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Leveraging RFID in Retail: From Stock Management to Customer Experience Enhancement

A Case Study Framework for Best Practices

Master's thesis

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Abstract

Radio-Frequency Identification (RFID) has long been associated with inventory management and operational efficiency in retail. However, recent developments show that RFID can also serve as a strategic enabler of customer experience, supporting digital transformation efforts. This thesis investigates how retailers can leverage RFID beyond stock optimization to enhance customer experience, while overcoming implementation challenges.

The study adopts a qualitative multiple case study approach, drawing on both primary and secondary data. Four companies from different retail sectors are examined: a luxury fashion brand (Luxury House), Decathlon, Uniqlo, and Kroger. Data were collected through semi-structured interviews and analysis of public sources, and were coded thematically across two dimensions: customer experience improvements and barriers to RFID implementation.

The findings highlight several best practices for enhancing customer experience through RFID, including real-time inventory visibility, personalized in-store services, seamless checkout, and omnichannel integration. The study also identifies recurring challenges, such as technical complexity, training needs, financial justification, and privacy concerns. Additional insights were observed around operational efficiency, data analytics, and sustainability.

Based on these findings, the thesis proposes a best practices framework to guide retailers in deploying RFID technology effectively. The framework outlines strategic, technical, and organizational components necessary to align RFID adoption with customer experience goals. This work contributes to the literature by bridging operational and experiential perspectives on RFID and offers actionable guidance for retail managers navigating RFID transformation initiatives.

Key words: RFID, retail, customer experience, best practices, framework, digital transformation, case study, inventory accuracy, checkout process, implementation challenges.

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1 Introduction and Context

1.1 Introduction

In recent years, the retail industry has been undergoing significant changes, driven by new technologies and shifting customer expectations. Consumers today expect a seamless shopping experience that is fast, convenient, and personalised, whether they are shopping online or in physical stores. To meet these demands, retailers are adopting digital tools that allow them to improve their operations and create more value for customers.

One of the most important technologies shaping this transformation is Radio-Frequency Identification (RFID). While RFID has been used in supply chain management for some time, it is now playing a growing role in customer-facing services, helping retailers create better shopping experiences. This shift reflects a broader trend in retail, where companies are moving beyond efficiency goals to focus on building stronger relationships with customers through digital innovation.

Despite the growing use of RFID, academic research has mostly focused on its impact on logistics and inventory management, with limited attention given to how the technology influences customer experiences. This gap is important because RFID has the potential to enable new services and touchpoints that change how customers interact with brands. Understanding this impact is essential for both researchers and industry professionals who are looking to make informed decisions about adopting RFID in their businesses.

This study aims to explore how RFID contributes to the customer experience in the retail sector. Using a multiple case study approach, the thesis examines real-world implementations of RFID across different retail companies, identifying key themes, challenges, and opportunities. By doing so, it hopes to provide new insights into how RFID can support retailers in offering better, more personalised services while also improving operational performance.

The following sections introduce the structure of the thesis and the context of the retail industry and RFID technology.

1.2 Structure of the Thesis

This thesis provides an overview of the research journey and the structure used to explore RFID technology and its role in the retail sector. It opens with Chapter 1, which introduces the topic, the

motivation for the research, and the industry context. Chapter 2 reviews existing academic literature on RFID in retail, exploring how the technology has been studied so far, what gaps remain, and why customer experience deserves closer attention. The methodology is outlined in Chapter 3, explaining the research design, case selection, data collection methods, and analysis approach. Chapter 4 presents the case study findings, examining how RFID has been implemented across different companies. Building on these findings, Chapter 5 develops a framework based on the results, proposing a structured approach for retailers to adopt RFID. Chapter 6 discusses the implications of these findings for both academic research and retail practice, while acknowledging the limitations of the study and identifying areas for future research. Finally, Chapter 7 summarises the key contributions and offers recommendations for both researchers and practitioners.

1.3 Industry Context and RFID Technology

1.3.1 Digital Transformation in Retail

Over the last decade, the retail sector has experienced what many call its second digital revolution. Digital transformation, which means using digital technologies in a planned way to change how businesses work and deliver value (Verhoef et al., 2015), has moved from being a side project in e-commerce to becoming part of every retailer's main strategy.

This change did not happen by accident. Three important factors created a clear need for change. First, smartphones and fast internet have made it easy for customers to compare prices, read reviews and share opinions in real time. Second, the COVID-19 pandemic pushed contact-free shopping into the mainstream and made digital services essential (Deloitte, 2024). Third, new online competitors showed that the old way of keeping online and offline shopping separate was no longer enough, and traditional retailers had to adapt or risk to fall behind.

These changes have been supported by several key technologies working together. Cloud and edge computing give companies flexible tools to handle large amounts of data. Artificial intelligence helps turn this data into useful information, such as personalised offers or better demand predictions. Mobile apps let customers access these services easily on their phones. The Internet of Things connects shelves, sensors and devices in stores, providing constant feedback about what is happening. Most importantly, Radio-Frequency Identification (RFID) gives accurate, real-time data on each product, helping retailers know where every item is at any time (Piotrowicz & Cuthbertson, 2014).

Thanks to these tools, retailers are now focusing not just on making operations more efficient, but also on creating a better experience for customers. Services like buy-online-pick-up-in-store, ship-from-store and self-checkout rely on the same real-time product data that also helps with stock management and planning. In this way, smooth operations and happy customers are no longer separate goals but two parts of the same digital strategy (McKinsey, 2023).

The key point is this: without reliable, real-time product data, the goal of offering a smooth, personalised and fast shopping experience is impossible to achieve. RFID has gone from being a tool for the warehouse to becoming a core part of how modern retailers meet their customers' expectations.

1.3.2 What Is RFID and How Does It Work?

Radio-Frequency Identification (RFID) is a technology that allows data to be transferred wirelessly between a small electronic tag and a reader. In retail, RFID helps businesses track and manage products by giving each item a unique digital identity, often based on the Electronic Product Code (EPC). This makes it possible to know where each product is at any time, whether in a warehouse, store or during transportation.

An RFID system has four main components: the RFID tag, the antenna, the reader, and the backend system. The RFID tag is a small device attached to a product. It can be passive (powered by the reader's signal), active (with its own battery) or semi-passive (a mix of both). Each tag typically stores an EPC, which is a global standard identifier. The EPC is often linked to existing product codes such as the European Article Number (EAN) or the Universal Product Code (UPC).

The antenna sends signals to activate the tag and receive information back. The reader processes the data received from the tags and sends it to the backend system, which often connects to tools like Enterprise Resource Planning (ERP), Customer Relationship Management (CRM) or Point of Sale (POS) systems.

There are different types of RFID, depending on the frequency used. Ultra-High Frequency (UHF) is the most common in retail because it allows longer reading distances and faster data transmission. In a typical retail workflow, tags are applied to products at the source, such as the manufacturer. When products arrive at a store, RFID readers scan the tags automatically, updating the system in real time. This helps with inventory accuracy, locating items, and supporting services like automated stock replenishment or customer-facing features like smart fitting rooms.

Overall, RFID enables retailers to manage their inventory in a more accurate and efficient way, providing the data needed to support both operations and customer experience improvements.

1.3.3 A Brief History of RFID in Retail

RFID technology has been explored in retail for over two decades, but its applications have evolved significantly over time. The early 2000s marked the first major wave of RFID adoption, driven primarily by large retailers such as Walmart. At that stage, the focus was on improving logistics and supply chain efficiency. By tagging pallets and cases with RFID, companies aimed to reduce shipping errors, improve warehouse operations, and increase visibility across the supply chain.

However, the high cost of tags and infrastructure, combined with technical challenges, limited large-scale adoption in the early years. Many early projects focused on back-end operations, with limited impact on store-level processes or customer interactions.

The second wave of RFID adoption began in the 2010s, as the technology became more affordable and reliable. Retailers like Zara, Uniqlo and Decathlon began using RFID tags at the item level, not just for shipping cartons or pallets. This shift allowed them to manage stock more accurately in stores, reduce out-of-stock situations, and support new services such as self-checkout and efficient returns. Item-level tagging also enabled real-time inventory tracking, which became essential for offering omnichannel services like buy-online-pick-up-in-store (BOPIS).

More recently, a third phase is emerging where RFID is used to improve the customer experience directly. Retailers are integrating RFID data into customer-facing applications such as smart mirrors, interactive fitting rooms, and mobile apps that show real-time product availability. This new focus goes beyond operational efficiency to create a more engaging and personalised shopping journey.

Despite these advancements, much of the existing research on RFID in retail still concentrates on logistics and inventory management, with less attention given to how the technology influences the customer experience. This gap highlights the need for further studies on the role of RFID in shaping modern retail interactions, an area that this thesis aims to explore.

2 Literature Review

2.1 Introduction

The purpose of this literature review is to explore how RFID technology is currently used in retail and to establish a clear understanding of key concepts underpinning this research. This integrated review combines theoretical definitions and empirical findings to analyze the state of academic and industry knowledge on the topic. While many studies have focused on the operational benefits of RFID, there is growing interest in how it can improve the customer experience. This review defines essential concepts such as retail, customer experience, and RFID technology, drawing from recent academic literature, and highlights the gap in structured frameworks for RFID's strategic use in customer-facing applications.

2.2 Key Concepts and Definitions

Retail is the process of selling goods and services directly to consumers for their personal use. It covers activities such as product selection, stocking, merchandising, and providing customer service, often in physical stores or online (Levy & Weitz, 2014). Retailers serve as intermediaries, offering customers access to a variety of products and creating convenience in the shopping process.

Customer Experience (CX) refers to the sum of all interactions a customer has with a brand, across different touchpoints and channels, from pre-purchase to post-purchase (Lemon & Verhoef, 2016). It involves both functional aspects, like service quality and product availability, and emotional responses such as trust and satisfaction. In retail, a strong customer experience can drive loyalty and competitive advantage.

Digital Transformation in retail refers to the strategic use of digital technologies, such as RFID, data analytics, and mobile platform, to reshape business processes, enhance customer experiences, and stay competitive in a rapidly evolving market (Verhoef et al., 2021). This is a global evolution that integrates technology into all aspects of retail operations and customer interactions.

RFID Technology (Radio Frequency Identification) uses radio waves to automatically identify and track items equipped with electronic tags (Tebaldi et al., 2023). In retail, RFID enables real-time tracking of stock, reduces errors, and improves both operational efficiency and the shopping journey by enabling features like faster checkout and product availability insights.

These definitions provide a shared vocabulary for understanding how RFID contributes to modern retail strategies focused on customer experience enhancement.

2.3 RFID in Retail

RFID technology has become an essential tool in modern retail operations. Its main role is to improve key processes such as inventory visibility, supply chain efficiency, and reducing product losses. These uses have been widely studied and adopted, making them the most common applications of RFID in retail. As the technology has developed, it is now seen as an important part of digital transformation in the sector, helping retailers keep up with changing market expectations and consumer habits.

First, RFID helps improve operational efficiency by making inventory data more accurate and visible. According to Shin and Eksioglu (2015), stores that use RFID see better labor productivity because of less manual scanning, quicker product handling, and fewer mistakes in stock records. Their study, based on a production function model, showed that RFID users perform better than others. This agrees with Koh et al. (2006), who found that better inventory management is one of RFID's key benefits, directly helping business performance. With RFID, retailers can restock at the right time and avoid mismatches in inventory, reducing waste and lost sales opportunities.

RFID also helps reduce common problems like stockouts and product losses. Hardgrave et al. (2011) showed through a field test that using RFID significantly lowered the number of times products were out of stock, especially in categories with fast turnover and many product options. Customers are more likely to find what they are looking for, which leads to better sales and satisfaction. Florea (2016) also noted that RFID adds value throughout the supply chain, from the factory floor to the shop floor, by giving better control and tracking of products. This creates a more transparent system where managers can act faster to solve problems.

A key development in this area is the move to item-level RFID tagging. This means each product has its own tag, not just boxes or pallets. Tebaldi et al. (2023) explain that this allows RFID to be used both in logistics and on the shop floor. Their concept of "Retail 4.0" describes RFID as central to collecting data in real time, connecting systems, and linking online and offline retail. Knowing the exact movement of each item also helps with display planning and shelf management. This detailed data supports better merchandising decisions and can even help predict future demand.

The cost and return of RFID have also been widely discussed. Alberto (2024) presents a return on investment (ROI) study that shows the benefits of RFID are higher than the costs in the long term.

While the upfront investment can be high due to equipment, software, and training, it pays off through lower labor costs, fewer errors in inventory, and better reaction to customer demand. In addition, fewer stockouts and more accurate restocking improve sales. The study shows that RFID is a smart investment, not just a technical improvement. It adds value in both operations and customer-facing areas.

RFID also helps different departments in a company work together more easily. It gives everyone access to the same up-to-date data, which supports faster and better decisions. Sales teams, supply chain managers, and marketing staff can all use the same information to plan their actions. By tracking items through their full journey, from supplier to shelf, retailers can also improve how they forecast demand and plan stock. This reduces overstock and understock situations, helping the company save money and improve efficiency.

Another benefit of RFID is its ability to support sustainability efforts. By making stock levels more accurate, companies can avoid overproduction and waste. More precise data also allows for better monitoring of returns, helping reduce unnecessary transport and handling. In an era where customers care about responsible business, this makes RFID an even more valuable tool.

To sum up, the general uses of RFID in retail are well proven and continue to grow. The technology brings strong benefits for store operations, especially in inventory control, supply chain management, and data sharing between departments. These basic advantages also make it easier to explore more advanced uses that focus on improving the customer experience and building smarter retail environments.

2.4 RFID applied to Customer Experience

Besides helping operations, RFID is now being used more and more to improve how customers experience shopping. Many practical examples and studies show that it can make shopping faster, more personal, and more enjoyable. This is becoming especially important as customer expectations grow and as stores try to match the convenience of online shopping.

One important benefit of RFID is how it can simplify everyday shopping steps. Vlachos (2024) reviews smart shopping carts that automatically scan items, show the total, and let customers pay directly, avoiding the traditional checkout line. This helps reduce waiting times and makes the shopping process smoother, especially in busy environments.

RFID can also make in-store shopping more interactive. Choi et al. (2015) describe how smart screens in stores use RFID to show customers extra product details or suggest matching items. This helps shoppers feel more informed and confident in their choices. Landmark and Sjøbakk (2017) add that RFID in fitting rooms can track which items customers try on and alert staff to offer help, improving the service. With this system, customers don't have to leave the fitting room to ask for another size or color as it can be requested through the system. This saves time and improves comfort.

Another key point is how RFID connects online and in-store shopping. Zebra Technologies (2015) explain that customers can check online whether an item is available in a specific store, reserve it and then pick it up in person. In the store, RFID can even guide them to the right shelf or automate the pickup. This kind of connection matches what today's shoppers expect: smooth transitions between digital and physical channels. It also helps retailers keep better track of inventory across all channels, making it easier to avoid problems like selling out-of-stock items.

