able to replenish more effectively, customer experience will be improved… we made good use of examples from the trial stores[R7].

So, obtaining staff buy in to RFID was very important, but providing training was also key and something that a few of the companies felt could have been improved: 'training was the big issue. Training could have been better in the roll out'[R10]; Checkout staff required more training than we first realised'[R5]. Others, however, recognised its importance and spent a considerable amount of time and resource getting it right and sustainable: 'whatever you do, invest in training materials for store staff and remember staff turnover, you won't regret it!'[R9]. As mentioned previously, one company in particular, incorporated the design and delivery of training programmes into their trial process to ensure it was fit for purpose, assessing staff reactions to the e-learning materials they had developed and whether they were sufficient to enable staff to begin to use the technology without any actual face-to-face external training.



Impact on Audit

As discussed in the previous section, reducing the cost of physical audits is one of the possible KPIs when an RFID system is introduced – the theory being that automated and semi-automated RFID counts could replace existing physical inventory audits undertaken by either third party companies or store staff. The reality for most of the companies taking part in this research was that their roll out plans saw little immediate change in current practices. Some of this was due to ongoing concerns about the veracity of the RFID data: 'we are planning to move to 2 physical counts a year from 4 – but we don't believe that we are still sufficiently confident in the RFID data to get rid of them [physical audits]'[R3]. For others it was an issue with how their external Auditors viewed RFID data:

> *"whatever you do, invest in training materials for store staff and remember staff turnover, you won't regret it!"*

> [the] Auditors have not yet agreed to use RFID counts instead of physical counts[R7]; external audit companies still require physical counts. Still relying upon the old inventory system for audit reasons – accountants have not

> adopted the RFID data yet – hopefully, these [requirements] will no longer be necessary – our next big project![R10].

However, some clearly had a transitional strategy in place: 'still doing twice yearly physical audits in house but the external auditors are now beginning to accept the idea of RFID counts'[R4]; '[we] will be moving from two [audits] to one per year … negotiating with auditors to accept RFID counts'[R4]. For one of the companies the roll out programme had already secured a significant change and saving in audit costs: 'we are moving from once a month to once a year – 75% reduction in staff audit hours'[R2]. Given the not inconsiderable costs associated with undertaking physical audits, and the clear potential for RFID systems to provide at least equivalent and arguably more reliable stock counts, it seems that future roll out programmes should take account of how this process might evolve.

"the challenges don't go away, you need to keep managing them"

Living with RFID

A number of the companies participating in this research reflected on their post roll out experience and the ongoing commitment required to manage RFID systems:

> it isn't a plug in and forget technology … you need to continue to make investments in processes and support, which is something we didn't do as an organisation. We rolled it out and said we are done without realising we needed a team behind it and we need to keep making incremental improvements to get better and better[R3].

Others agreed about the need for RFID systems to be continually monitored and managed: 'the challenges of RFID don't go away, you need to keep managing it'[R4]. Understanding this ongoing commitment was part of most of the roll out business cases of these companies, but not all and as part of this, some reflected upon the data consequences of rolling out RFID: 'it [the roll out] has made us realise that we need to get a data lake sorted out'[R3]; 'data synchronisation is key but difficult – integration is so difficult to get right and we continue to learn and work on it[R10].

It became clear from all of the companies taking part in this research that the issue of integration was one of their biggest challenges on their RFID journey and so the next section of this report will now consider this in more detail.



The Challenges of Integration

This is the topic that united all of the companies and generated the most exasperation when respondents were interviewed for the research:

> was it easy to integrate NO, definitely not! It took a long time, there was a lot of resistance towards integration[R7]; data synchronisation is key but difficult – integration is so difficult to get right[R4]; data integration? We have not found it easy[R6].

Part of the challenge came from perhaps understandable concerns from the business about the potential impact on existing systems and day-to-day operations essential to profit generation: 'we were not allowed to interfere with the existing sales process at the checkout – [the business wants] change without change!'[R8]; 'the business was worried about being dependent on the new system'[R4].



There were three areas that were considered to offer particular challenges: connecting with supply chain systems (such as DC inbound data), the main retail stock system (ERP), and the store point of sale system (EPOS), with the last of these being a potentially crucial data collection point in the RFID journey. Only four of the companies taking part in this study could be regarded as having a fully integrated RFID interface at the POS, where store staff have a single-step process for recording the transaction and the EPC[38] code. For others it was something they would like to do but cost remained a key stumbling block:

> The RFID system is pretty much standalone – would love to link to EPOS at some point but considerable cost involved'[R1]; The POS element was a real struggle. [We] have RFID pads at the POS – every day [staff] miss between 3-6% of tags despite all best efforts[R2]; we looked at using a EPC barcode [to get around the problem] but a lengthy project would be required – would require 23 different systems to change[R5].

While the issue of mis-reads at POS or not having the capacity to record RFID tags as products are purchased did not necessarily affect the ability of some case studies to deliver their overall ROI, it did mean that for some, data fixes had to be put in place to ensure subsequent SKU counts remained accurate: 'when an RFID transaction takes place [at the checkout] …we had to find a way of updating the RFID system – it works but it is not perfect'[R5]. For another retailer, the desire to deal with the issue of fraudulent returns is requiring a POS intervention that will use a 2d barcode rather than an RF reader because the costs of getting the former to work was considerably less than the latter.

Getting Systems to Talk

Part of the problem came down to the nature of the data that flows in most existing inventory systems compared with that generated by RFID systems: 'the existing system struggled to cope with the degree of detail offered by RFID, [it was] not able to move from style level to item level[R7]. For another company it was when the data was created: 'one problem is that the RFID data is in real time while the other data is daily – which data is correct at any point in time?'[R4]. But perhaps the biggest challenge was for those businesses where less than 100% of all merchandise was RFID tagged: 'it's hard to integrate systems unless you have a 100% tagging strategy[R8]. This inevitably leads to multiple data flows as non-RFID and RFID-tagged products flow through the retail supply chain: 'we still have two information flows – RFID and traditional data inventory flows – they communicate with each other, but they are still separate. It is a very gradual process of introducing the technology to the business'[R9].