RFID can also improve how customers feel about their overall experience. Nabi et al. (2023) show that after RFID was introduced at LuckyOne Mall, customer satisfaction increased. Shoppers found what they needed more easily, and service was quicker. RFID also supported loyalty programs and personalized offers, which made the experience more engaging. Another good example is UNIQLO. According to Tan and He (2020), the brand uses RFID to help customers find products, speed up payment and keep shelves stocked, making the overall experience better and reducing frustration.

RFID is also useful for staff, who can better support customers when they know exactly where each product is. With real-time stock updates, employees can answer questions faster and give more accurate information. This leads to better service and helps build customer trust. At the same time, managers can use the data to understand customer flow in the store and adjust layouts to make shopping more convenient.

In short, RFID is not just a tool for improving operations. It is also a way to create smoother, smarter and more enjoyable shopping experiences. Whether through faster checkout, better product information, helpful service, or better coordination between online and in-store shopping, RFID is helping stores meet the expectations of modern customers. As the technology continues to evolve, its role in shaping the future of customer experience in retail will likely become even more important.

2.5 Challenges

Although RFID brings many benefits, it also comes with some challenges that can slow down or complicate its use in retail. These barriers are often related to cost, technology, organizational issues, and customer perceptions. Understanding these difficulties is important for planning successful RFID adoption.

One of the main challenges for retailers is the cost and technical complexity of implementing RFID systems. Hossain (2023) explains that RFID requires investment in hardware like tags and readers, software systems, and staff training. These costs can be high, especially for small or mid-sized retailers. Koh et al. (2006) also mention that technical issues, such as system integration and compatibility between different devices, can be difficult to manage. In some cases, retailers do not have the technical knowledge needed to set up or maintain RFID systems, which increases their reliance on external vendors. This can lead to delays and extra expenses.

Another common difficulty is organizational resistance. When new technologies are introduced, employees might be unsure how it will affect their job or may feel uncomfortable using new tools. Hossain (2023) points out that staff training and clear communication are essential to avoid pushback. Without support from employees, even well-planned RFID projects can face problems. The case of Adler, by Leitz et al. (2018), shows how careful change management helped the company handle internal resistance and successfully introduce RFID in their stores. Their approach included involving staff in the process from the start and offering regular updates and training.

In addition to technical and internal issues, customer concerns also play a role. Some people worry that RFID might be used to track them without their knowledge. Novotny et al. (2015) show that privacy is a key concern for many consumers, especially when RFID is used in customer-facing applications. Mukherjee et al. (2018) add that the customers reaction depends on their trust in the brand. If people believe a company respects their privacy, they are more likely to accept smart technologies like RFID-enabled fitting rooms. On the other hand, if the brand has a weak reputation, customers may feel uncomfortable or even avoid using such services.

These challenges do not mean that RFID should be avoided, but they do show that retailers need to plan carefully. By understanding the potential barriers, businesses can take steps to prepare and respond. This includes budgeting for long-term costs, investing in training, being transparent with customers, and creating a supportive environment for change. With the right strategies, the benefits of RFID can still be achieved while reducing the risks.

2.6 Research Gap

While the value of RFID in improving inventory and supply chain operations is well documented, its role in enhancing customer experience has mainly been explored through individual case studies. These examples demonstrate promising results in areas such as personalized service, faster checkout, and in-store product tracking. However, what is still missing is a broader understanding of how these applications can be implemented successfully across different types of retail settings.

For instance, Tebaldi et al. (2023) call attention to the growing use of RFID in customer-facing applications but underline that these remain isolated efforts rather than structured practices. Similarly, Landmark and Sjøbakk (2017) show how RFID can be used to observe and improve customer behavior in fashion stores, but their findings are limited to a single context. Other contributions, like the industry case described by Choi et al. (2015), further confirm the potential of RFID in enhancing the shopping experience, but again without offering a repeatable or scalable model.

The lack of a comprehensive framework or guide leaves a gap in both academic and practical knowledge. Retailers interested in using RFID to improve customer experience often have to rely on trial and error or replicate isolated success stories without a clear strategy. This opens an opportunity to explore and organize these scattered insights into a more structured approach.

2.7 Conclusion and Research Question

In summary, RFID has proven to be a highly effective technology for managing retail operations. It helps retailers gain better visibility of their inventory and reduce errors or losses. At the same time, there is growing evidence that RFID is beginning to influence customer experience through a series of service innovations, already demonstrated in some retail companies.

Despite these promising signs, the literature still lacks a unified framework or clear guidelines on how to use RFID specifically for enhancing customer experience. While several case studies offer interesting insights, they remain limited to individual business contexts.

This literature review highlights the need to move from isolated examples to a more general understanding of best practices. Therefore, this thesis aims to answer the following research question:

How can RFID technology be used strategically in retail to enhance the customer experience, and what are the best practices for implementing it successfully?

Through multiple case studies, this research identify successful approaches and common challenges, with the goal of proposing a practical framework that retailers can apply to deliver better customer experiences through RFID.

3 Research Methodology

3.1 Research Design

To investigate how RFID technology enhances the customer experience in retail, this study adopts a qualitative, multiple case study approach. This methodological choice allows for an in-depth examination of a contemporary phenomenon within its real-life context, which is a fundamental requirement for case study research (Yin, 2009). The research is focused on a bounded number of organizations where RFID has been actively implemented, with particular attention to the operational, technological, and organizational contexts in which it is deployed to support customer experience improvement.

A qualitative strategy is particularly suitable for this type of research because it emphasizes understanding over measurement. The objective is not to quantify the impact of RFID using standardized variables but to explore the many ways in which it contributes to customer satisfaction, service quality and personalization. This approach allows to analyze complex organizational behaviors and strategic decisions that are often missed in quantitative studies. The research question requires an interpretive understanding of interactions between technology, staff and customers in dynamic retail settings.

By adopting a multiple case study design, this research increases its capacity to identify patterns and contrasts across various contexts. Each case offers a unique environment, yet similarities across cases can help pinpoint best practices that can be generalizable. This design ensures that the findings are not overly dependent on the practices and structure of a single organization. Instead, the inclusion of several companies with varying characteristics (such as size, market positioning and degree of technological maturity) helps to provide a more global understanding of how RFID contributes to customer experience.

Furthermore, the exploratory nature of the research reflects the novelty of the topic in academic literature. The role of RFID in improving customer-facing operations, as opposed to logistical or inventory-related functions, has not been widely theorized or empirically tested. Consequently, this research does not rely on a fixed set of hypotheses but instead begins with broad research objectives and lets empirical findings inform theoretical development. Emerging concepts and relationships are shaped iteratively on the basis of existing literature and insights gained from data collected in the field.

The design follows best practices in case study methodology, as outlined by Dube & Pare (2003) and Yin (2009), emphasizing the need to clearly define the unit of analysis, ensure contextual richness, and avoid manipulating the research setting. Each case is embedded in its own environment, and data is collected and interpreted with sensitivity to its specific organizational and cultural dimensions. The emphasis on natural processes and behaviors also differentiates this research from experimental or quasi-experimental designs, where variables are artificially manipulated.

Importantly, this study takes a positivist approach, which means it aims to objectively analyse what can be observed and measured in the real world. Key aspects of the study, such as how RFID is implemented, how it can affect customer satisfaction, and how services are delivered in stores is clearly defined. These aspects is carefully examined across different case studies. The goal is to draw conclusions that are based on real evidence and that can be useful beyond just the companies being studied. This approach helps make the research more consistent, repeatable, and trustworthy.

In sum, this research design provides a structured yet adaptable foundation to explore the role of RFID in shaping modern retail experiences. It considers the complexity of organizational contexts, while ensuring that the results can contribute to both the advancement of theory and the provision of actionable information for retail practitioners. Crucially, the ultimate objective of this research is to synthesize the insights gained from multiple case studies into a comprehensive and practical framework. This framework consolidates best practices, challenges, and strategic guidelines for using RFID to enhance customer experience in retail, offering a valuable tool for both academic researchers and industry professionals.

3.2 Case Selection

The selection of case studies in this research have followed two main criteria. First, each company must have implemented, or be in the process of implementing, RFID technology in its retail operations. Second, the use of RFID in these companies must contribute, at least in part, to improving the customer experience. This can include applications such as faster checkout, better product availability, or more personalized services. These criteria ensure that all selected cases are relevant to the research question and help provide meaningful insights.

The primary case in this study is a luxury fashion retailer, referred to as the "*Luxury House*". This company has been chosen because I am currently working for them, as a consultant intern, which gave me unique access to internal processes and key stakeholders. This access allowed for first-

hand observation of how RFID is used, as well as the opportunity to conduct in-depth interviews with employees involved in the implementation. Studying the Luxury House was particularly valuable because it represents the high-end segment of retail, where customer expectations for service quality are especially high.

Three additional companies have been selected as secondary cases to provide comparison and a broader view across different retail sectors. The first is Decathlon, a global leader in sporting goods retail. Decathlon is known as one of the most advanced companies in terms of RFID adoption. It uses RFID for inventory control, fast self-checkout, and product availability, making the shopping process more efficient and convenient for customers. Because of its large scale and long-standing commitment to RFID, Decathlon serves as an important reference case.

The second secondary case is Uniqlo, a Japanese fast fashion retailer that has implemented RFID across its entire supply chain and in-store operations. Uniqlo uses RFID to improve product availability and speed up checkout, especially in busy urban locations. As a major global retailer, Uniqlo represents a highly competitive sector where customer experience is closely tied to operational efficiency.

The third secondary case is Kroger, a major food retail chain in the United States. Kroger is currently adopting RFID technology to improve stock management, monitor product freshness, and reduce waste. These efforts directly impact customer experience by ensuring that products are available and meet quality expectations. Including Kroger helps add diversity to the study by representing the grocery sector, which has so far been slower to adopt RFID technology due to high implementation costs. Kroger stands out as one of the first large-scale food retailers to roll out RFID at this level.

These four companies (Luxury House, Decathlon, Uniqlo, and Kroger) offer a balanced and diverse selection of cases. They cover a range of retail sectors: luxury fashion, sporting goods, fast fashion and food retail. They also differ in terms of geographic origin, market position, and customer profiles. This variety helps make the research findings more applicable across the retail industry. It also allows the study to consider both sector-specific practices and general best practices. By comparing these companies, the research identified patterns and strategies that contribute to successful RFID use for enhancing the customer experience in different retail contexts.

3.3 Data Collection Methods

This research combines both primary and secondary data collection methods to provide a well-rounded and detailed understanding of how RFID technology is used to improve customer experience in different types of retail environments. Using both approaches allowed the study to balance internal organizational insights with publicly available external information, ensuring a broader and more accurate picture of current practices and strategies.

3.3.1 Primary Data

Primary data for this study was collected through a series of semi-structured interviews conducted at the Luxury House, which is the focal case of the research. Semi-structured interviews were well-suited for qualitative, exploratory studies because they offer a balance between structure and flexibility. On one hand, they ensured consistency by following a set of predetermined questions or themes and on the other, they allowed interviewees to elaborate freely, which often leads to the discovery of unexpected yet valuable insights. This flexibility was particularly important in a study focused on evolving technologies like RFID, where implementations and experiences can vary significantly from one context to another.

I have designed an interview guide, which can be consulted in Appendix 1, that reflects the main themes of this study. It includes open-ended questions covering the motivations for adopting RFID, its perceived and actual impact on customer experience, technical and organizational challenges faced during implementation, and any lessons learned along the way. These themes are intended to stay aligned with the research objectives and also address areas where academic literature remains limited.

I conducted 4 interviews of participants who are directly involved in RFID implementation. My goal was not to maximize the number of interviews, but to capture rich and diverse perspectives across the roles. I spoke with IT consultants and project staff to ensure coverage of both strategic and technical insights. All interviewees were fully informed about the purpose of the study and how their input was going to be used.

3.3.2 Secondary Data

In parallel with the primary data, secondary data was collected to analyse the three additional case companies: Decathlon, Uniqlo, and Kroger. This data included a variety of sources such as white papers from technology providers, publicly available company reports, published case studies,

articles from reputable business and technology news platforms and expert analyses found on industry blogs and forums. These sources helped determine how each company communicates its RFID strategy, and how these strategies were perceived and discussed in the public domain.

Secondary data was particularly useful as I did not have access to internal decision-makers or internal processes as I am not personally affiliated with neither of these companies. While secondary data lacks the depth and interaction of interviews, it offers a broader overview and highlights patterns and initiatives across multiple organizations. However, this type of data sometimes presented a biased or overly positive view, especially when published by the companies themselves. To reduce this risk, data from different sources were taken into account to verify consistency and reliability.

Moreover, secondary data was used not only to describe RFID implementations but also to compare them against the findings from the primary case. This comparative analysis helped me identify recurring success factors, variations in approach, and sector-specific challenges. It also allowed me to assess how widely certain practices are adopted and whether they can be considered best practices across the retail industry.

In summary, this study's approach to data collection combines the depth and richness of semi-structured interviews with the extent and contextual information provided by secondary sources. This dual approach strengthened the credibility of the findings through triangulation, enabled a more detailed understanding of how RFID is used across different retail formats, and supported the development of a practical framework that can be adapted by various types of retailers. Thanks to this combination, the study aims to offer insights that are both grounded in real experience and informed by broader industry trends.

3.4 Data Analysis Methods

To analyse the data collected through interviews and secondary sources, I used a thematic analysis approach. It is well-suited for qualitative research because it focuses on identifying patterns, themes and relationships within the data. It allowed me to compare insights both within and across the selected cases and helped ensure that findings are grounded in the data itself. Thematic analysis allowed me to organize and interpret the data systematically, while still allowing flexibility to capture unexpected observations that could arise during the analysis process.

The themes I focused on include RFID applications in retail environments, the impact of these applications on customer experience, the challenges encountered during implementation, and the

outcomes, both expected and unintended. These thematic categories are closely tied to the research objectives and were also used to guide the interview design and secondary data collection. Using consistent themes from the start of the research process ensured continuity and alignment between data collection and analysis.

The analysis process began with coding the data collected from the interviews at the Luxury House and from the secondary sources for Decathlon, Uniqlo, and Kroger. Coding involved labelling portions of the text with descriptive tags that capture key ideas, concepts, or experiences. For example, responses related to RFID implementation barriers were coded under “Technical Reliability & Hardware” or “Training & User Adoption”, while statements about improved inventory accuracy or faster checkout processes were grouped under “Seamless Checkout” or “Inventory & Stock Accuracy”.

As part of the coding process, I first read through all transcripts and documents to familiarize myself with the content, then began assigning codes manually using Microsoft Excel. This tool helped me structure and manage the data, making it easier to identify patterns across different sources and highlight connections that were not immediately obvious.

After initial coding, I grouped similar codes together to form broader themes. For example, individual codes like “Checkout speed” and “Self-checkout” both fell under the theme “Seamless Checkout.” This process was reflective, meaning that themes evolved as I went deeper into the data.

To increase the credibility of my findings, I applied a cross-case comparison. This involved analyzing similarities and differences between the Luxury House and the three secondary cases. I looked for patterns that appear across multiple companies, as well as strategies or outcomes that were unique to a particular context. The goal was to understand not only what practices are common, but also why certain approaches work better in specific environments.

Another key technique I used was triangulation. By comparing findings from primary data (interviews) to secondary data (reports, articles, and case studies), I could check whether certain assertions or observations were confirmed in different types of sources. This helped strengthen the reliability and depth of the research.

Overall, the thematic analysis supported by coding, case comparison and triangulation provided a solid basis for drawing conclusions about the role of RFID in improving the customer experience in retail.

3.5 Limitations and Challenges

As with any qualitative research, this study faced several limitations and challenges that must be acknowledged. Being transparent about these limitations is essential to clarify the scope of the findings and guide future research.

One of the main constraints I encountered concerns access to internal data at the Luxury House. Although my internship as an external consultant working for this company gives me valuable insights and informal access to operational processes, it does not grant me full transparency into strategic decision-making. Some documents, especially those related to internal performance evaluations or investment decisions, are protected by confidentiality rules and therefore remained inaccessible. Additionally, the availability of certain key staff members (particularly those in leadership roles) were limited, which restricted the diversity of viewpoints captured through interviews. And, as well, due to the high confidentiality of the customer base of the Luxury House and my external consultant status, I was unable to access to customers for interviews. This limitation prevented the inclusion of direct customer perspectives in the study, which could have added valuable insights into the customer experience dimension of RFID implementation.

This study was also bounded by time and scope. The research reflects the state of RFID use as it stands in 2025. Since technology and retail practices evolve quickly, some observations and conclusions may become outdated over time. Additionally, the selected cases mainly involve large international companies headquartered in Western countries. While these cases are valuable for understanding established and large-scale RFID use, they may not fully represent smaller or non-Western retail environments. As a result, the applicability of some insights could be limited outside these contexts.

The use of secondary data for the three external case studies also presented specific limitations. Public sources such as news articles, company reports, or white papers provided useful context, but they lacked detailed operational insights and reflect strategic thinking. Some materials, especially those produced by RFID vendors or company marketing departments, contained promotional bias and focused on benefits while downplaying implementation difficulties. The reliability of these sources is not always verifiable, which required careful cross-checking to validate the claims made.

Another limitation concerns the sample size. This research includes only four companies, with primary data collected from just one of them. Although these cases were selected for their relevance and diversity, the small and non-random sample limits the ability to generalize findings to the

broader retail industry. In addition, I have not included direct feedback from customers. Therefore, the conclusions about customer experience are based on organizational perspectives and not on consumer interviews or surveys.

There is also the issue of researcher bias. Because of my role as an intern at the Luxury House, I might unconsciously have interpreted the data in a way that aligned with Luxury House's positive narrative. To address this, I used triangulation: comparing interview responses with secondary data and conducted cross-case analysis to reduce subjective influence.

It is important to emphasize that this study is exploratory in nature. While the findings are not intended to be universally applicable, they may be generalizable to a wide range of retail contexts, particularly those that share operational and technological characteristics with the cases studied. However, they may not apply as well to highly specialized or niche retail environments. The insights should therefore be seen as broadly relevant but still context-aware.

For future research, I recommend expanding the scope by including direct interviews with customers to understand their actual perceptions of RFID-enhanced experiences. In addition, studies conducted in smaller, independent retailers or in non-Western markets could provide insights into how RFID is used in different conditions.

3.6 Ethical Considerations

Conducting this research responsibly required careful attention to ethical standards. Throughout the study, I followed my university's research ethics guidelines to ensure that all participants were treated respectfully, that data was handled appropriately, and that no harm came to individuals or organizations involved in the research.

One of the key ethical principles I followed was informed consent. Before participating in interviews, all individuals were clearly informed about the purpose of the study, the topics that were going to be discussed, and how their responses were going to be used. I also informed them that the data they provided were used exclusively for academic purposes related to this master's thesis.

Confidentiality was another important concern, especially given the involvement of Luxury House. To protect the identity of participants, the names of interviewees were not included in the thesis. Additionally, sensitive internal information, such as company strategies, financial data, or proprietary processes, were not shared without explicit permission. All internal documents or

insights obtained through my internship were handled carefully, and I avoided including any content that could risk breaching company confidentiality.

I also took care to avoid any conflict of interest arising from my position as an intern. While my role gave me access to valuable insights, it also required that I maintained objectivity and remained critical when analyzing the data. I took steps to reflect on my own position during the research process and make sure that any findings were grounded in evidence, not personal interpretations or assumptions.

All digital data, including interview recordings and transcripts, were only accessible to me. When no longer needed for the research and the thesis, the data will be deleted. No part of the data was shared or will be shared publicly beyond this thesis.

In summary, ethical considerations were central to the research process. By ensuring informed consent, protecting confidentiality, following academic standards, I aimed to conduct this study in a transparent, respectful and responsible way.

4 Case Analysis

4.1 Introduction

This chapter presents the findings from the case analysis, building on the methodological approach described in the previous chapter. Through a qualitative multiple case study design, this research investigates how RFID technology is used across four different retail contexts to improve customer experience and the challenges that arise during implementation. The chapter aims to provide an in-depth exploration of the patterns, contrasts, and insights that emerged from the data collected in the field.

The chapter begins with a series of detailed case narratives, each offering a contextualized account of RFID adoption in a specific company: Luxury House, Decathlon, Uniqlo, and Kroger. These narratives focus on the unique features of each case, covering aspects such as RFID deployment strategies, customer experience impacts, and the challenges faced. Following the case narratives, the chapter moves into a thematic cross-case analysis, which is divided into two parts: an examination of how RFID improves customer experience and an analysis of the challenges and barriers to successful implementation. Each theme is discussed through a comparison across cases, highlighting similarities, differences, and patterns of practice.

The chapter concludes by summarizing the preliminary best practices that emerged from the analysis. These raw insights provide a foundation for the structured best practices framework developed in Chapter 5. While the main focus remains on customer experience and implementation challenges, the analysis also acknowledges additional themes that surfaced during the study. Together, these findings offer a comprehensive overview of how RFID is being used in retail to improve customer experiences and the factors that shape its effectiveness.

4.2 Cases Narratives

4.2.1 Case Narrative – Luxury House

Disclaimer: For confidentiality reasons, the company in this case is referred to as "Luxury House."

Context

Luxury House is a globally renowned brand in the high-end fashion and luxury sector, established in the early 20th century in Europe. Known for its iconic handbags, signature fragrances, and elegant apparel, the brand has maintained a prestigious position in the luxury industry by combining

heritage craftsmanship with cutting-edge innovation. Operating in over 60 countries with a network of boutiques and a growing digital presence, Luxury House employs several thousand people worldwide, including artisans, designers, sales advisors, IT specialists, and marketing teams. The brand's strategic vision emphasizes blending tradition with modernity, focusing on sustainability, customer experience, and technological innovation. RFID is a key part of this strategy, enhancing operations while ensuring an exclusive and seamless customer journey.

RFID Implementation

The rollout of RFID at Luxury House began in 2019 and is still ongoing, although it is now nearing completion. The initiative started as a pilot in selected boutiques and gradually expanded into a global rollout. Today, RFID is integrated across the entire supply chain, from tagging products at the manufacturing stage to store-level operations. Items receive unique RFID tags at the factory, enabling seamless traceability through the distribution network and into boutiques. RFID accelerates receiving processes: for example, a pallet that once took 20 minutes to process can now be scanned in under two minutes. This efficiency extends to daily inventory counts, which have been reduced from several hours to just 20 minutes. RFID also powers client-facing innovations: in selected boutiques, smart mirrors embedded with RFID readers recognize products and display detailed visuals, styling suggestions, and availability information in real-time. Fashion Advisors use handheld devices and a dedicated app to locate products instantly on the sales floor, ensuring a smoother client experience.

The implementation of RFID at Luxury House has involved significant organizational and technical efforts. Teams across retail, IT, and logistics collaborated through a structured change management process, including detailed guidelines, training kits, and support materials to ensure consistency in boutiques worldwide. To support the global rollout, single points of contact were designated at the global, regional, and boutique levels, creating a clear governance structure to guide deployments and maintain alignment. Attention to boutique design, such as antenna placement and shielding, was critical to ensuring reliable detection, while global coordination ensured that processes were adapted to local market specificities. In parallel, Luxury House is currently organizing workshops with different regions and users to explore new use cases of RFID linked to customer experience, demonstrating an ongoing commitment to innovation and learning (Interview 1, 2025).

Customer Experience Impact

RFID at Luxury House has improved the customer experience in several ways. Inventory accuracy and stock visibility allow fashion advisors to respond instantly to customer requests, reducing waiting times and eliminating the need for backroom searches. Customers benefit from a seamless in-store journey: in smart mirror-equipped boutiques, they can enter in the fitting room with an item and see high-resolution visuals on the mirror and styling recommendations. This interaction feels effortless and personalized, reinforcing the brand's luxury positioning. RFID also enables left-right shoe matching and prevents mismatched products, ensuring that items are complete and ready for the customer. When purchases are completed, the RFID tags are deactivated, allowing customers to leave the boutique without triggering alarms, maintaining a smooth and elegant experience.

Fashion advisors report positive feedback: RFID reduces time spent on logistics, allowing more focus on storytelling, styling, and relationship building. Customers notice the faster service, the "magical" mirror interactions, and the confidence that comes from knowing the item is authentic and traceable. RFID thus helps create a more engaging and luxurious shopping environment that aligns with the brand's values.

Challenges and Barriers

The rollout of RFID at Luxury House was not without challenges. From a technical perspective, ensuring tag readability on complex products, such as items with metal details or delicate materials, required careful testing and adjustments. Antenna placement, shielding, and store layout had to be optimized for reliable detection, which sometimes involved redesigning boutique spaces. Change management was a critical factor: given the global scale, a clear structure with dedicated points of contact at global, regional, and boutique levels was established to coordinate deployments. Training staff on the RFID tools, apps, and processes was essential to ensure adoption, especially given the addition of digital features like the smart mirrors.

Privacy concerns were addressed through a "privacy by design" approach: RFID tags carry only product identifiers, not customer data, and are deactivated upon purchase. Mirror interactions are linked to clients' existing profiles within the brand's secured digital ecosystem, ensuring data protection. However, cultural sensitivities in different markets, such as concerns about reflection and image in Japan, required adaptations in boutique design, such as replacing mirrors with simple screens.

Outcomes

The introduction of RFID at Luxury House has yielded significant benefits. Receiving times have been reduced by up to 90%, inventory counts that once required night shifts can now be performed daily in minutes, and locating specific items on the sales floor has become almost instantaneous. These operational gains free up staff to focus on the customer relationship, which is reflected in positive feedback from fashion advisors and clients alike. Customers appreciate the speed, personalization, and reassurance that RFID enables, from knowing a product's authenticity to enjoying a seamless checkout process without security alarms.

Looking ahead, Luxury House is exploring new applications of RFID, including using it to automate replenishment in boutiques. The brand's experience demonstrates how RFID, when carefully implemented, can serve as a powerful enabler of both operational excellence and elevated customer experiences in luxury retail.

4.2.2 Case Narrative – Decathlon

Context

Decathlon, founded in 1976 near Lille, France, has grown into the world's largest sporting goods retailer with over 1,817 stores in 79 countries and a team of more than 101,100 employees by 2024. The company follows a vertically integrated business model meaning it manages every stage of the product lifecycle (design, manufacturing, distribution, and retail) all in-house. This approach allows Decathlon to offer a huge range of more than 10,000 products under its 20+ in-house brands, catering to customers interested in a wide variety of sports and activities. However, managing such a broad assortment across a global network of stores has not been easy. Stockouts and missed sales became a growing concern, pushing the company to look for better ways to manage its operations. Decathlon turned to RFID technology as a key solution, aiming to improve stock accuracy, reduce costs, and offer a better shopping experience for customers (Decathlon United Media, 2022, HUAYUAN, 2023). RFID became a long-term strategic investment to support Decathlon's mission of making sports accessible to as many people as possible.

RFID Implementation

Decathlon's journey with RFID started in 2008 when it ran small pilot projects in a few stores in France to test how the technology could improve stock visibility and operations (Decathlon United Media, 2022). After promising results, the company expanded its trials to nine stores and

warehouses across Europe in 2011. In 2013, Decathlon became the first global retailer to tag all its private-label items at the factory level by embedding unique EPC/RFID tags into product packaging and labels. This step allowed the company to track items throughout the entire supply chain from production to the sales floor (HUAYUAN, 2023). By 2019, Decathlon had fully scaled up its RFID system, tagging 100% of SKUs and installing more than 50,000 RFID readers across its distribution centres, stores, and factories (HUAYUAN, 2023). The system combines fixed tunnel readers for checking carton contents, handheld devices for store operations, and starting in 2022, autonomous robots for daily cycle counts and product location tracking (RFID Journal, 2022). These robots help Decathlon manage its large inventory more effectively, supporting services like ship-from-store and click-and-collect. RFID data also feeds into Decathlon's digital platforms, enabling more accurate product availability updates for customers.

Decathlon's RFID strategy goes beyond simple inventory tracking. The technology is deeply integrated into operational workflows from inbound logistics to customer-facing services. Warehouse teams use RFID tunnels to validate shipments quickly and accurately, while store staff rely on handheld devices to locate products in real-time, even in large-format stores. The deployment of autonomous robots for stock checks not only increases counting speed but also improves accuracy by reducing human error. RFID also supports Decathlon's sustainability goals, as better inventory accuracy helps the company reduce overproduction and waste, aligning with its broader circular economy initiatives.

Customer Experience Impact

The introduction of RFID has brought major improvements to the customer experience. With significantly improved inventory accuracy, customers can check online if an item is available at a specific store and trust the information they see (HUAYUAN, 2023). Decathlon has also made checkout much faster by introducing RFID-enabled self-checkout stations and mobile POS systems. In some stores, average queue times have dropped from 20 minutes to less than one minute and space once used for traditional checkout counters has been freed up for other uses (Global Retail Sporting Goods Leader, 2018). Staff no longer need to spend as much time counting inventory manually, so they can focus more on helping customers, offering advice, and creating a more personal shopping experience.