"it's hard to integrate systems unless you have a 100% tagging strategy"

Other respondents echoed this approach: 'the RFID system is separate to the legacy system with the former providing data to the latter. The RFID data overrides the legacy data. The EPOS system is separate to the RFID system[R5]. A third interviewee also flagged up this issue: 'have a parallel data system – RFID data flows into the existing system but could just revert back to using EAN codes at the checkout. [We have] found it very difficult to integrate[R4].

Dealing with this issue clearly generated much head scratching for many of the RFID implementation teams in these companies:

> had to create work around hacks, so we created middle wares to try and connect the two, definitely not a perfect system and there are definitely some risks and opportunities for errors to happen'[R7]; had to create translation tables to ensure RFID fitted with existing ERP (Enterprise Resource Planning)[R8].

For some the choice of system to manage the RFID data was an issue: 'the integration issue is still the problem – still a lot of noise. Next version of software will improve things, but the software has been our limitation – integration has been our real issue with the business model'[R7]. For one company in particular, the degree of complexity and challenge presented by integration issues had raised questions about their ability to successfully roll out RFID across the business:

> *"the integration issue is still the problem – still a lot of noise. Next version of software will improve things, but it has been our limitation – integration has been our real issue with the business model"*

> now trying to extend to more and more stores but have not put the resource in to fix the data integration issues. Wouldn't say we have lost control but this has become a major point of potential failure[R10].

Even where a company had made the commitment to go for full integration, it was clear that it had not been an easy journey:

> we have a completely integrated system – integrated with EPOS and inventory system. It was a complex process to get right – in my view most of the POS companies do not know how to do it. We have not found it easy[R6].

So, it would seem that for most of the companies taking part in this research the issue of data integration represented probably the biggest challenge in their RFID journey – how to bring RFID-derived data into alignment with existing systems in a way that was cost effective and kept disruption to a minimum. As with the introduction of an RFID system itself, the general advice would be to carefully review how RFID-related data integration will interact with, and impact upon, existing systems and processes, and adopt a relatively modest incremental approach that takes account of them.

> *"understanding what the aims and objectives of any proposed RFID system will require in terms of data integration should be part of the very early stages of the planning process"*

Furthermore, it seems very clear that understanding what the initially defined aims and objectives of any proposed RFID system will require in terms of data integration with existing business systems should be part of the very early stages of the planning process. However, what is also clear, despite the problems highlighted above, is that full data integration is not always necessary to enable a satisfactory ROI to be achieved – for some of the companies, relatively limited use of the data emanating from their RFID system still generated more than enough value to warrant its use. For these companies, part of the ongoing RFID journey is to understand how greater integration can be achieved over time and in a way that continues to make financial sense.

Loss Prevention and RFID

While only two of the 10 case-study companies set out with the explicit aim to utilise their RFID system to impact upon retail loss, it is a topic that has frequently been discussed when considering the potential use cases of RFID[39]. It is therefore worthwhile reviewing why, for the most part, the companies taking part in this research largely eschewed its use to deal with retail losses.

Loss Prevention in Context

One of the great challenges of managing retail loss is the lack of precise data on its causes, making the development of ameliorative actions more akin to guesswork than calculated intervention. The reason why the causes of most losses remain unknown is due to the way in which loss or 'shrink' data is often generated.

"one of the great challenges of managing retail loss is the lack of precise data on its causes, making the development of ameliorative actions more akin to guesswork than calculated intervention"

Typically, a retailer's shrink number will be calculated when periodic physical stock audits are undertaken, which reveal the difference between the amount of stock (either in terms of value or number of items) the system thinks the business should have on hand (based upon the difference between the amount of stock acquired versus the amount sold through checkouts), and what is actually present. The discrepancy is 'shrink', often expressed as a percentage of the total amount. So, a company that buys 100 units and sells 80, with 10 remaining in stock has a shrink rate of 10% – 10 items have gone missing. Because there is very often a time lag between when an item has gone missing and when a physical audit takes place that recognises the loss (for those undertaking annual audits, it could be up to a year), it can be very difficult to know why it happened. Did the item ever arrive at the store? Was it returned to the supply chain but the transfer not recorded? Did a customer steal it? Did a member of staff steal it? There are many reasons why losses may occur but very often because of the data time lag, ascertaining the root cause is almost impossible.

Given this, the potential for RFID systems to generate stock level data much more frequently (most of the case-study companies were generating RFID data every one to three weeks), and for some, enable awareness of product location, then impacting on retail losses would seem like an excellent opportunity. However, hardly any case studies in this research actively used their RFID system for managing retail losses. A number of factors emerged to explain why this was the case, although it is worth noting that one of the companies was much more proactive in this respect and sought to use the data from their RFID tags to identify and react to non-purchased product exiting their stores, but they were very much in the minority.

Vulnerability of Tags

Perhaps the most significant challenge respondents identified was the relative fragility of the RFID tags they had decided to use – swing tags and simple stickers – which made them very easy to remove by a would-be thief and hence not activate security gates at the exit: 'tag is easy to defeat – it's the right tag for our products for selling but not for security'[R6]; '[we] realise the tag is only any good with opportunistic thieves[R8].

"tag is easy to defeat – it's the right tag for selling but not security"

Evidence from other studies has certainly shown that the type of security tag being used can influence the degree to which some types of thieves are deterred, with hard Electronic Article Surveillance (EAS) tags generally being regarded as offering a more effective deterrent potential[40]. This raises an interesting organisational conundrum when it comes designing and implementing an RFID system. To what extent do you want RFID to replace an existing hard tag EAS system, which is likely to be applied in-store and often on selected products[41]? Interestingly, one of the case-study

companies started out using a hard RFID tag applied in store, potentially getting both the stock visibility data benefits combined with the risk amplification attributes of an existing EAS hard tag. But, the in-store tag application process was found to be difficult to deliver consistently, particularly when the stores were busy and the programme was rolled out to bigger outlets, which undermined the efficacy of the stock visibility data.

While there are companies that have utilised a RFID-enabled hard tag applied away from the store environment (either in DCs or at the point of manufacture) that did not participate in this research, the primary goal of the case-study companies was finding a cost-effective way of improving stock visibility. For them, source-tagging utilising a once-use swing tag/sticker offered a cheap and relatively simple supply chain solution compared with the alternative of a multi-use hard tag that inevitably needs a more involved supply chain-driven recycling process.



Deciding what approach is best will be a very company-specific decision based upon the nature of the products being stocked, the design of the supply chain, the capability of the manufacturers and above all, the extent to which controlling shrinkage is seen as a primary goal for the investment. Certainly, for the companies taking part in this research, the additional complexity and cost of applying a RFID-enabled hard tag made opting for swing tags and stickers a much more compelling business case for them.

It was also interesting to note that for two companies, they purposefully did not want their RFID tags and stickers to be regarded as a 'security' tag because they were concerned about would-be thieves deciding to remove/destroy the RFID tag prior to leaving the store (in an attempt to evade detection), which in turn would negatively impact upon stock file accuracy:

> only using RFID as a loss detection tool and not loss prevention. We don't want thieves to realise that it is the RFID tags that are offering security because they will begin to remove the tags and we will lose [stock] accuracy[R1]; don't want RFID tags to be viewed as security tags – will affect stock accuracy. Not a high priority to link to EAS podiums[R10].

Again, trying to utilise the chosen technology for security was seen as potentially undermining the primary goal of the system – stock integrity.

Exit Gate Reliability

For those companies that had opted to use their RFID tags as a form of EAS, or had tried them as part of their trial process, they also faced challenges trying to read the tags at store exits: 'exit reads are poor'[R6]; 'the theft antennae are not performing well, they cannot capture accurate loss numbers well'[R3]. As detailed earlier, companies using this technology were getting read rates of between 70% and 80% and this was confirmed by store visits where staged attempts to remove unpurchased product revealed that on occasions, this rate could drop to as low as 60%. There is certainly much developmental work underway to improve the read rate of overhead/exit readers, but for now, few of the case-study companies were prioritising the reading of tags as they exited their stores.

Impacting on the Shrinkage Fog

As detailed earlier, one of the potential loss prevention-related benefits of RFID was delivering greater product transparency concerning where and when stock loss was occurring. On this, case studies had very mixed views, no doubt largely influenced by the degree of data integration they had achieved. For some, RFID had done little to lift the fog surrounding their shrink number:

> feel that the shrink number got more complex – added new forms of admin shrink. Find it hard to zone out store errors from the shrink numbers[R6]; it [RFID] has not really provided any great insights into better understanding shrinkage and loss – we need more integration and scale before it might make a difference[R10].

But for others, it had provided them with greater clarity about what the causes of the lost might be: 'I think RFID reduces the shrink fog – it helps to rule out many process-based causes of shrink'[R9]; 'RFID has enabled us to iron out all the obvious system glitches that caused some shrinkage – most of the store losses are now malicious'[R2]. Certainly, where the RFID system is able to reduce the amount of 'unknown stock' in the store, through identifying errors inherited from the supply chain, then it can play an important role in helping to reduce the volume of non-malicious losses recorded by stores.

As mentioned above, these rather contradictory views on the impact of RFID on awareness of the scale and extent of retail losses can be partly explained by the degree of integration and the capacity to capture data movement across the supply chain, but it is also a function for some of tag penetration in the business. If you have less than 100% of SKUs tagged, then inevitably there will be dual data flows within the business – one for non-RFID-tagged product and another for tagged SKUs. In addition, the continuation of manual counts for RFID enabled products and how this data is assimilated, can actually, make it more challenging and complex to fully understand the overall shrinkage and loss picture in a retail store.

Enabling Innovation

A particularly interesting development for one retailer was the ability to test store interventions more quickly and cheaper than ever before: 'weekly stock counts give us huge insights – we can now test ideas in the stores really quickly and cheaply'[R2]. Measuring the impact of any loss prevention-related intervention has always been a difficult and involved experimental process, requiring the careful manual counting of stock before, during and after an intervention has been introduced, and comparing this with identical data collected in control stores, to understand what loss had occurred and what could be attributed to the intervention rather than random change. Where stores are now counting stock on a weekly basis as part of BAU, then measuring the impact of an intervention becomes a much more straightforward process and opens up the prospect of not only identifying loss prevention interventions that might actually work to reduce loss, but also being able to fine tune them to meet the specific circumstances of particular store environments[42].

> *"weekly stock counts give us huge insights – we can now test ideas in the stores really quickly and cheaply"*

Identifying Hot Products and Amplifying Risk

Finally, it is interesting to note how some companies were beginning to use RFID-driven data as a loss prevention facilitator – helping them to identify 'hot products' (those regarded as much more likely to suffer from loss) and giving staff more opportunity to become guardians of control, amplifying the sense of risk for would-be thieves. In the case of the former, hot products were targeted with more traditional forms of security such as hard EAS tags, while in the latter, staff now had more time to be on the shop floor because RFID had reduced the time it took to complete other tasks, such as restocking and stock counting. They could then engage more with would-be customers and prospective thieves, encouraging sales and deterring theft: 'store staff now have more time to act as a positive deterrent to theft because the time spent restocking is much less'[R3].

> *"store staff now have more time to act as a positive deterrent because the time spent restocking is much less"*

There is certainly a significant body of evidence to suggest that engaged and engaging store staff are one of the most effective loss prevention tools a retailer can deploy and so this particular Intervention Mechanism, while difficult to accurately measure, may well be RFID's most important contribution to controlling malicious forms of retail loss[43].

Learning Lessons

One of the great benefits of not being an early adopter of a particular technology is the opportunity to learn from the experiences of those brave souls who decided to be pioneers! This section of the report brings together the many and varied lessons learnt by the 10 case-study companies as they progressed on their RFID journey.

Understand Your Business

Not unlike any change management project in retailing, planning is a fundamental part of the process and for some taking part of this research, they felt that they could have done more: '[we] didn't plan well enough, particularly in terms of impact on current systems[R2]; 'the biggest challenge is doing the change management… this is something we underestimated at the beginning'[R3].

"we didn't plan well enough, particularly in terms of impact on current systems"

As detailed earlier, initiating an RFID project is now perhaps more about evaluating how current processes and business practices will be impacted than it is navigating a series of technological hurdles. Indeed, one respondent advised against becoming overly influenced by the latter: 'don't let the technology provider dictate what you should be doing – they often want the business to change its processes to fit the technology'[R5].