RFID also powers new services like electronic article surveillance (EAS) to reduce theft and digital product passports which give customers access to care instructions, authenticity details, and soon, resale and re-commerce tracking (IMD Business School, 2023). Customers benefit from the peace

of mind that comes with guaranteed authenticity while Decathlon benefits from higher customer trust and loyalty. The digital product passport concept also supports Decathlon's sustainability strategy by encouraging reuse and second-hand markets.

Challenges and Barriers

Deploying RFID across such a large organisation came with several challenges. Technically, Decathlon had to solve issues with tag performance on tricky items like metal tools and water bottles which required tweaks to label designs and even product packaging to ensure tags could be read accurately (HUAYUAN, 2023). On an organisational level, adopting RFID required a big cultural shift. Cross-functional teams were created to bring together IT, supply chain, store operations, and product design teams to align processes, train store staff, and integrate RFID into existing ERP systems (Decathlon, 2022). This change demanded strong communication and project management skills as well as dedicated resources for training and support. The financial investment was also significant as the company needed to purchase hardware, software, and integration services. Decathlon reduced costs by developing some of its own reader solutions and using its global scale to negotiate better deals.

Moving to daily inventory counts with robots generated a massive amount of data which required upgrades to analytics tools, replenishment algorithms, and decision-making systems to effectively manage and use the new information (RFID Journal, 2022). Data governance became a priority with new protocols developed to ensure data accuracy and reliability. Staff training was an ongoing effort as RFID processes evolved over time, requiring employees to adapt to new tools and workflows. Change management was essential to ensure store teams fully embraced the technology and understood its benefits both for customers and for operational efficiency.

Outcomes

The results of Decathlon's RFID strategy have been impressive. Early pilot stores reported an 11% year-on-year sales increase thanks to better stock availability and fewer stockouts. Shrinkage or inventory loss from theft or errors fell by 9% after the rollout of RFID-based EAS systems (IMD Business School, 2023). Inventory counting has become up to 5 times faster, allowing for more frequent stock checks and quicker replenishment (Global Retail Sporting Goods Leader, 2018). Beyond these operational improvements, Decathlon has seen higher customer satisfaction confirmed by internal surveys and higher Net Promoter Scores (NPS). Customers appreciate the shorter queues, accurate stock information, and overall smoother shopping experience.

Decathlon’s long-term commitment to RFID shows how technology, when matched with clear business goals, can create real benefits for customers and employees alike. Decathlon’s story highlights how a global retailer can use RFID not just to cut costs and improve efficiency but also to deliver more value to customers and maintain a competitive edge in the retail industry. The case also demonstrates how strategic technology investments can support broader company values such as sustainability, affordability, and inclusivity. Decathlon’s journey with RFID continues to evolve, paving the way for further innovations in retail technology and customer service.

4.2.3 Case Narrative – Uniqlo

Context

Uniqlo traces its origins to 1949, when it was established as a textiles manufacturer named Ogori Shōji in Yamaguchi, Japan. The Uniqlo brand itself was launched in 1984 with the opening of the first Unique Clothing Warehouse store in Hiroshima. Uniqlo is now one of the largest global apparel retailers, known for its LifeWear concept, offering high-quality, functional and affordable clothing designed for everyday life. As of 2024, Uniqlo operates over 2,400 stores worldwide, with a strong presence in Japan, China and growing operations in Europe and North America. The brand is owned by Fast Retailing, Asia’s largest apparel company, which emphasizes innovation and sustainability as core principles. Uniqlo's business model integrates design, production and retail under one roof, enabling it to respond quickly to market trends and consumer demands. However, managing such a vast and diverse supply chain comes with challenges like maintaining inventory accuracy and delivering a seamless customer experience across channels. To address these issues and support its ambition of becoming a leading digital apparel retailer, Uniqlo has made RFID a cornerstone of its operations since 2017, when it began embedding RFID tags in all products globally (HUAYUAN, 2023; Wall Street Journal, 2023).

RFID Implementation

Uniqlo’s RFID implementation spans the entire supply chain, from manufacturing to distribution, retail stores and e-commerce fulfillment. RFID tags are embedded in every product's price tag at the production stage, enabling item-level tracking through the supply chain. Warehouses and distribution centers are equipped with RFID readers that facilitate faster and more accurate receiving, picking, and shipping processes, contributing to higher supply chain efficiency and better inventory management (HUAYUAN, 2023; Tan & He, 2019). Automated warehouses using RFID

technology have significantly reduced labor needs and improved operational accuracy (HUAYUAN, 2023).

In-store, RFID powers several innovations, including RFID-enabled self-checkout systems, which allow customers to place their shopping baskets in a designated bin and have all items scanned and billed automatically without manual barcode scanning (Cashierless, 2024). This system reduces checkout times, enhancing customer convenience, especially during peak hours (Wall Street Journal, 2023; Cashierless, 2024). RFID readers installed in stores also provide real-time stock data, enabling staff to monitor product availability and improve replenishment efficiency. Some flagship stores feature RFID-enabled smart mirrors and interactive screens, helping customers access detailed product information, availability, and styling suggestions (HUAYUAN, 2023; Impinj, 2023).

Customer Experience Impact

The impact of RFID on Uniqlo's customer experience is substantial. The system has significantly improved inventory accuracy, reduced stockouts, and enabled faster replenishment, ensuring that customers can find the products they want when they visit the store (Wall Street Journal, 2023). RFID-powered self-checkout counters provide a frictionless payment experience, often described by customers as "retail magic" (Impinj, 2023). The convenience of simply placing items in a bin and checking out without scanning each product manually enhances the overall shopping experience and reduces waiting times. Additionally, real-time inventory visibility allows Uniqlo to offer services like click-and-collect, with orders placed online available for pickup in-store within 24 hours (HUAYUAN, 2023).

The integration of RFID data also enables Uniqlo to analyze customer preferences and buying patterns, supporting personalized marketing and improved product assortment. For instance, understanding which products are tried on frequently but not purchased helps inform design changes and marketing strategies (Cashierless, 2024). Customers appreciate the improved service speed, accurate product information, and the seamless blend of online and offline shopping options, reinforcing Uniqlo's brand promise of simplicity, quality, and affordability.

Challenges and Barriers

During Uniqlo's RFID rollout, the high initial investment required for RFID hardware, software integration, and staff training posed a significant barrier, especially at the early stages of adoption (Cashierless, 2024). Technical issues, such as occasional glitches in self-checkout systems and tag

readability on certain products, have also been reported (Cashierless, 2024). Privacy concerns, though minimal, have been raised regarding data collection, particularly as RFID systems gather detailed information about inventory movement (Wall Street Journal, 2023).

Adapting the technology to different markets and store formats also required careful planning. For example, store layouts had to be adjusted to ensure accurate RFID detection, and staff training was critical to ensure smooth operations (Wall Street Journal, 2023). Nevertheless, Uniqlo's experience shows that a well-executed RFID strategy can overcome these hurdles and deliver substantial benefits.

Outcomes

The outcomes of Uniqlo's RFID implementation have been significant. The company has reported a "significant reduction in out-of-stock" items, improved inventory accuracy, and enhanced customer satisfaction (Wall Street Journal, 2023). Self-checkout systems powered by RFID have reduced checkout times by half, while automated warehouses have achieved up to 90% labor savings and increased operational efficiency (HUAYUAN, 2023; Cashierless, 2024). Sales data accuracy has improved, enabling more responsive and data-driven decision-making.

Uniqlo's success with RFID demonstrates how technology can transform retail operations and customer experiences. The case highlights the importance of long-term investment, cross-functional collaboration, and continuous innovation in driving digital transformation. As Uniqlo continues to expand globally, RFID remains a key enabler of its strategy to offer a seamless, omnichannel shopping experience and maintain its competitive edge in the fast-paced apparel industry.

4.2.4 Case Narrative – Kroger

Context

Kroger, founded in 1883 in Cincinnati, Ohio, is one of the largest grocery retailers in the United States, operating nearly 2,800 stores across the country under banners such as Kroger, Fred Meyer, Ralphs, Dillons, and Smith's. With a workforce of approximately 500,000 associates, Kroger serves over 11 million customers daily, offering a wide range of products from fresh groceries to pharmacy services. The company is known for its focus on customer service, sustainability, and innovation, with flagship initiatives such as its Zero Hunger, Zero Waste program. In recent years, Kroger has faced the challenge of balancing operational efficiency with sustainability goals, particularly in reducing food waste and ensuring freshness in perishable categories. To address these challenges,

Kroger has embarked on a large-scale RFID initiative, working closely with Avery Dennison to introduce item-level RFID tagging across its fresh departments (Avery Dennison, 2024; Packaging Europe, 2024).

RFID Implementation

Kroger's RFID journey began in 2024 with a pilot rollout in its bakery departments, marking the first step in what could become one of the largest RFID deployments in the grocery sector (RFID Journal, 2024). RFID tags embedded in product labels enable real-time visibility into inventory levels, allowing Kroger to track baked goods such as bread, muffins, and cookies throughout the supply chain and in stores. The program is expanding over the next 18 months to cover most of Kroger's 2,750 stores (IMPINJ, 2024; Chain Store Age, 2024). The initiative aims to maximize freshness, reduce waste, and improve the associate and customer experience by enabling faster inventory counts, automated stock replenishment, and shelf availability monitoring (Grocery Dive, 2024).

Kroger's RFID system is designed to capture data at the item level, allowing the company to identify products approaching expiration, optimize first-in-first-out inventory management, and better understand customer purchasing patterns. RFID technology also supports the company's broader sustainability goals, helping reduce food waste by ensuring that perishable items are sold before spoilage (Avery Dennison, 2024; Packaging Europe, 2024).

Customer Experience Impact

The introduction of RFID at Kroger is expected to significantly enhance the customer experience. By improving inventory accuracy, customers can expect to find fresh products reliably on shelves, reducing out-of-stock situations and improving product availability (IMPINJ, 2024). RFID data enables associates to spend less time on manual stock checks and more time assisting customers, improving service quality and engagement (Chain Store Age, 2024). The technology also facilitates faster replenishment of popular items and supports Kroger's omnichannel strategies, such as click-and-collect and in-store pickup options (Packaging Europe, 2024).

RFID's ability to provide granular data on stock movement and shelf availability enhances Kroger's ability to respond to demand fluctuations, improving operational agility. Customers benefit from better product availability and a shopping experience that aligns with Kroger's sustainability commitments, contributing to a positive brand perception.

Challenges and Barriers

Kroger's RFID implementation has faced several challenges, including the high initial investment in hardware, software, and training required to scale the system across multiple store formats (RFID Journal, 2024). The technical complexity of applying RFID to food products, such as ensuring reliable tag readability in environments with moisture, metal, or packaging variations, posed significant challenges that required collaboration with Avery Dennison to overcome (Grocery Dive, 2024). Additionally, convincing stakeholders across the organization of the long-term benefits of RFID, beyond the pilot phase, was essential for scaling the project (RFID Journal, 2024).

Regulatory considerations, such as food traceability mandates under the Food Safety Modernization Act (FSMA), also influenced Kroger's decision to adopt RFID, as the technology supports more detailed and accurate recordkeeping for perishable goods (IMPINJ, 2024).

Outcomes

Kroger's RFID rollout is still in progress, but early results indicate promising outcomes. In pilot bakery departments, RFID has significantly reduced manual inventory counting time, improved on-shelf availability, and minimized food waste by ensuring products nearing expiration are sold promptly (RFID Journal, 2024; Avery Dennison, 2024). Kroger anticipates that the technology will enhance customer satisfaction by improving freshness and product availability while supporting its Zero Hunger, Zero Waste goals. The initiative positions Kroger as a leader in RFID adoption within the grocery sector, demonstrating how digital innovation can improve operational efficiency, sustainability, and customer experience in food retail (Packaging Europe, 2024; Chain Store Age, 2024).

Kroger's experience serves as a case study for how RFID can be a transformative tool for grocery retailers, offering insights for the broader industry on overcoming challenges, managing costs, and aligning technology with strategic sustainability objectives.

4.3 Thematic Cross-Case Analysis: Improving Customer Experience with RFID

4.3.1 Inventory & Stock Accuracy

Inventory and stock accuracy refers to the ability of a retailer to maintain precise, real-time information on stock levels across stores and warehouses. In the context of RFID technology, achieving high inventory accuracy is essential for optimizing operational efficiency, reducing out-

of-stock situations, and enhancing the overall customer experience. Accurate stock data enables timely replenishment, better product availability, and streamlined sales processes.

Across the four case studies, a shared recognition emerges that RFID plays a crucial role in improving inventory accuracy. Luxury House uses RFID in boutiques to improve stock accuracy and speed up counting processes (Interview 3, 2025). This approach helps ensure the availability of products while minimizing manual errors. Moreover, the system enables Fashion Advisors to quickly check if a particular item is in stock, enhancing the customer experience by providing immediate answers to customer inquiries (Interview 3, 2025). By improving stock visibility and enabling faster replenishment, RFID allows Luxury House to maintain the level of service expected in the high-end retail sector.

Decathlon leverages RFID to maintain continuous product availability in stores, integrating accurate inventory tracking into daily operations to reduce stockouts and enhance customer satisfaction (Decathlon United Media, 2022). Decathlon's approach highlights how accurate stock data can support operational agility, enabling quick adjustments in response to demand fluctuations. The RFID system allows for frequent cycle counts without disrupting store activities, which is particularly relevant for a large product assortment like Decathlon's. By maintaining high stock accuracy, Decathlon ensures that customers can consistently find the products they seek, supporting both sales performance and brand loyalty.

Uniqlo relies on RFID to enhance inventory data accuracy and support decision-making across its stores, helping the company maintain a reliable view of stock levels and reduce discrepancies (Prakasa, E. and Wandebori, H., 2024). This capability contributes to more efficient replenishment cycles and reduces the risk of stockouts. By integrating RFID into their broader retail strategy, Uniqlo leverages accurate stock data to streamline store operations and support customer satisfaction. The company's use of RFID demonstrates how technology can optimize core processes and support a seamless shopping experience.

Kroger uses RFID sensors for item-level tracking in its fresh departments, focusing on both stock availability and product freshness, which reflects a broader approach to inventory accuracy that includes quality management (Grocery Dive, 2024). RFID allows Kroger to monitor product movement from delivery to shelves, ensuring that items are properly stocked and rotated. This helps reduce waste and improve product availability for customers, aligning with Kroger's objectives of efficiency and sustainability. By using RFID for perishable goods, Kroger extends the concept of inventory accuracy to include freshness and shelf-life control.

In summary, all four cases underline the critical importance of RFID in enhancing inventory and stock accuracy. While Luxury House and Decathlon focus on fashion and sports retail, Uniqlo and Kroger illustrate how RFID supports accurate, data-driven stock management in diverse retail sectors, from apparel to fresh food. The shared outcome is improved operational efficiency and customer experience, tailored to the specific challenges of each industry.