Carrying out detailed process mapping of the products that will be included in the project is key, including understanding what really happens throughout the supply chain: 'we found that at busy times, staff cut corners – we needed to understand how RFID would work in the real world'[R8]; 'we wish we had mapped the store processes more clearly to understand all the exceptions and the problems staff might encounter using RFID'[R9]. In this respect, a number of respondents recommended that early involvement of representatives of end users was important: 'make sure those who will be using it and understand the processes, are involved from the start'[R6].

It is also important to understand your business in terms of the ways in which the physical estate may impact upon the successful introduction of RFID: 'recognise the limitations imposed by your physical estate – shielding, Wi-Fi coverage and so on'[R6]. Many of the companies taking part in this research came up against, and continue to be challenged by, their retail environments, and so it is critical that this is taken into account when planning a RFID project.

Clearly Articulate the Need

Respondents to this research also stressed the critical importance of thinking through the extent to which RFID will be used in the business: 'think about how far you want to go with RFID – we will never get to 100% tagging because some assortments do not make it possible – fast moving, short term sales items, very small items'[R6]. They also recommended keeping a clear and determined focus on what needed to be improved in the business, rather than potentially becoming side tracked by the technological components of the project: 'need to understand the current processes – you have to keep asking yourself the question: what do I need to improve and will RFID deliver this improvement or can something else do this?'[R3].

"you have to keep asking yourself the question: what do I need to improve and will RFID deliver this improvement or can something else do this?"

Ensure Board Level Support and Engage Stakeholders

The role of senior management in both the initiation and subsequent delivery of an RFID project is key – without their support it is unlikely that it will succeed. In addition, case-study companies were unanimous in emphasising the need to secure cross-organisational support for their RFID initiative: 'work hard on engagement in the company – worth the investment'[R8]; 'use stakeholder analysis to identify all your key players in the business and

how they might feel about being involved in a project'[R7]; 'Involve more people at the beginning, particularly those that are resistant (finance and production)'[R4]. As detailed earlier, most RFID projects cut across entire organisations and their successful introduction and integration requires early and sustained engagement across retail businesses.



Understand the Technology

Compared with RFID pioneers in the early to mid 2000s, retailers utilising the current generation of technologies have far fewer issues to confront and resolve: 'the technology is working, no question anymore, tag reliability is fine, readers are fine'[R3].

"the technology is working, no question anymore, tag reliability is fine, readers are fine"

Undoubtedly some of the same issues remain prescient – products that contain metals or viscous fluids will continue to be a challenge as will environments that are not conducive to the free movement of radio waves, such as enclosed metal shelving and dense building materials. But greater awareness of these issues together with a determination to minimise their impact was a clear message coming from the case-study companies: 'we will not get rid of the challenges of RF technologies, but we have to manage them and find solutions'[R3].

Some respondents were also very keen to emphasise that the technology is simply a means to an end and that any choices on investment needed to be clearly made within the broader business case for introducing RFID: 'it is now less about the technology and more about cost'[R6]. As detailed earlier, most companies had opted for remarkably simple systems with few technological components – handheld readers with a software interface being the most common. The rationale behind this was primarily driven by cost and pragmatism, focussing on what needs to be introduced to enable the ROI to be achieved.

Avoid Tagging in Store

All 10 companies taking part in this research had opted for a long-term strategy that involved the RFID tags being applied at the point of manufacture. While there are other case studies in the public domain that have adopted a strategy where the tags are applied further along the supply chain, such as in DCs, there is general agreement that it is not a good idea to build an RFID programme where the tags are applied in the retail store[44]. It is an environment where it is difficult to ensure consistency and sustainable compliance or achieve economies of scale.

"all companies had opted for a long-term strategy that involved RFID tags being applied at the point of manufacture"

Recognise the Omni Channel Imperative

As one respondent very clearly put it: 'if you want to be a big player in omni-channel then you need to think seriously about investing in a merchandise identification system'[R3]. As retail environments become more fluid, with consumer expectations growing for a highly flexible and responsive shopping experience, meeting that need cost effectively is undoubtedly a growing imperative for many if not all retailers. Getting traditional retail business models to flex across physical and virtual shopping spaces requires levels of stock accuracy and transparency that are simply impossible with existing modes of stock accounting and auditing – the margin of error it generates makes the business model increasingly unsustainable.

How improved levels of merchandise identification are achieved is of course open to debate, but for all

of the companies taking part in this research, their RFID-driven system was regarded as a key player in enabling the businesses to develop and sustainably manage their increasingly complex omni channel retail offering.

Standards Matter

While case-study companies varied in the degree to which they were sensitised to the importance of adopting RFID-based standards, all agreed that without them, it would be more difficult to innovate and evolve in the future[45]: 'standards enable tags to become a commodity and then you do not need to be associated with a particular [tag] provider'[R10]; 'if you do not have standards it can stifle innovation – look at Bluetooth for instance'[R3]. Many pointed to the standards offered by GS1 because they were regarded as a way of minimising problems in the supply chain: '[we are] GS1 compliant – it reduces confusion in the supply chain'[R8]. But it was not just standards concerning technologies that was thought to be important, some companies also emphasised the need for standards concerning the collection, collation and storage of data:

"if you do not have standards it can stifle innovation"

> [there are] so many closed/encapsulated systems offered by providers which cause problems when wanting to charge for any movement of data between systems. Once you have standardised data then you can get various suppliers to innovate because they have clarity and confidence in the underlying data supply[R3].

This respondent went on to recommend utilising standards around how the data was stored by retailers, an issue that some had found to be problematic: 'if you are setting out on an RFID project then it makes sense to utilise the standards associated with an [Electronic Product Code Information System] EPCIS[46] repository'[R3]. This is a GS1 standard aimed at enabling businesses across the retail supply chain to share detailed product information regardless of the technologies being used to hold and transfer the data. It is regarded as a way of: 'answering the "what, where and when" questions to meet consumer and regulatory demands for accurate and detail product information'[47].