Case Study	Key Findings for Inventory Accuracy
Luxury House	RFID enables faster, more precise stock counting in boutiques; Fashion Advisors can check product availability on the spot.
Decathlon	Continuous product availability supported by RFID stock management, enabling agile operations and reducing stockouts.
Uniqlo	RFID enhances inventory data accuracy, supports decision-making, and reduces discrepancies across stores.
Kroger	RFID ensures item-level tracking for stock availability and freshness, particularly in fresh departments, supporting waste reduction.

4.3.2 Seamless Checkout

Seamless checkout refers to the ability for customers to complete purchases quickly and easily, without delays or friction at the point of sale. In the context of RFID technology, it involves automating and streamlining payment processes, often through cashierless systems or self-checkout options. This innovation can significantly enhance the customer experience by reducing wait times and enabling a more convenient shopping journey.

The case studies show varying degrees of RFID integration for seamless checkout. Luxury House has not implemented self checkout systems through RFID. This is primarily because, in a high-end retail environment, the checkout process is intentionally designed as part of the personalized customer service experience. Customers are not expected to perform checkout tasks themselves, and staff members are responsible for facilitating transactions as part of a luxury service model. However, RFID helps Fashion Advisors make sales more quickly and efficiently.

Decathlon has made seamless checkout a central feature of its retail strategy. The company uses RFID technology in self-checkout systems, allowing customers to scan all items at once, drastically reducing the time spent at the cash register (Decathlon United Media, 2022; GS1 US, 2021). These systems are part of Decathlon's broader focus on operational efficiency and customer autonomy, as self-checkout counters are present in most of their stores. This approach not only reduces waiting times but also empowers customers to manage their shopping experience independently, which is aligned with Decathlon’s large-format, high-traffic store model.

Uniqlo has also made significant use of RFID for seamless checkout. In most of their stores, RFID-powered cashierless systems have been implemented to simplify the checkout process. Customers can complete transactions without individually scanning items, as the RFID system automatically identifies all items at once (Cashierless, 2024; Focus RFID, 2023). Uniqlo's strategy demonstrates a strong commitment to using RFID to improve operational efficiency and create a smoother customer journey. The system is designed to reduce queues and improve store flow, allowing staff to focus on customer support rather than transaction processing.

Kroger shows limited use of RFID for seamless checkout. The available data suggests that Kroger has not prioritized the implementation of cashierless systems or self-checkout based on RFID (Grocery Dive, 2024). Instead, the retailer focuses on stock tracking and freshness management in its fresh departments, where RFID ensures accurate inventory control and product quality.

Case Study	Key Findings for Seamless Checkout
Luxury House	Self checkout is not prioritized but RFID helps Fashion Advisors handle transactions more efficiently as part of the luxury experience.
Decathlon	RFID is used in self-checkout systems to allow customers to scan all items at once, reducing waiting times and queues.
Uniqlo	RFID enables cashierless systems in some stores, simplifying the checkout process and improving customer flow.
Kroger	Seamless checkout is not a focus; RFID is not used to implement cashierless or self-checkout systems.

4.3.3 Supply-chain Traceability

Supply-chain traceability refers to the ability of retailers to track and monitor the movement of products from production to the point of sale, ensuring transparency, authenticity, and operational efficiency. RFID technology plays a critical role in enabling detailed, real-time visibility across the entire supply chain. Importantly, this traceability has a direct impact on customer experience, as it enhances product availability, reliability, and trust in the items they purchase.

For Luxury House, RFID is used to ensure authenticity and traceability throughout the product journey. The system allows items to be tracked from production to billing, with antennas installed at key points such as delivery, stock movement, and checkout to monitor product location and status (Interview 4, 2025). This traceability helps maintain customer confidence in product authenticity and supports the brand's high standards for quality (Interview 2, 2025). The ability to ensure that each item is genuine and correctly documented reinforces the sense of exclusivity and care that customers expect from a luxury brand.

Decathlon has fully integrated RFID across its supply chain, using the technology to ensure global traceability from production to stores and warehouses (HUAYUAN, 2025; GS1 US, 2021). Fixed RFID readers are installed in logistics warehouses, and each product is tagged for traceability, supporting transparency and operational efficiency (HUAYUAN, 2025; Finnish Business Blog, 2023). This comprehensive traceability enables Decathlon to provide customers with accurate information about product availability, origins, and characteristics, improving their confidence in the brand. It also helps manage product recalls and ensures that customers receive the right products at the right time. Decathlon acknowledges the challenges of scaling RFID implementation across a global network, which requires careful management and coordination (RFID JOURNAL, 2022).

Uniqlo uses RFID to improve visibility into its supply chain, enabling the tracking of inventory from production facilities to retail locations (Wall Street Journal, 2023). This capability is crucial for managing the fast fashion model, where accurate inventory flow and responsiveness are essential. By providing real-time stock information, RFID ensures that customers can find the products they want, when they want them. The system helps Uniqlo avoid stockouts, overproduction, and delays, enhancing the overall shopping experience (IMPINJ, 2023; HUAYUAN, 2024).

Kroger applies RFID to support food traceability across its supply chain, particularly in fresh product categories. RFID tags allow Kroger to track products from suppliers to shelves, helping the company manage recalls quickly and efficiently, ensuring food safety, and maintaining customer trust (IMPINJ, 2024). The ability to trace products back to their origin enables Kroger to respond promptly in case of issues, reducing the impact of recalls and improving transparency for customers. This capability directly benefits customers by ensuring that the products they purchase are safe, fresh, and compliant with standards. RFID also contributes to Kroger's sustainability goals by reducing waste and improving inventory accuracy, further enhancing customer satisfaction (Packaging Europe, 2024; Chain Store Age, 2024).

Case Study	Key Findings for Supply-chain Traceability
Luxury House	RFID enables end-to-end traceability from production to billing, ensuring authenticity and reinforcing customer trust in product quality.
Decathlon	RFID is fully integrated into the supply chain, providing global traceability and supporting accurate product information for customers.
Uniqlo	RFID improves supply chain visibility from production to stores, helping avoid stockouts and ensuring customers can find the products they want.
Kroger	RFID enables food traceability from suppliers to shelves, supporting recalls, food safety, and transparency for customers.

4.3.4 Personalized & Immersive Experiences

Personalized and immersive experiences refer to the ability of retailers to create customized, engaging interactions for customers, often by leveraging technology such as RFID. This can include interactive displays, smart fitting rooms, or personalized recommendations that enhance the shopping journey.

The case studies reveal that Luxury House leverages RFID to create immersive and tailored in-store experiences. RFID is embedded in smart fitting rooms, where antennas hidden behind interactive mirrors detect the items a customer brings in. As the customer enters the fitting room with their selected products, the system identifies each item using RFID and automatically displays product information, videos and photos showing how the items have been worn in fashion show. The Fashion Advisor assists the customer throughout the experience by providing personalized recommendations based on the items they have chosen and offering complementary suggestions such as matching accessories or higher-end alternatives (Interview 3, 2025; Interview 4, 2025). This combination of RFID-driven technology and personal assistance enhances the exclusivity and sophistication of the shopping journey.

Uniqlo has also explored the use of RFID for personalized experiences, particularly in some stores where RFID-enabled fitting rooms detect items and provide contextual recommendations to support product discovery (Yu Guo, Jingwen Luo, 2023). However, Uniqlo's use of RFID for personalization remains limited compared to its core focus on inventory accuracy and seamless checkout.

Decathlon and Kroger do not use RFID for personalized or immersive experiences. The available data indicates no evidence of RFID being used to support interactive displays, smart fitting rooms, or tailored customer interactions in these cases.

Case Study	Key Findings for Personalized & Immersive Experiences
Luxury House	RFID enables smart fitting rooms where items are detected upon entry; interactive mirrors show product videos and photos, and Fashion Advisors provide recommendations.
Decathlon	No use of RFID for personalized or immersive experiences was found.
Uniqlo	RFID is used in some stores for fitting room interactions, supporting product discovery and contextual suggestions.
Kroger	No use of RFID for personalized or immersive experiences was found.

4.3.5 Product Quality & Trust

Product quality and trust in the context of RFID refer to how technology can enhance product freshness, traceability, and the after-sales service provided by retailers. This theme combines two sub-themes: the management of product freshness and the improvement of after-sales service and customer engagement.

For Luxury House, RFID is used to strengthen the after-sales experience. After a fitting session, which takes place in a smart fitting room equipped with RFID-enabled mirrors, Fashion Advisors can send the styling board (generated directly from the fitting room's system) along with the payment link and e-receipt directly to the customer's private chat thread (Interview 3, 2025). This seamless follow-up is perceived as a high-end, concierge-level service, particularly appreciated by top-tier clients, as it extends the shopping experience beyond the store visit and reinforces trust in the brand (Interview 3, 2025).

Decathlon and Uniqlo, both mention the potential for RFID to enhance post-sales interactions, including facilitating returns. By using RFID to verify product authenticity, they can prevent fraudulent returns and streamline the process for both customers and staff (GS1 US, 2021; IMPINJ, 2023).

Kroger has implemented RFID in its bakery departments to improve product freshness and traceability. RFID tags help monitor stock rotation and expiration dates, ensuring that bakery items are safe, fresh, and compliant with food safety regulations (Avery Dennison, 2024; Path to Purchase Institute, 2024). This approach also supports Kroger's efforts to reduce waste by tracking product shelf life and avoiding spoilage (Packaging Europe, 2024).

Case Study	Key Findings for Product Quality & Trust
Luxury House	RFID supports after-sales service by enabling Fashion Advisors to send styling boards generated from smart mirrors, payment links, and receipts directly to customers.
Decathlon	RFID support customer returns by verifying product authenticity and preventing fraudulent returns, though no current examples are detailed.
Uniqlo	RFID support customer returns by verifying product authenticity and preventing fraudulent returns, though no current examples are detailed.
Kroger	RFID in bakery departments ensures product freshness, safety, and waste reduction by supporting stock rotation and expiration tracking.

4.3.6 Omnichannel & Integration

Omnichannel and integration refer to the ability of retailers to provide a seamless customer experience across multiple channels, both online and offline, by synchronizing data, processes, and services. In the context of RFID, this theme explores how retailers leverage technology to connect physical stores with e-commerce platforms, enable efficient product tracking, and support cross-channel operations.

The case studies reveal that Luxury House is exploring the integration of RFID into an omnichannel strategy. The technology allows for real-time stock visibility across boutiques and warehouses, enabling better management of product availability and facilitating online orders with in-store pickup (Interview 2, 2025).

Decathlon uses RFID to enable omnichannel integration by allowing customers to check product availability in specific stores directly from the website. This functionality helps customers plan their visits, ensures a better shopping experience, and demonstrates how RFID supports cross-channel services (Decathlon United Media, 2022).

Uniqlo has also used RFID to strengthen its omnichannel capabilities. The system supports accurate stock tracking across stores and warehouses, enabling services like click-and-collect and facilitating faster fulfillment of online orders (Prakasa, E. and Wandebori, H., 2024). By integrating RFID into its inventory management system, Uniqlo can offer customers a more reliable and consistent shopping experience, whether they shop in-store or online.

Kroger does not show evidence of leveraging RFID for omnichannel purposes based on the available data. This indicates a limited focus for now on cross-channel integration within its current RFID strategy.

Case Study	Key Findings for Omnichannel & Integration
Luxury House	RFID enables real-time stock visibility across channels, supporting online orders with in-store pickup and product tracking.
Decathlon	RFID allows customers to check product availability in specific stores through the website, supporting omnichannel services.
Uniqlo	RFID supports cross-channel operations, enabling click-and-collect and faster online order fulfillment.
Kroger	No use of RFID for omnichannel or integration purposes was found.

4.3.7 Brand Attraction & Wow Effect

Brand attraction and the wow effect refer to the ability of retailers to create a memorable and impressive shopping experience that reinforces the brand's identity and leaves a lasting impression on customers. RFID technology can contribute to this by enabling innovative store features, personalized services, and seamless interactions that elevate the in-store experience.

For Luxury House, RFID-enabled mirrors in smart fitting rooms play a central role in delivering a wow effect. The integration of RFID with interactive mirrors allows customers to see detailed product information, styling suggestions, and complementary items in an immersive way (Interview 4, 2025). Many customers enjoy interacting with the mirror, often treating it like a game, which makes the shopping experience playful and memorable. This innovative approach not only enhances the customer experience but also strengthens the brand's image as a leader in luxury and innovation. The unique design of the fitting rooms, combined with the technology, impresses customers and contributes to the exclusive atmosphere of the boutiques (Interview 4, 2025).

Decathlon uses RFID-powered self-checkout systems, where customers can scan all their items at once without needing to scan individual barcodes. Many customers express amazement at how quickly and efficiently the system works, creating a sense of technological innovation and convenience (GS1 US, 2021). This self-checkout experience contributes to Decathlon's image as a modern and customer-focused retailer, where efficiency and ease of shopping are key.

Uniqlo, like Decathlon, also uses RFID to support brand image by creating a seamless and enjoyable shopping experience with self-checkout process, where all items are detected instantly (Yu Guo, Jingwen Luo, 2023). This smooth and innovative integration of technology enhances Uniqlo's reputation as a forward-thinking and customer-centric brand.

Kroger does not present specific data related to RFID's role in creating a wow effect or enhancing brand attraction. The available information suggests that Kroger focuses on operational efficiency rather than leveraging RFID as a tool for brand image.

Case Study	Key Findings for Brand Attraction & Wow Effect
Luxury House	RFID-enabled smart fitting rooms with interactive mirrors create a wow effect and reinforce the brand's image as innovative and exclusive.
Decathlon	RFID-powered self-checkout systems impress customers by instantly detecting items without scanning, enhancing the brand's modern image.
Uniqlo	RFID-enabled self-checkout amazes customers by detecting all items instantly, reinforcing Uniqlo's image as a modern and customer-centric brand.

Case Study	Key Findings for Brand Attraction & Wow Effect
Kroger	No evidence of RFID use for brand attraction or creating a wow effect was found.

4.4 Thematic Cross-Case Analysis: Challenges and Barriers of RFID Implementation

4.4.1 Implementation Challenges & Strategy

After examining how RFID contributes to customer experience, this section shifts focus to the challenges and barriers that retailers face when implementing the technology.

Implementation challenges and strategy refer to the barriers, technical constraints, and organizational complexities that retailers face when adopting RFID, as well as the strategies they develop to manage these challenges. The cases reveal that introducing RFID in a retail context often requires substantial adjustments across processes, infrastructure, and culture.

For Luxury House, one of the main challenges was defining how to tag all products. The need to create a global process was complicated by the fact that regions operate independently, leading to difficulties in standardization (Interview 1, 2025). Technical limitations, such as ensuring tag placement on delicate products, and market-specific adaptations added further complexity (Interview 4, 2025).

Decathlon faced challenges related to adapting packaging for RFID tags and integrating the technology across logistics and store operations (Decathlon United Media, 2022; Finnish Business Blog, 2023). The scale of implementation across a global network introduced complexity, with issues such as managing information systems, ensuring process consistency, and overcoming resistance to change (RFID JOURNAL, 2022; João Bernardo Meleiro Parreira, 2017). To address these challenges, Decathlon modified its approach by embedding RFID tags directly inside products instead of attaching them externally. This strategy allows the tag to remain intact even during returns, preserving the EPC history and supporting better traceability (Decathlon United Media, 2022). Additionally, the company worked to align managers and employees to the RFID vision, helping teams internalize the value of the technology (Finnish Business Blog, 2023).

Uniqlo encountered challenges in balancing the benefits of RFID with its costs and technical demands (HUAYUAN, 2024). The global rollout required supplier collaboration, as not all partners were ready to integrate RFID into their production lines (Focus RFID, 2023; Yu Guo, Jingwen Luo, 2023). Uniqlo mitigated these challenges by optimizing operations across its supply chain, from

manufacturing to logistics, to create a seamless and integrated system (IMPINJ, 2023). Early experiences with RFID in 2017 also highlighted the importance of refining processes and addressing operational inefficiencies (Fast Retailing, 2019).

Kroger faced challenges related to the practical aspects of implementing RFID in food retail, particularly adapting tag placement for different product types (FineLine Technologies, 2024; Grocery Dive, 2024). The complexity was heightened by the larger number of manufacturers and product variations in the grocery sector compared to apparel, which added difficulties for collaboration with vendors and achieving standardization.

Case Study	Key Findings for Implementation Challenges & Strategy
Luxury House	Challenges include defining product tagging, standardizing global processes, managing change, and adapting RFID to luxury items and markets.
Decathlon	Challenges include packaging adaptations, global scalability, process consistency, and resistance to change; solutions include embedding tags inside products and aligning teams.
Uniqlo	Key challenges include costs, supplier collaboration, technical complexity; strategies include supply chain optimization and process refinement.
Kroger	Barriers include adapting RFID tag placement to diverse product categories, vendor collaboration, and standardization.

4.4.2 Financial & ROI Considerations

This theme focuses on the financial aspects of RFID implementation, including the cost barriers, return on investment (ROI) considerations, and the strategic decisions retailers make to ensure the economic viability of RFID projects. The cost of RFID implementation is often cited as the biggest factor hindering its widespread adoption in the market, particularly for smaller retailers who struggle to justify and manage the investment required.

For Decathlon, RFID is considered an investment that requires careful financial justification. According to GS1 US (2021), Decathlon acknowledges the need to evaluate the costs and benefits of RFID, particularly when implementing it at scale across global operations. The company's strategy is to view RFID as a long-term enabler of operational efficiency, recognizing that while initial investments are substantial, the benefits in terms of process improvements, inventory accuracy, and customer satisfaction justify the expenditure over time.

Uniqlo also emphasizes the need for a strategic financial approach to RFID. The literature highlights that Uniqlo carefully considers the costs of implementing RFID relative to its expected benefits, with a focus on long-term efficiency and operational gains (Yu Guo, Jingwen Luo, 2023).

RFID is seen as a key component of Uniqlo's store automation strategy, and despite the initial costs, the company is committed to its deployment as part of a broader digital transformation (Cashierless, 2024).

Kroger highlights the financial challenges of adopting RFID in the grocery sector. According to IMPINJ (2024) and RFID JOURNAL (2024), Kroger still have to weigh the significant costs of RFID technology, such as tag application, infrastructure investment, and system integration, against the expected benefits in inventory accuracy, traceability and safety improvements. These financial considerations are especially complex in the food sector, where margins are tighter, and the diversity of products increases the cost of implementation. This complexity helps explain why Kroger stands out as one of the first major grocery retailers to adopt RFID at scale, given the significant financial challenges and the need for large-scale investment.

For Luxury House, no mention of financial and ROI considerations was found in the interviews.

Case Study	Key Findings for Financial & ROI Considerations
Luxury House	No data found.
Decathlon	RFID is viewed as a long-term investment requiring careful financial justification, balancing costs against expected operational benefits.
Uniqlo	Strategic financial planning guides RFID adoption; costs are weighed against long-term efficiency and automation goals.
Kroger	Financial challenges include high implementation costs, tag application, and system integration in a complex grocery environment.

4.4.3 Privacy & Compliance

This theme explores how retailers address privacy concerns, manage customer data, and comply with regulatory standards when implementing RFID systems. Privacy is a critical issue, as RFID involves tracking items and potentially connecting them to customer interactions, raising questions about transparency and responsible data use.

For Luxury House, privacy concerns were a key consideration in the design of the RFID system. Some Fashion Advisors expressed that clients were initially skeptical, fearing the idea of "a chip in every garment" (Interview 4, 2025). To address these concerns, the company emphasized that no client profiles are linked to RFID data and that RFID is strictly used for inventory and product tracking purposes (Interview 4, 2025).

Decathlon, Uniqlo, and Kroger all acknowledge the importance of transparency and clear communication when it comes to RFID use and data collection. They emphasize the need to inform customers about how RFID is used, manage expectations, and ensure compliance with privacy regulations (Finnish Business Blog, 2023; Cashierless, 2024; FineLine Technologies, 2024).

Case Study	Key Findings for Privacy & Compliance
Luxury House	Privacy concerns addressed by ensuring no customer profiles are linked to RFID data.
Decathlon	Highlights the need for transparency and customer communication about data usage.
Uniqlo	Privacy concerns about data collection are acknowledged, with a focus on compliance and transparency.
Kroger	Emphasizes transparency and customer education to build trust and ensure safe data practices.

4.4.4 Technical Reliability & Hardware

This theme addresses the technical challenges retailers face with RFID systems, focusing on hardware reliability, antenna placement, and read accuracy. Reliable technical infrastructure is essential for ensuring consistent RFID performance and preventing errors that could impact operations.

For Luxury House, technical reliability has been an important concern, especially in the design of its smart fitting rooms. Challenges included poor antenna placement and shielding issues, which affected detection accuracy (Interview 4, 2025). To improve system performance, the team rebuilt the mirror stack inside the fitting rooms and continually worked on enhancing detection through better antenna placement and shielding adjustments (Interview 3, 2025; Interview 4, 2025).

Uniqlo reports that while RFID is generally reliable, occasional read errors can occur, which may affect inventory accuracy and system performance (Cashierless, 2024). This underlines the need for ongoing monitoring and adjustments to maintain technical reliability.

No specific data related to technical reliability or hardware was found for Decathlon or Kroger.

Case Study	Key Findings for Technical Reliability & Hardware
Luxury House	Faced challenges with antenna placement and shielding; rebuilt mirror stack to improve detection accuracy.
Decathlon	No data found.
Uniqlo	Reports occasional read errors that impact inventory accuracy, requiring monitoring and adjustments.

Case Study	Key Findings for Technical Reliability & Hardware
Kroger	No data found.

4.4.5 Training & User Adoption

This theme explores how retailers manage staff training and promote user adoption when implementing RFID systems. Successful adoption depends on employees understanding the technology, trusting its benefits, and integrating it into daily routines.

For Luxury House, training was a critical part of the RFID rollout. Staff needed to learn how to use new hardware, which required dedicated training sessions to build familiarity and confidence (Interview 2, 2025). The company invested heavily in training efforts, emphasizing that when advisors trust the system, they are more likely to use it effectively (Interview 2, 2025). However, adoption was not always straightforward: some employees were reluctant to adopt new technologies, and certain regions of the company showed more skepticism than others, highlighting the need for tailored change management approaches (Interview 4, 2025). To promote consistency across regions, Luxury House trained all advisors in Europe on a single tool, ensuring a standardized approach and smoother adoption (Interview 3, 2025).

Luxury House also stands out for organizing workshops with regional teams to explore and co-create new RFID use cases (Interview 1, 2025). This participative approach engages staff, fosters innovation, and helps identify context-specific applications, contrasting with other cases where RFID adoption was primarily top-down.

No data related to training and user adoption was found for Decathlon, Uniqlo, or Kroger.

Case Study	Key Findings for Training & User Adoption
Luxury House	Emphasized dedicated staff training and the importance of trust in technology; trained all European advisors on a single tool for consistency; faced staff reluctance in certain regions.
Decathlon	No data found.
Uniqlo	No data found.
Kroger	No data found.

4.5 Cross-Case Evidence Overview (Triangulation Matrix)

Table 4-1 on the next page pulls together every theme identified in the two preceding cross-case analyses and maps it against the four cases. Each cell shows whether evidence for the theme is

present (✓) or absent (✕), and the right-hand column assigns a convergence rating that signals how strongly the evidence aligns across cases:

Agreement: corroborated by at least three cases.
Complementary: supported by two or three cases with no conflicting evidence.
Singleton: reported in only one case.
Divergence (not observed here): cases provide contradictory evidence.

This quick map lets you see at a glance which themes are well backed, and which ones aren't, before we dive into the preliminary best practices in section 4.6.

Table 4-1 Triangulation matrix of themes across four cases

Theme	Luxury House	Decathlon	Uniqlo	Kroger	Convergence rating
Inventory & Stock Accuracy	✓	✓	✓	✓	Agreement
Seamless Checkout	✓	✓	✓	✕	Complementary
Supply-chain Traceability	✓	✓	✓	✓	Agreement
Personalised & Immersive Exp.	✓	✕	✓	✕	Complementary
Product Quality & Trust	✓	✓	✓	✓	Agreement
Omnichannel & Integration	✓	✓	✓	✕	Complementary
Brand Attraction & Wow Effect	✓	✓	✓	✕	Complementary
Implementation Challenges & Strategy	✓	✓	✓	✓	Agreement
Financial & ROI Considerations	✕	✓	✓	✓	Complementary
Privacy & Compliance	✓	✓	✓	✓	Agreement
Technical Reliability & Hardware	✓	✕	✓	✕	Complementary
Training & User Adoption	✓	✕	✕	✕	Singleton

4.6 Preliminary Best Practices

4.6.1 Introduction

This section presents the preliminary best practices identified from the cross-case analysis of the four case studies. These practices are derived directly from the thematic analysis conducted in sections 4.3 and 4.4, reflecting the raw insights observed across the different companies. They

represent common approaches, success factors, and solutions that emerged from the data, and serve as a foundation for the best practices framework that will be developed in Chapter 5.

While the primary focus of this study is on customer experience and the challenges of RFID implementation, it is important to acknowledge that other themes also emerged during the analysis. Although these themes were not the core focus of this thesis, they offer additional perspectives on how RFID technology can impact retail operations, and they will be discussed in this section.

4.6.2 Raw Best Practices for Improving Customer Experience

One key best practice observed across cases is to ensure accurate and frequent RFID-based inventory checks to maintain product availability and reduce out-of-stock situations. This is evident in practices such as daily counts at Luxury House, weekly cycle counts at Uniqlo, nightly robotic counts at Decathlon, and real-time freshness tracking at Kroger. These examples demonstrate how inventory accuracy is foundational to enabling a smooth and reliable customer experience.

Another best practice is to implement RFID-enabled checkout solutions, such as self-checkout systems, to streamline the purchasing process and reduce wait times, if it aligns with the brand's identity and customer expectations. For example, Decathlon and Uniqlo have integrated RFID into their checkout systems to create a faster and more convenient experience for customers, whereas Luxury House focuses on other customer experience priorities aligned with its luxury image.

Integrating RFID with customer-facing technologies, such as interactive mirrors or digital displays, is also a promising best practice. Luxury House’s smart fitting rooms, for example, enhance the personalization of the shopping journey by recommending complementary products and displaying multimedia content. This shows how RFID can be leveraged beyond operational efficiency to create immersive customer experiences.

RFID can also contribute to brand differentiation and a memorable in-store experience. Decathlon’s 1-hour click-and-collect service, powered by RFID, and Luxury House’s premium smart mirror concept both illustrate how the technology can be used to support a brand’s image and promise.

Another recurring best practice is the integration of RFID into omnichannel strategies. By linking RFID data with online platforms, companies like Uniqlo and Decathlon ensure customers have real-time visibility on product availability, whether shopping online or in-store.

Furthermore, RFID supports product quality assurance by enabling better traceability. Luxury House uses RFID to reinforce authenticity and exclusivity, while Kroger applies it to ensure freshness in the bakery department. This builds customer trust and confidence.

Finally, using RFID to improve product traceability along the supply chain is a key insight from Decathlon and Kroger, as it allows customers to understand where products come from and how they are handled.

4.6.3 Raw Best Practices for Overcoming RFID Implementation Challenges

A key best practice for overcoming RFID implementation challenges is to approach projects with clear strategic planning. Across cases, successful RFID adoption involved defining clear goals, ensuring alignment with business objectives, and considering brand-specific factors. For example, Luxury House prioritized maintaining its brand image by selectively applying RFID to customer-facing features, while Decathlon and Uniqlo focused on operational integration at scale.

Providing comprehensive training and support for staff is another essential practice. For instance, Luxury House highlighted the importance of ongoing coaching and support to ensure proper use of RFID systems in customer interactions. Uniqlo and Decathlon mentioned having trained their staff, but no specific cases were mentioned.

Addressing technical challenges is a recurring theme across cases. Decathlon's experience with RFID robots shows the importance of optimizing hardware placement and calibration for accurate reads, while Kroger's focus on product freshness emphasizes the need for fine-tuning tag detection in specific environments. Continuous technical refinement is crucial for reliable system performance.

Ensuring a clear business case and long-term return on investment is another insight that emerges. While initial RFID deployment costs are high, cases like Uniqlo and Decathlon show that long-term gains in efficiency, stock accuracy, and customer satisfaction can justify the investment. Linking RFID outcomes to measurable KPIs is essential for securing stakeholder support.

Finally, proactive management of privacy and compliance concerns is critical. Across cases, companies were careful to clarify that RFID tags are not linked to personal data and to reassure customers that their privacy is protected. Transparent communication helps mitigate resistance and builds trust in RFID systems.

4.6.4 Reflections on Additional Themes (Grey Zone Insights)

While the primary focus of this study was on customer experience and implementation challenges, the analysis also uncovered additional insights related to operational efficiency, security, data and analytics, and sustainability. These themes, while not central to the research question, offer valuable perspectives on the broader impact of RFID in retail.

One recurring observation is that RFID improves operational efficiency by automating stock counting and freeing staff from routine tasks. This allows store associates to spend more time assisting customers, indirectly contributing to a better shopping experience.

RFID also supports security and loss prevention by enabling better product tracking and reducing theft. While not a direct focus in the case studies, Decathlon's use of RFID in self-checkout systems and security gates suggests its potential in this area.

The potential of RFID as a data source for business intelligence also emerged. While underutilized in the cases studied, there is an opportunity for retailers to leverage RFID data for analytics, such as understanding customer behavior patterns or optimizing store layouts.