Undertaking Trials

As detailed earlier, all companies had undertaken various types of trials to ascertain what technologies to use and how they would perform in their business context. The length of time taken varied enormously although most proof of concept trials lasted around about 3 months and were carried out in just a few stores. RFID Pilot Trials tended to last longer and involved more stores with varying degrees of complexity to understand how the proposed system would work both with existing business processes but also in different retail environments.

Naturally, there were mixed views about how long this should take, for some they warned against doing this too quickly: 'Had to resolve the process-related issues in the [pilot] stores and 2 months was not enough time …'[R9]. For others, they felt they had taken a bit too long: 'perhaps adopt a more quick and dirty approach rather than considered and cautious'[R6]. Perhaps the key lesson on trials is to ensure that by the end of the period, the following questions had been satisfactorily answered:

- To what extent will RFID deliver the proposed improvements in agreed KPIs and achieve an ROI?
- How well or not will the technology work in various retail settings?
- How will RFID operate within current business processes and what would need to change?
- How will staff respond to and use the technology?
- What needs to be put in place to ensure any future roll out will be sustainable and successful?

Measuring Impact

Ultimately, RFID is an intervention used to enable the business to be more successful in meeting its core objectives of being a sustainably profitable retailer. In and of itself an RFID system is little more than a combination of technologies that provide the user with actionable data. As detailed earlier in this report, most case-study companies had relatively few KPIs they wished to

"start with a few KPIs – if you try to measure everything you will be lost"

achieve and for many there was a good reason for this: 'start with a few KPIs – if you try to measure everything you will be lost'[R1]. But it was also important to understand how the chosen KPIs will be achieved – the Intervention Mechanisms that need to be triggered to see a positive change: 'for us, only one KPI: increased sales … which is driven by stock integrity, generating accurate replenishment'[R8].

Rolling Out RFID

Every one of the case-study companies had made the commitment to roll out their RFID programme more broadly across their businesses and a number offered a series of advisory points on this issue:' Roll out [was] too quick: 'was like trying to build a car while racing it down the highway'[R2]. Others agreed and advised against organisational enthusiasm hampering a successful roll out process: 'sometimes [you] need to slow the business down when it comes to roll out'[R6]. The scope of an RFID roll out is significant and companies reflected upon the importance of fully understanding how it will impact upon store operations in particular: 'RFID touches every part of the business and the change management in the store is huge'[R1]. Two other issues were considered particularly key: ensuring the timing of the roll out did not adversely impact upon the business: 'avoid peak retail times for roll out'[R5]; and putting in place an effective and sustainable training programme for using the RFID system: 'train staff properly'[R5]; 'invest in training materials for store staff and remember staff turnover!'[R8]; 'think about who will do the training when you operate across multiple countries'[R9].

Integrating RFID-Generated Data

By far and away the biggest headache these companies faced as they progressed on their RFID journey was the thorny issue of integration of the RFID-generated data with legacy retail systems. A number felt they had not planned sufficiently well on how to resolve this issue and counselled future adopters to not only take integration seriously but think very early on in the process the extent to which they want new and existing data systems to communicate. While views varied as to when retail IT departments should be involved, many encouraged early engagement: 'IT need to be involved early on – integration issues generated many problems to be resolved'[R4].

RFID is an Ongoing Journey

Case-study companies were keen to remind prospective users that RFID systems are not a plug and forget technology – they require ongoing commitment to ensure they remain fit for purpose and capable of delivering the KPIs originally required by the business to justify any recurring investment. This was evidenced by the ongoing use of Key Performance Drivers (KPDs) by many of the companies – indicators tracking the overall 'health' of the system: 'we have had to put measures in place to make sure it [the RFID system] continues to work properly'[R2]. Others also pointed to the need to recognise the costs associated with building upon and expanding their current system: 'Future developments of the system require proper resourcing'[R1].

> *"we have had to put measures in place to make sure the RFID system continues to work properly"*

Not unlike retailing itself, RFID systems need to evolve as circumstances change and new opportunities become apparent. As detailed earlier, one of the attractions of investing in RFID is the potential key role it can play in enabling a business to remain competitive, and as such continuing to reflect on how it might do this would seem a judicious strategy to adopt.

Keep it Simple

The final piece of advice offered by many of those contributing to this research was to remember to keep it simple. Indeed, some reflected on how they had not followed this advice when they set out: 'we could have potentially built something simpler and more streamlined'[R2]; 'don't over complicate it – you are likely to scare off other parts of the business and the project will not get off the ground'[R5]. As part of this, keeping the core purpose of what RFID can and cannot do was considered key: 'remember, RFID simply gives you data – if you do nothing with it [the data] then you just have a nice shiny expensive tool!'[R6].

Future Developments

This final section of the report begins by first looking at some of the future uses and developments envisaged by the case-study companies taking part in this research before moving on to consider the ways in which they would like to see the RFID industry better support their work in the future.

Fitting Rooms and Magic Mirrors

The most frequently cited future development related to gaining greater visibility and understanding of how consumers use changing rooms and how they may begin to interact with 'smart' mirrors. Of particular interest was the types of products being taken into changing rooms: 'how many people are taking clothes into fitting rooms, number and type of products taken in'[R8]; 'fitting rooms are an interesting space for future development – knowing what has entered and then what has been sold – help with size availability and messages to staff to help[R3].

> *"fitting rooms are an interesting space for future development – knowing what has entered and then what has been sold"*

Others talked about how RFID would be able to help with the 'digitisation' of the store and the extent to which various technologies could be developed to utilise the EPC code on the RFID tag to help the consumer product-selection process: 'digital futures for stores – smart mirrors, interactive changing rooms[R6]. While none claimed to be actively trialling this technology at the moment, it was certainly at the forefront of their thinking about what to explore next with RFID-enabled technologies.

Heading Back Down the Supply Chain

The second most mentioned development was beginning to utilise the RFID capability in the supply chain prior to the store: 'next phase is to get it into the Supply Chain and gain benefit from it in that environment'[R2]; 'currently have no connection between DC and the stores for E-commerce or using RFID. So, starting to work on the DCs to use RFID'[R6]. It was recognised that in the pre-store environment a different business plan would be required to understand whether a payback would be achieved and what KPIs would be most appropriate to achieve this. However, as detailed earlier, much of the recurrent cost (the purchase and application of the tag) was already covered by KPIs associated with retail stores and so rolling back down the supply chain was seen to offer significant potential.

The only concern expressed by some was understanding how item level tagging would be able to produce sufficiently high read rates in what are likely to be challenging environments for RFID tags. However, others were more interested in using RFID to track shipments rather than individual items – something which a number of the case-study companies were already successfully doing.

Broadening Coverage

A number of respondents were particularly interested in beginning to broaden the range of SKUs covered by RFID, including the tagging of retail assets such as returnable transport items such as totes, dollies, racks and pallets. For one retailer the next immediate goal was getting the business to the point where 100% of all stocked products were tagged, a significant turning point that they believed would have profound implications for simplifying and streamlining their current dual data flow process (as detailed earlier, for other retailers they could not envision ever developing an ROI for adopting this approach given some of the products they stock).

What was interesting was that very few talked explicitly about prioritising greater integration at the POS, possibly because for some it was already underway, while for a number of others, the cost implications, because of the size of their retail estate, were still too profound to make the ROI deliverable in the near term.

Improving Data Collection Interfaces

Because all 10 case-study companies were exclusively dependent upon store staff using

some form of handheld reader to collect data on a regular basis in the front and back of the store, a number had plans for developing the usability and interface of these devices. This included making them smaller and/or more powerful: 'looking at watch-based handhelds for staff'[R7]; making the data interface more flexible and dynamic: 'want staff to be able to see what is in the store at all times so they can better help customers'[R3]; and ensuring users are given the most appropriate feedback when they are undertaking stock counts: 'we needed to get [store] staff to understand to work to the [company SKU] target rather than 100% – 100% accuracy generally costs too much money to achieve in terms of productivity'[R7].

Many of the companies taking part in this research had witnessed significant improvements in this technology already, particularly through working closely with their providers, and as handheld computer devices in general continue to develop, this was certainly viewed as an area for significant future investment.



Improving Tags

As mentioned throughout this report, all of the respondents had few or no issues with the quality of the tags they were now using; for some it was now about developing tag technology further to enable them to be used on a broader range of products (such as those containing fluids and higher quantities of metal) and achieving greater miniaturisation to minimise their impact upon certain types of packaging: 'tags are getting smaller, so [our] packaging people can be more creative about what you can put them on'[R7].

Others were also looking at how tag designed could be improved in the future to deal with the challenges of reading tightly compacted products reliably and consistently[48].

Exploring Overhead Readers

While only one case-study company was actively testing overhead readers in any meaningful way, others were certainly interested in understanding how this technology may evolve in the future: 'long way to go with fixed readers but believe they are the future'[R7]. The challenge expressed by many was obtaining a realistic ROI in the near future, particularly for those retailers with relatively large stores currently containing metal shelving[49].

Getting Geographical Spread

A number of the companies taking part in this research had established an RFID system in parts of their global organisations but not others and so their future ambitions were targeted primarily upon broadening out their geographic spread to cover other regions where they had stores.

Delivering Checkout-less Stores

One of the early lofty ambitions of RFID was enabling retail stores to be able to eliminate the need for retail stores to have checkouts. RFID enabled products would be automatically associated with a consumer, via some form of ID (such as an RFID-enabled loyalty card and connected payment card) and as they left the store they would be charged for the products associated with them.

Of course, the reality has proved much more challenging to deliver and to date no retailer has managed to deliver this experience outside a tightly controlled test store[50]. However, one of the retailers taking part in this research was confident that this was not only one of their short to medium term business goal but that it was also achievable in the next few years. As the saying goes, watch this space[51]!

Creating Seamless Merchandise Visibility

As discussed at the beginning of this report, while the focus has been on the use of RFID systems, the aspect that brings the real value is the ID component of the system – the ability to recognise objects uniquely – to make a retailer's merchandise fully visible throughout the supply chain and

beyond. For a number of retailers in this study, it was the transformative nature of this data that was a key part of the future development of their businesses:

> the ID is the transformation in retail – the unique transaction, the product; the shopping experience. Our future retail environment may well contain a suite of interfaces that allow EPC to be communicated via a range of technologies – beacons, barcodes, sound, vision; RF[R4].[52]

Developing Data Capabilities

The final future development offered by some of the retailers taking part in this research was expanding the ways in which they utilised the data generated by their RFID systems. As mentioned earlier, a concern for some had been their inability to properly manage the flow and volume of data associated with RFID – their lack of a data lake had foreshortened many of their plans for undertaking some analytical activities. For others it was about broadening access to the data via, Cloud technologies to enable more functions within the business to seek greater business insights. For instance, one company pointed to the way in which data derived from product entering changing rooms would help with future product design: 'do all mediums going into a changing room turn into a large?'[R8]. As with all emerging data sets, it is knowing what the right questions are to ask in order to maximise its capability and part of this comes from encouraging as broad a range as possible of users to engage with it.

Industry Changes

The final part of this section summarises some of the main issues that respondents felt the RFID industry could help them to resolve, some of which have already been covered above. In the first instance, a number felt that more could be done to develop a forum where retailers could share their thoughts, concerns and ideas: 'I would like to make a call out to industry bodies to do more work to reach out to us and find out what it is that we want'[R3]. This is not dissimilar to concerns raised by those working in loss prevention who have often expressed the concern that technology providers seem to develop solutions searching for problems rather than communicating with them more directly to better understand the actual concerns they would like to see technologies developed to address. It could well be that a body such as GS1 could utilise its existing extensive network to facilitate this dialogue in the future.

Two other interconnected issues were put forward by some respondents: tags and overhead readers. On the former, some wanted greater standardisation around tag performance[53], while others were keen to see further miniaturisation and perhaps predictably a reduction in prices. A number of others highlighted that further work on improving how tags are secured to products would be useful.



As detailed earlier, the main issue with RFID tags is now not the reliability of the technology itself, but more how it is applied to the product and whether it can adequately survive the journey along the retail supply chain. An extension of this is of course whether the tag can be secured sufficiently well to deliver security-related benefits without comprising the quality and feel of the product or impact adversely on the ROI. For some this can be delivered by greater integration of the tag into the product itself although this then raises questions about its ability to remain a viable amplifier of risk – balancing durability with visibility will remain a key determinant to be addressed in the future.