Finally, RFID can support sustainability goals by helping retailers manage waste, extend product life cycles, and provide transparency into sourcing and production. Examples include Kroger's freshness tracking to reduce food waste and Decathlon's commitment to circular economy practices.

These additional insights highlight the multifaceted benefits of RFID and suggest avenues for future research beyond the customer experience focus of this thesis.

4.6.5 Conclusion

This chapter has presented the findings from the case analysis, offering a comprehensive view of how RFID technology is implemented and leveraged across different retail sectors. The individual case narratives in Section 4.2 provided a detailed account of each company's context, RFID applications, customer experience impacts, and the challenges they faced. The cross-case analysis in Sections 4.3 and 4.4 then synthesized these findings, identifying common patterns and unique approaches across the cases. This thematic comparison revealed that while the benefits of RFID for customer experience are widely recognized, challenges remain in areas such as technical integration, staff training, and balancing brand identity with new technology.

The raw best practices outlined in Section 4.5 summarize these insights, highlighting practical lessons learned directly from the cases. These include ensuring accurate inventory tracking, integrating RFID into customer-facing features where relevant, providing thorough staff training, managing technical challenges proactively, and communicating clearly about privacy and data security. Additionally, other themes such as operational efficiency, loss prevention, data analytics, and sustainability emerged as important areas where RFID can indirectly benefit retail operations, even though they were not the central focus of this study.

These findings provide a strong foundation for the next chapter, where the insights gained will be refined into a structured framework of best practices for using RFID to enhance customer experience in retail. This framework will serve as a practical guide for companies seeking to implement RFID technology in a way that aligns with their business goals and customer expectations.

5 Framework Development: the RFID-CX Maturity Ladder

5.1 Introduction & Methodological Basis

Chapter 4 presented the case narratives and cross-case thematic analysis, showing how retailers across sectors use RFID to improve customer experience while facing common challenges such as technical reliability, financial justification, and user adoption. Despite these differences, a key insight emerged: while each retailer's journey is unique, their RFID implementation often follows a recognisable pattern of capability progression. This observation underlines the need for a structured, transferable roadmap to guide retailers in using RFID to enhance customer experience (CX).

Chapter 5 addresses this gap by introducing the RFID-CX Maturity Ladder (see Figure 5-1), a practical framework developed from the case findings. This ladder is designed to help retail practitioners understand and navigate the stages of RFID adoption, balancing operational enablers, customer-facing benefits, and potential challenges at each stage. The model is based on three main data sources: the seven themes of customer experience improvement (identified in section 4.3), the five challenges or barriers (analysed in section 4.4), and the grey-zone opportunities (such as sustainability and advanced analytics) that emerged during the analysis and that were mentioned in section 4.5.4.

The following section describes this practical framework in details. The final parts of the chapter present a step-by-step implementation playbook and validates the framework against the cases studied.

5.2 In-Depth View of the RFID-CX Maturity Ladder

The RFID-CX Maturity Ladder is a structured framework that guides retailers through the stages of RFID implementation, linking operational capabilities with customer experience outcomes. It helps decision-makers understand not only what benefits RFID can deliver, but also what capabilities must be in place at each stage, and what challenges are most likely to arise.

The ladder is composed of four sequential stages: Foundation, Efficiency, Engagement, and Differentiation. Each stage builds upon the previous one, reflecting the progression observed across the cases analysed in Chapter 4. A feedback loop is integrated into the model to reflect the iterative nature of real-world implementations, where retailers often need to revisit earlier stages to refine processes, improve technical performance, or adapt to changing market conditions.

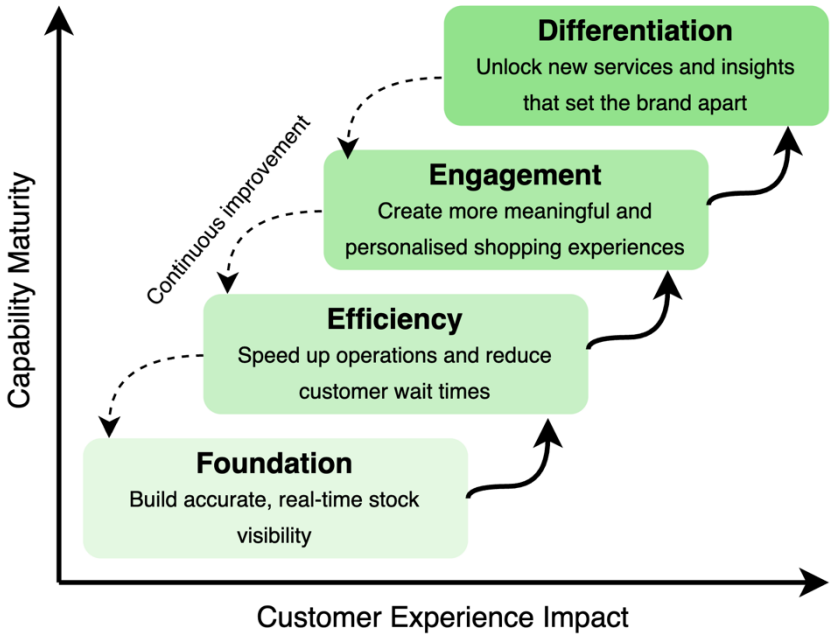

Figure 5-1 The RFID-CX Maturity Ladder – a staged model linking RFID capabilities to customer experience outcomes, with an iterative feedback loop for continuous improvement.

5.2.1 Stage 1 – Foundation (“Find it”)

The first stage of the RFID-CX Maturity Ladder focuses on establishing accurate, real-time visibility of stock across the retail network. This capability forms the essential building block for all further RFID-enabled customer experience improvements. By ensuring that each item is correctly tagged and systematically tracked, retailers can provide reliable information about product availability, helping customers find what they need and reducing frustration linked to stockouts or misplaced items.

Key enablers at this stage include source tagging, establishing robust data models (such as the EPC), and implementing the necessary hardware and software infrastructure to support consistent and accurate reads. Although primarily operational, this stage has a clear customer-facing impact by improving basic availability and building trust in the retailer’s ability to deliver on promises.

The main challenges typically encountered at this stage are technical reliability (ensuring accurate and consistent reads in varied retail environments) and staff adoption, as employees adjust to new processes and technologies. Early grey-zone benefits, such as identifying shrinkage hotspots through item-level data, may also begin to emerge, offering additional value even in the foundational stage.

5.2.2 Stage 2 – Efficiency (“Get it fast”)

The second stage of the RFID-CX Maturity Ladder focuses on improving operational speed and reducing friction in the customer experience. Once accurate, real-time stock visibility is in place, retailers can begin using RFID to automate and streamline processes such as stock replenishment, inventory transfers, and checkout operations. This stage is where RFID moves beyond internal stock tracking to directly influence the customer journey, by making transactions quicker and reducing wait times.

Typical capabilities developed in this stage include self-checkout systems powered by RFID, automated replenishment triggers for out-of-stock items, and improved click-and-collect services. The customer experience benefits are clear: shorter queues, faster product retrieval, and fewer errors at the point of sale, all contributing to a smoother, more efficient shopping experience.

Key challenges in this stage focus on financial justification and return on investment (ROI). The costs associated with deploying RFID at scale across multiple stores can be significant, and retailers may struggle to quantify benefits in purely financial terms. Change management is also critical, as staff need to adapt to new workflows and customers must be introduced to new service models like RFID self-checkout.

Grey-zone opportunities, such as improved sustainability through reduced product waste and more efficient logistics, can begin to emerge more clearly at this stage.

5.2.3 Stage 3 – Engagement (“Trust & Wow”)

The third stage of the RFID-CX Maturity Ladder focuses on creating more meaningful and personalised interactions with customers. Once foundational capabilities and process efficiencies are established, retailers can use RFID data to enhance the shopping experience by surfacing relevant information, offering tailored services, and building greater trust and transparency. This stage represents a shift from efficiency gains to customer-centric value.

Capabilities developed at this stage could include interactive features such as smart mirrors in fashion stores, RFID-triggered product passports in sporting goods or freshness badges in grocery environments. These applications allow customers to access detailed product information, verify authenticity, or discover sustainability credentials. The aim is to make customers feel reassured, informed, and personally engaged with the brand.

Key challenges at this stage primarily relate to privacy and compliance, as the use of personalised data raises concerns about how customer information is collected, stored, and used. As well, many customers unfamiliar with RFID may think that the tags are trackers that could follow them back home. Retailers must ensure transparency, provide clear and simple options for customer consent, and comply with data protection regulations. Customer acceptance of new features, such as interacting with smart devices or scanning products for information, can also present a barrier and requires careful user education and experience design.

5.2.4 Stage 4 – Differentiation (“Stand out and lead”)

The fourth stage of the RFID-CX Maturity Ladder focuses on unlocking advanced capabilities that allow retailers to differentiate their brand and build a long-term competitive advantage. At this stage, RFID data is no longer used just for internal efficiency or basic customer engagement, but becomes the foundation for creating unique services, driving innovation, and reinforcing a retailer’s strategic positioning.

Capabilities in this stage include advanced analytics for predictive demand shaping, dynamic pricing strategies, and personalised recommendations based on purchase patterns. Retailers may also implement circular services, such as resale or repair programs, that contribute to sustainability goals and align with evolving customer expectations. These applications build on earlier stages but push the boundaries of what RFID can enable, creating a distinctive value proposition that is hard for competitors to replicate.

Key challenges in this stage are mainly related to system integration complexity, as advanced RFID solutions must connect seamlessly with enterprise platforms, analytics engines, and external partners. Data governance becomes critical, as the volume and sensitivity of data increase, and cross-functional alignment is essential to ensure that the benefits of differentiation are fully realised across departments.

Grey-zone benefits such as sustainability metrics and advanced analytics capabilities reach full maturity at this stage. These outcomes not only improve operational decision-making but also strengthen a retailer’s public image as an innovative and responsible business.

5.3 Implementation Playbook & Managerial Guidelines

The RFID-CX Maturity Ladder provides a structured framework, but successful implementation requires a clear, practical approach. This section offers a step-by-step playbook that retailers can

follow to guide their RFID journey, regardless of sector or company size. It outlines key actions, roles, and a recommended timeline, helping decision-makers translate the ladder into real-world results.

5.3.1 Step 1: Diagnose the starting point

Retailers should begin by assessing their current capabilities against the RFID-CX Maturity Ladder. This includes evaluating stock accuracy levels, existing process automation, customer engagement initiatives, and readiness for advanced analytics. KPIs can be used as benchmarks, for instance, stock accuracy rate, queue times or engagement metrics.

5.3.2 Step 2: Pilot and learn

Once the starting point is identified, a focused pilot is recommended. This may involve one store, a specific product category, or a selected customer journey (e.g., click-and-collect). The pilot should test key processes, monitor KPIs, and uncover barriers such as technical reliability issues, staff training needs, or customer acceptance challenges. Weekly review cycles are recommended to track progress and adapt the solution based on feedback.

5.3.3 Step 3: Scale and iterate

After a successful pilot, retailers can scale their RFID solution across additional stores or categories. As deployment expands, regular performance reviews should continue to ensure that the solution delivers the expected value and that technical and organisational challenges are addressed. The feedback loop in the RFID-CX Maturity Ladder highlights that continuous improvement is essential: retailers may need to revisit earlier stages to refine processes, upgrade hardware, or adapt customer touchpoints.

5.3.4 Roles and responsibilities

Successful implementation requires clear ownership. Typically, a senior manager or project lead oversees the project, while operational teams manage day-to-day execution. IT leads ensure system integration and data reliability, while store managers play a critical role in training staff and ensuring local adoption.

5.3.5 Challenge focus across stages

The following table summarises where each of the five core challenges is most likely to appear during the RFID implementation journey. This overview helps anticipate and proactively address key risks at each stage.

Table 5-1 Implementation challenges across RFID-CX Maturity Ladder

Stage	Technical Reliability	Financial / ROI	Privacy & Compliance	System Integration	Staff Adoption
Foundation	High	Medium	Low	Low	Medium
Efficiency	Medium	High	Medium	Medium	High
Engagement	Medium	Medium	High	Medium	Medium
Differentiation	Low	Medium	High	High	Low

5.4 Validation Across Cases

To confirm the relevance and applicability of the RFID-CX Maturity Ladder, this section presents a short analysis of each case study, showing how their RFID journeys align with the framework and illustrating the model's flexibility across different retail sectors.

5.4.1 Luxury House

Luxury House has reached the Engagement stage of the ladder (stage 3), having implemented RFID-enabled smart mirrors in fitting rooms and achieving accurate item-level stock visibility across boutiques. These capabilities allow for tailored recommendations and enhanced service interactions. However, the company has not yet advanced to Differentiation, as it has not fully integrated advanced analytics or developed cross-channel services that go beyond the store-level experience. Building these data capabilities and creating more innovative, data-driven services will be key to progressing to the next stage.

5.4.2 Decathlon

Decathlon is positioned between the Engagement and Differentiation stages. Their widespread RFID self-checkout, fast replenishment processes, and early experiments with circular services such as take-back programs show a strong foundation for moving forward. However, Decathlon has not yet fully scaled advanced analytics or created distinctive, data-driven customer services that can set them apart from competitors. The next step is to leverage RFID data for predictive insights, sustainability metrics, and broader service differentiation.

5.4.3 Uniqlo

Uniqlo is currently at the early stage of Engagement, having introduced few RFID-enabled fitting rooms and scanless checkout experiences. These features contribute to a more seamless shopping journey, particularly in flagship stores. However, Uniqlo has not yet advanced to Differentiation, as its RFID capabilities are not yet fully leveraged for predictive analytics, circular services, or advanced personalisation at scale. Further development of data capabilities will be necessary to unlock the potential of Differentiation.

5.4.4 Kroger

Kroger remains in the Foundation stage, focusing on establishing reliable stock visibility through RFID tagging and initial pilots for freshness management in select categories. The company has not yet progressed to Efficiency because it has not implemented broad process automation using RFID, such as automated replenishment or self-checkout solutions. In addition, the Foundation stage itself is far from complete, as many products remain untagged due to supplier constraints. Without these capabilities, Kroger cannot yet deliver significant operational efficiency gains or customer-facing improvements at scale.

This case analysis demonstrates that while each retailer operates in a unique context, the progression outlined by the RFID-CX Maturity Ladder provides a consistent, flexible roadmap for scaling RFID capabilities and enhancing customer experience.

6 Discussion

6.1 Introduction

The previous chapter introduced the RFID-CX Maturity Ladder, a practical framework designed to guide retailers through the stages of RFID implementation, from building basic stock visibility to delivering advanced, data-driven customer experiences. The framework was developed through cross-case analysis, drawing on real-world examples from Luxury House, Decathlon, Uniqlo and Kroger, each positioned at different stages in their RFID journey.