The final issue raised focussed upon a desire to see what one respondent described as: 'better overhead solutions that actually work in real life'[R8]. As detailed earlier, this is a technology some have tried, and others continue to test. Without doubt, the concept is highly desirable – potentially automating one of the RFID-related process steps that still takes a considerable amount of time – staff manually scanning product in the front and back of retail stores. Undoubtedly, the technology will continue to develop and for those companies that can deliver an approach that fits squarely within current ROI models, they may have some success in persuading interested retailers to adopt it.

Endnotes

1 Brock, D. L, (2001) 'The Electronic Product Code – A Naming Scheme for Physical Objects', *Auto-ID White Paper*, WH- 002, January; Brock, D. L, (2001) 'The Physical Markup Language – A Universal Language for Physical Objects', *Auto-ID White Paper*, WH-003, February.

2 Sarma, S., Brock, D.L., Ashton, K., (2000) *The Networked Physical World, Proposals for Engineering the Next Generation of Computing, Commerce & Automatic-Identification*, AutoID Center: Boston; McKinsey Global Institute (2015) *The Internet of Things: Mapping the Value Beyond the Hype*, McKinsey Global Institute: New York.

3 Agarwal, V., (2001) *Assessing the benefits of Auto-ID Technology in the Consumer Goods Industry*, AutoID Center: Boston; Chappell, G., Ginsburg, L., Schmidt, P., Smith, J., Tobolski, J., (2002) *Auto-ID on Demand: The Value of Auto-ID Technology in Consumer Packaged Goods Demand Planning*, AutoID Center: Boston; Moran, H., Ayub, S., McFarlane, D., (2003) *Auto-ID Use Case: Improving Inventory Visibility in a Retail Company – Impact on Existing Procedures and Information Systems,* AutoID Center: Boston.

4 Kambil, A., Brooks, J., (2002) *Auto-ID Across the Value Chain: From Dramatic Potential to Greater Efficiency & Profit*, AutoID Center: Boston.

5 Alexander, K., Gilliam, T., Gramling, K., Grubelic, C., Kleinberger, H., Leng, S., Moogimane, D., Sheedy, C., (2002) *Applying Auto-ID to Reduce Losses Associated with Shrink*, AutoID Center: Boston.

6 From a video of Kevin Ashton (and others) in 2002 describing the AutoID Center and RFID. See also Srivastava, B. (2004) 'Radio frequency ID technology: The next revolution in SCM', *Business Horizons*, 47 (6): 60-68.

7 Ziegler, M. (2004) 'From Promise to Performance', *Elsevier Food International,* (4), pp. 74-77.

8 Huber, N., Michael, K. and McCathie, L. (2007*) Barriers to RFID Adoption in the Supply Chain*, Faculty of Informatics Paper, University of Wollongong: New South Wales.

9 Ilic, A., Harrison, M., Bhattacharyya, R., Board, E., Minisci, M., Humora, R., Hogan, B., (2016) *Privacy and Security Implications of the Internet of Things: Response to the US Federal Trade Commission Request for Comments*, AutoID Center: Boston; Kelly, D. (2008) *The Politics of RFID: The Issues*, University of Arkansas: Arkansas; Thiesse, F., Staake, T., Schmitt, P. and Fleisch, E. (2011) 'The Rise of the "next-generation bar code": an International RFID Adoption Study', *Supply Chain Management: An International Journal*, 16 (5): 328-345.

10 Hardgrave, B. and Patton, J. (2016) *2016 State of RFID Adoption Among US Apparel Retailers*, Auburn University, Auburn; Edwards, J. (2009) 'An RFID Fashion Statement', *RFID Journal;* Miles, R., Mitchell, Y. & Hardgrave, B. (2010) *Item-level RFOD for Apparel/Footwear: The JC Penney RFID Initiative*, Sam W. Walton College of Business, Arkansas; Patton, J. & Hardgrave, B. (2008) *RFID as Electronic Article Surveillance (EAS): Feasibility Assessment*, Sam M. Walton College of Business, Arkansas; Salmon, K. (2016) *Kurt Salmon RFID in Retail Study 2016*, Kurt Salmon, New York.

11 Recent publicised examples of retailers presenting their case studies on how RFID is being utilised in their companies include: JC Penney, Marks & Spencer, Jack Wills, John Lewis, Decathlon, and Sport Zone. See also Auburn University (2014) *Annual Audit Report 2013-2014*, Auburn University: Auburn.

12 See Kay, M. and Salmon K. (unknown date) 'RFID: Well Within Reach', *Apparel*, Supplement, 1-8.

13 Beck, A. (2002) *Automatic Product Identification and Shrinkage: Scoping the Potential*, A White Paper for ECR Brussels: ECR Europe.

14 Throughout this report, the phrases RFID, RFID system and RFID technologies will be used to describe a system whereby some form of uniquely identifiable taggant is attached to a retail product, which can then be identified using a range of different Readers, which in turn communicate with a software system that is able to recognise, record and where appropriate associate that taggant with other retail data. While there are numerous variants of this system, the basic elements remain consistent: some form of unique tag, a variety of readers to identify the tag and a software system to offer analysis.

15 Yin, Y. (1993) *Application of Case Study Research*, Sage: London.

16 Because of the location of two of the companies taking part, interviews were undertaken via Skype.

17 One company was not prepared to share how many tags they purchased a year other than that it was more than the average for all the other companies taking part. Hence the total number is the minimum quantity purchased and is likely to be more.

18 The exchange was provided by: http://www.xe.com/currencyconverter/.

19 Thiesse et al (2011) op. cit. discuss the problems associated with adopting this approach.

20 Thiesse et al (2011) ibid, also concluded that the support of senior management was critical.

21 For background see: Varvasovsky, Z. and Brugha, R. (2000) 'A Stakeholder Analysis', *Health Policy and Planning*, 15 (3): 338-345.

22 https://www.rfidjournallive.com.

23 See for instance: https://www.gs1.org/epc-rfid.

24 For the impact of changing levels of RFID technological capability see for instance: Thiess, F., Al-Kassab, J. and Fleisch E. (2009) 'Understanding the value of integrated RFID systems: a case study from apparel retail', *European Journal of Information Systems*, 18: 592-614.

25 It is worth noting that all of the companies had also invested in some form of localised tag printing technology to deal with stock that either arrived without a tag, had lost its tag somewhere in the store, had incorrect data on the original tag, or had been returned by a customer without a tag. This enabled store staff to generate and record new tags on the RFID system.

26 For instance, see Salmon, K. (2016) *Kurt Salmon RFID in Retail Study 2016,* Kurt Salmon: New York, where it is not clear whether some of the metrics presented should be viewed as ROIs, KPIs or as 'Key Retail Metrics', and how they are being affected by the introduction of RFID.

27 See for example: Marr, B. (2010) *How to Design Key Performance Indictors*, API White Paper, The Advance Performance Institute: https://www.bernardmarr.com.

28 This author would like to express gratitude to Hans-Peter Schiedt and Joachim Wilkens from C&A for sharing this phrase as part of their contribution to this research.

29 For an extensive empirical review of a large number of RFID case studies, albeit it from 6 years ago, see: Waller, M., Cromhout, D., Patton, J., Williams, B. and Hardgrave, B. (2011) *An Empirical Study of Potential Uses of RFID in the Apparel Retail Supply Chain*, University of Arkansas: Fayetteville.

30 These estimates are broadly in line with a recent survey undertaken by Kurt Salmon (2016) ibid.

31 This was achieved because in some retail stores there was not the physical space to accommodate the ranges being sent by the supply chain and RFID data enabled this issue to be identified and store stock holding adjusted accordingly.

32 See for instance: https://www.rfidjournal.com/articles/view?16788, which reflects on why scepticism in RFID derived data may prevail.

33 This figure is calculated by using an estimate provided by Ton (Ton, Z. (2012) 'Why "Good Jobs" Are Good for Retailers', *Harvard Business Review,* January-February, https://hbr.org/2012/01/why-good-jobs-are-good-for-retailers), that suggests approximately 10% of retail turnover can be accounted for by staff costs, and using this together with the calculated turnover for the 10 companies taking part in this research and the assumption that a 4% saving could be achieved by the introduction of RFID.

34 See Powanga, M. and Powanga, L. (2008) 'Deploying RFID in Logistics: Criteria and Best Practices and Issues', *The Business Review, Cambridge,* 9 (2): 1-10, for a review of the need for developing performance measures for RFID systems.

35 It is important to recognise that organisations such as GS1 have been working hard to develop a series of standards concerning the operability of many of the component elements of RFID systems, such as tag data standards, data transmission, air interfaces, readers and software interfaces: https://www.gs1.org/epc-rfid.

36 Some retailers offer the facility for an RFID tag to be 'killed', whereby its functionality is either electronically turned off, or permanently destroyed: https://www.rfidjournal.com/faq/show?37.

37 For a hypothetical review of what an ROI for an apparel retailer might look like see: RFID Journal (2015) *ROI Calculator*, www.rfidjournal.net/apparel_roi_calculator.xls.

38 One of the case-study companies did not make use of the EPC number on the RFID tag and instead linked it to an existing EAN code when a transaction was being processed. In this respect, while it is a one-step process at the checkout, integration of the EPC number with existing legacy inventory systems did not take place.

39 For a typically enthusiastic review of what RFID could do to reduce malicious retail losses see: Wyld, D. and Budden, M. (2009) 'Upping the Ante: Using RFID as a Competitive Weapon to Fight Shoplifting and Improve Business Intelligence', *The International Journal of Managing Information Technology,* 1 (10): 1-10.

40 Beck, A. (2016) *Amplifying Risk in Retail Stores: The evidence to date on making shop thieves think twice*, An ECR Community White Paper, Brussels: ECR Community; Beck, A. and Palmer W. (2011) 'The Importance of Visual Situational Cues and Difficulty of Removal in Creating Deterrence: The Limitations of Electronic Article Surveillance Source Tagging in the Retail Environment', *Journal of Applied Security Research,* 6 (1): 110-123.

41 Some technology companies active in both RFID and loss prevention seem to advocate not using a hard tag RFID solution, although they do not discuss associated issues relating to the vulnerability of soft tags to be removed by shop thieves: Nedap (unknown date) *RFID White Paper: How to prevent shrinkage levels when introducing mobile checkouts in retail stores*, Nedap: place of publication not known.

42 One of the challenges of delivering effective loss prevention is understanding how any given retail environment, both in terms of its physical layout and broader social and cultural environment, affects the ability of interventions to work. While financial imperative and ease of management often drives businesses towards uniformity, very often a one size fits all approach does not always deliver the best results.

43 Beck (2016) op. cit.

44 See for instance: Miles, R., Mitchell, Y. and Hardgrave, B. (2010) *Item-level RFID for Apparel/Footwear: The JC Penney RFID Initiative*, RFID Research Center, University of Arkansas: Fayetteville.

45 Thiesse et al (2011) op. cit. also found that the adoption of standards helped to neutralise technology-related barriers to utilising RFID.

46 For more information visit: https://www.gs1.org/epcis.

47 Ibid.

48 See for instance the Tagged-Item Performance Protocol (TIPP) Guideline developed by GS1: https://www.gs1.org/epc-rfid/tagged-item-performance-protocol-tipp-guideline.

49 For an example of how RFID and other technologies may be used to provide continuous merchandise visibility see this example: http://rfidarena.com/2015/4/28/bringing-continuous-area-reading-into-the-shop-floor.aspx.

50 For the most recent iteration of this idea see Amazon's Amazon Go video: https://www.youtube.com/watch?v=NrmMk1Myrxc. For a previous version of this idea see IBM's 2006 RFID video: https://www.youtube.com/watch?v=eob532iEpqk.

51 See McKinsey Global Institute (2015), op cit, for projections of what this might be worth to the retail community by the mid 2020s.

52 See for instance the developments in SGTIN, which combines a GTIN with a unique product or serial number: https://www.epc-rfid.info/sgtin;

53 It may be that some of the respondents were not aware of the recent developments undertaken by GSI on this issue, see: https://www.gs1.org/epc-rfid/tagged-item-performance-protocol-tipp-guideline.