The following sections move beyond the descriptive framework to critically reflect on its theoretical implications, discuss its limitations, and explore opportunities for future research. This transition from applied findings to academic reflection helps position the ladder within the broader context of retail innovation and technology adoption.

6.2 Theoretical Implications

The RFID-CX Maturity Ladder contributes to the academic literature by bridging the gap between operational RFID implementation studies and broader theories of technology adoption, innovation diffusion, and customer experience management. While previous research on RFID in retail has often focused on technical performance or isolated case studies, this framework offers a structured, transferable model that links RFID capabilities directly to customer experience outcomes. This contribution aligns with the principles of the Technology Acceptance Model (TAM), a widely used theory in information systems that explains how perceived usefulness and ease of use influence the acceptance and adoption of new technologies. The ladder extends this idea by illustrating how capabilities evolve over time in a retail context, helping to guide the long-term integration of RFID into customer experience strategies.

Furthermore, the ladder aligns with the Resource-Based View (RBV) of the firm, suggesting that the staged development of RFID capabilities can lead to sustained competitive advantage when they are rare, valuable, and difficult for competitors to imitate.

The iterative nature of the framework, with its feedback loop for continuous improvement, also reflects the realities of digital transformation processes in retail. Rather than presenting RFID as a one-off solution, the model acknowledges that capabilities must evolve, be refined, and sometimes revisited in response to changing market demands and technological advancements.

In summary, the theoretical contribution of the RFID-CX Maturity Ladder lies in its ability to synthesise practical insights from case studies with established academic concepts, offering a clear and adaptable structure for understanding how RFID can drive customer experience innovation in retail.

6.3 Practical Implications

The RFID-CX Maturity Ladder provides a useful framework for retailers seeking to enhance customer experience through RFID technology. By structuring the adoption journey into four progressive stages (Foundation, Efficiency, Engagement and Differentiation), the ladder helps retailers understand what capabilities to focus on at each stage and how these contribute to customer experience outcomes. This practical orientation is valuable for decision-makers across functions, including operations, IT, and customer experience teams.

For operational teams, the ladder clarifies which processes benefit most from RFID at each stage, such as stock accuracy, replenishment speed, and self-checkout efficiency. IT teams can use the ladder to plan system integration priorities and address technical barriers such as read accuracy, privacy and compliance issues, and integration with legacy systems. For customer experience teams, the ladder highlights how RFID can enable more engaging and personalised interactions, while also offering opportunities to build trust through transparency and sustainability features.

Moreover, the ladder can help retailers align internal stakeholders by showing that RFID adoption is not a one-time project but an evolving capability that supports long-term strategic goals. By understanding the progression of capabilities and the associated customer benefits, retailers can set realistic expectations, allocate resources effectively, and ensure that technology investments are closely linked to delivering customer value.

Overall, the RFID-CX Maturity Ladder serves as a practical tool for retail organisations to navigate the complex process of RFID implementation, ensuring that customer experience remains central to technology adoption efforts.

6.4 Limitations of the Study

While the RFID-CX Maturity Ladder provides a useful and transferable framework for understanding RFID implementation in retail, this study has several limitations that should be acknowledged.

First, the analysis is based on a limited number of case studies, which were selected for their relevance and availability of data. Although I've chosen the cases to cover a variety of retail sectors (luxury, fashion, sporting goods and grocery), the analysis may not fully represent the diversity of retail environments globally, particularly in markets with different levels of technological maturity or regulatory frameworks.

Second, the qualitative nature of the study means that the framework is grounded in subjective interpretations of interview data and secondary sources. Due to the reliance on secondary sources published online for several cases, the available information tended to emphasise success stories and outcomes rather than the challenges and barriers encountered. As a result, the barriers to RFID implementation were most clearly identified in the case of Luxury House, where access to internal testimonies and interviews provided deeper insights into the practical difficulties faced.

Third, the ladder assumes a general sequence of progression from Foundation to Differentiation, but real-world implementations may not follow a strictly linear path. Retailers may revisit earlier stages, skip stages, or implement elements of multiple stages simultaneously depending on their strategic priorities, available resources, and market conditions. This is why the framework incorporates an iterative feedback loop, highlighting the importance of continuous improvement.

Overall, these limitations should be considered when interpreting the results of this study. They reflect the specific scope and context of the research and suggest that further exploration in different settings would help refine and validate the framework’s applicability.

6.5 Future Research Directions

Building on the insights and limitations of this study, several avenues for future research can be identified to deepen the understanding and application of the RFID-CX Maturity Ladder.

First, future studies could aim to quantitatively validate the framework across a larger and more diverse set of retail contexts. This would involve collecting data on RFID adoption, customer experience outcomes, and performance metrics across a wider range of retailers, sectors, and regions. Such research could test whether the ladder’s stages and associated KPIs consistently align with measurable improvements in customer experience and operational performance.

Second, further qualitative research could explore how different retail sectors adapt the ladder’s stages to their specific contexts, particularly those not covered in this study, such as pharmacy,

electronics, or convenience stores. This could reveal sector-specific challenges, enablers, and grey-zone opportunities that refine the framework.

Third, future research could investigate the customer perspective more deeply, focusing on how shoppers perceive and engage with RFID-enabled services, and whether these perceptions differ across cultural and market contexts. This would provide a more holistic view of how RFID impacts customer trust, loyalty, and purchase behaviour.

Finally, longitudinal studies could track the evolution of RFID implementation over time within a single organisation or across multiple cases, shedding light on how firms navigate the iterative process of continuous improvement and capability development. This would provide valuable insights into the dynamics of RFID adoption beyond a static, single-point-in-time analysis.

These future research directions offer opportunities to build on the foundation established in this study, enhancing the relevance, robustness, and practical value of the RFID-CX Maturity Ladder for both academia and industry.

7 Conclusion and Recommendations

7.1 Summary of Findings

This thesis aimed to explore how RFID technology can be implemented in retail to improve customer experience, and to develop a practical framework to guide this process. Through a multiple case study approach, analysing the experiences of Luxury House, Decathlon, Uniqlo and Kroger, a key insight emerged: while each retailer's RFID journey is unique, a common pattern of capability progression can be identified.

The result of this analysis is the RFID-CX Maturity Ladder, a four-stage model that describes how retailers typically move from establishing stock visibility (Foundation), to improving operational speed (Efficiency), to creating personalised and engaging customer interactions (Engagement), and finally to offering differentiated, data-driven services (Differentiation). Each stage builds on the previous one, but the framework also recognises the need for continuous improvement and iteration.

The ladder is supported by examples from the case studies, with Luxury House advancing toward Engagement through smart mirrors and stock visibility, Decathlon positioned between Engagement and Differentiation, Uniqlo at the beginning of Engagement, and Kroger still focused on building Foundation capabilities. The framework also integrates known barriers to RFID implementation, such as technical reliability issues, ROI challenges and privacy concerns, providing a practical roadmap for navigating these challenges.

Overall, the study demonstrates that RFID has the potential to enhance customer experience in retail, but its success depends on a structured, staged approach that considers both technical and customer-facing aspects of implementation.

7.2 Managerial Recommendations

Based on the findings of this study, several key recommendations can be provided to retailers who are considering or currently implementing RFID solutions.

First, retailers should recognise that RFID implementation is not a one-time project, but an ongoing journey. The RFID-CX Maturity Ladder shows that success comes from building capabilities step by step. Retailers should start by focusing on the Foundation stage, ensuring accurate stock visibility, and only move to Efficiency and Engagement stages once the basics are solid. Skipping steps may result in technical issues and a lack of customer trust.

Second, it is important for retailers to align their internal teams early in the process. RFID adoption impacts multiple departments, including operations, IT, and customer experience teams. Clear communication and shared goals can help ensure smooth implementation and avoid misunderstandings that could slow down progress.

Third, retailers should anticipate and prepare for common challenges. Technical reliability issues, ROI concerns, and privacy regulations are frequent barriers that must be addressed proactively. Pilot programs and gradual scaling can help identify and resolve problems before large-scale deployment.

Lastly, retailers should consider how RFID can enhance customer experience beyond efficiency. Transparency, sustainability, and personalised services can all be supported by RFID data, creating additional value for customers and differentiating the brand.

By following these recommendations, retailers can use the RFID-CX Maturity Ladder as a practical guide to implement RFID solutions in a way that delivers long-term benefits for both the business and its customers.

7.3 Final Reflection

This thesis has explored the potential of RFID technology to enhance customer experience in the retail sector and has developed a practical framework, the RFID-CX Maturity Ladder, to guide retailers in this journey. The case studies analysed show that while each retailer's context is unique, the progression of capabilities often follows a similar pattern, from building stock visibility to delivering advanced, differentiated services. However, the research also highlights the challenges retailers face along the way, including technical reliability, return on investment, and privacy concerns.

Ultimately, this work underlines that RFID is not just a tool for operational efficiency, but a strategic asset that, when implemented thoughtfully, can transform how retailers serve their customers. It encourages retailers to think beyond technology as a technical solution and instead see it as an enabler of trust, transparency, and innovation.

As RFID adoption continues to grow, this study hopes to inspire retailers and researchers together to explore new ways to create value through technology, placing the customer experience at the heart of retail transformation.

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Appendices

Appendix 1 - Interview Guide

This is the Interview Guide used for the semi-structured interviews I've conducted for this thesis. The name of the company has been changed in the questions to ensure confidentiality.

General

1. Can you briefly describe your role at [Luxury House]?

RFID and customer experience

1. Can you explain how RFID technology is currently used in [Luxury House]?
2. Were there any specific business objectives set when RFID was introduced?
3. What improvements have you observed since RFID has been rolled out in the stores?
4. From your perspective, how does RFID impact the customer experience at [Luxury House]?
5. Have you observed any feedback from fashion advisors or customers?

Challenges and barriers

1. What were the main challenges during the implementation phase of RFID?
2. From your experience, what are the organizational challenges that RFID adoption faced (ex. staff training, adaptation, integration with other systems)?
3. Are there concerns around privacy or data security that need to be addressed?
4. How did the company manage these challenges? Were there strategies put in place?

Future

1. In what ways do you think RFID could further enhance the customer journey at [Luxury House] in the future?
2. In your opinion, what are the best practices for successfully leveraging RFID for customer experience?

3. In your view, how has RFID changed the way customers interact with products at [Luxury House]?

Appendix 2 - Extract of codified data

Below is a small extract from the data codified into themes, here specifically the main theme “Inventory & Stock Accuracy”.

Text Segment	Source	Case	Specific Theme	Main Theme
(…) RFID technology enables employees to concentrate on customer service, while ensuring product availability.	Decathlon United Media	Decathlon	Product Availability	Inventory & Stock Accuracy
RFID helps satisfy customers by allowing them to see if the bike they want is available, including where it is available, in order to buy it.	GS1 US	Decathlon	Inventory visibility	Inventory & Stock Accuracy
Internal surveys by the retailer revealed customer dissatisfaction over stockouts, leading to RFID as a way to improve its inventory accuracy and store replenishment.	Ralf W. Seifert, Richard Markoff	Decathlon	Inventory accuracy	Inventory & Stock Accuracy
We are also using the system to search quickly for products in response to customer enquiries.	Fast Retailing	Uniqlo	Product location assistance	Inventory & Stock Accuracy
Uniqlo also stated that RFID technology has greatly reduced the out-of-stock phenomenon on the sales floor, and at the same time prevented shoppers from being unable to shop due to out-of-stock, thereby improving customer satisfaction.	Focus RFID	Uniqlo	Product availability	Inventory & Stock Accuracy
That data is critical for Uniqlo in improving the accuracy of inventory in stores, adjusting production based on demand, (…)	Wall Street Journal	Uniqlo	Inventory accuracy	Inventory & Stock Accuracy
Our work with Avery Dennison will improve inventory visibility, which means products will be on the shelves when our customers want them, (…)	Avery Dennison	Kroger	Inventory visibility	Inventory & Stock Accuracy
Kroger will rolling out Radio-Frequency Identification (RFID) inventory automation technology across fresh departments in an effort to provide workers with more frequent and accurate inventory information, (…)	Grocery Dive	Kroger	Inventory accuracy	Inventory & Stock Accuracy
Kroger also expects RFID-enabled, item-level digital identification to produce more frequent and accurate inventory information	Chain Store Age	Kroger	Inventory accuracy	Inventory & Stock Accuracy
RFID enables the fashion advisor to find products more quickly in the boutique using the localisation feature.	Interview #1	Luxury House	Product location assistance	Inventory & Stock Accuracy
Advisors report that back-room searches have virtually disappeared, giving them more face-time with clients.	Interview #2	Luxury House	Product location assistance	Inventory & Stock Accuracy
Advisors love that they no longer leave the cabin to fetch alternatives, they just check availability on the app.	Interview #3	Luxury House	Product availability	Inventory & Stock Accuracy

Appendix 3 – Use of AI tools

During the development of this thesis, I used several AI tools to support my work in a complementary and responsible way.

Preliminary Phase

Before officially starting the thesis, I used ChatGPT to reflect on potential research directions aligned with the internal data I could access at Luxury House. This helped me view the relevance and feasibility of different topics, and to define a research question that was both meaningful and realistic within my company context.

Literature Review

After conducting the literature review, I used NotebookLM to create concise summaries of the articles I had read. It allowed me to extract and organize the main ideas from the texts more efficiently, making it easier to refer back to them during the writing process.

Case Analysis

For the case study section, I conducted my interviews at Luxury House via Microsoft Teams. To focus entirely on the conversations and ensure better interaction with the interviewees, I used Microsoft Copilot to automatically transcribe the interviews. This allowed me to avoid being distracted by note-taking and improved the quality and depth of the interview content.

Framework Development

After developing a first version of the framework based on the insights I gather, I used ChatGPT for critical feedback. My aim was to assess whether the framework could be applicable to retailers beyond the case companies I've studied. To avoid bias or overly positive validation, I clearly instructed the tool at the beginning of the prompt:

"From now on, stop self-validating me. Use only your knowledge and respond in the most objective manner."

This helped me identify potential limitations and consider broader implications of the framework.

General support throughout the Thesis

Throughout the entire writing process, ChatGPT also helped me better understand how to structure academic content, particularly in sections where I was uncertain about conventions or transitions between ideas.

When I had difficulty expressing a complex thought in English, I used DeepL to translate my intended message from French, my native language.

Additionally, I used ChatGPT to rephrase paragraphs in a more formal and academic tone, and to correct spelling and grammar mistakes (especially since I did not attend the academic writing course offered at UTU). I used the following standard prompt for this purpose:

"Rephrase this paragraph using a formal academic tone and correct any spelling errors. The ideas expressed must not be touched."

The use of these AI tools contributed to the clarity, coherence, and structure of the thesis without compromising its originality or academic integrity.